



Swansea University  
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An exploration of the awareness of hygienic swimming behaviours and an evaluation of  
a public health intervention, to reduce the transmission of cryptosporidium.

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## Abstract

Background: Educating swimming pool users about hygienic swimming behaviours, such as not swimming whilst suffering from diarrhoea and vomiting, is key to reducing the transmission of cryptosporidium, which is an infectious disease. There is limited literature focusing on hygienic swimming behaviours.

Aim: To explore awareness of hygienic swimming behaviours and to develop and evaluate a public health intervention to reduce the transmission of cryptosporidium.

Methods: A study was conducted using an exploratory sequential design, involving semi-structured interviews with 28 stakeholders (e.g. swimmers, pool operators). These findings informed the development of a questionnaire completed by 407 swimmers/parents of swimmers. These studies explored awareness and ways to raise awareness of hygienic swimming behaviours. The findings informed the development of a poster to raise awareness of such behaviours, and a small-scale evaluation was conducted with 153 respondents.


Findings and discussion: Many factors were identified which influenced hygienic swimming behaviours, including current awareness, cultural factors and the design of swimming facilities. Respondents identified a variety of methods for raising awareness, of hygienic swimming behaviours with a poster in the changing rooms being the most preferred method. Positive feedback was provided about the poster, which was perceived as being easy to read and informative. Of note, respondents also reported that the poster had encouraged them to consider their own hygienic swimming behaviours.

Implications and recommendations: A resource has been created as part of this study, and it is hoped that it will be used by swimming facilities across Wales, and potentially further, to encourage people to swim, and to do so hygienically. The poster developed has raised awareness of hygienic swimming behaviours and received positive feedback in terms of evaluation from swimmers/parents of swimmers and endorsement from Public Health Wales. Permission to include the Public Health Wales logo on the poster demonstrates the value and importance of the message, especially as currently there is no legal requirements for swimming pools to display such information.

## Declarations and Statements

### DECLARATION

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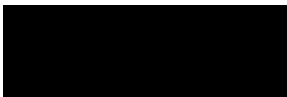
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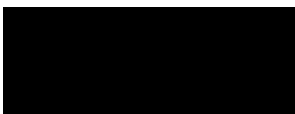
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# 1. Chapter One: Introduction

## 1.1. Introduction

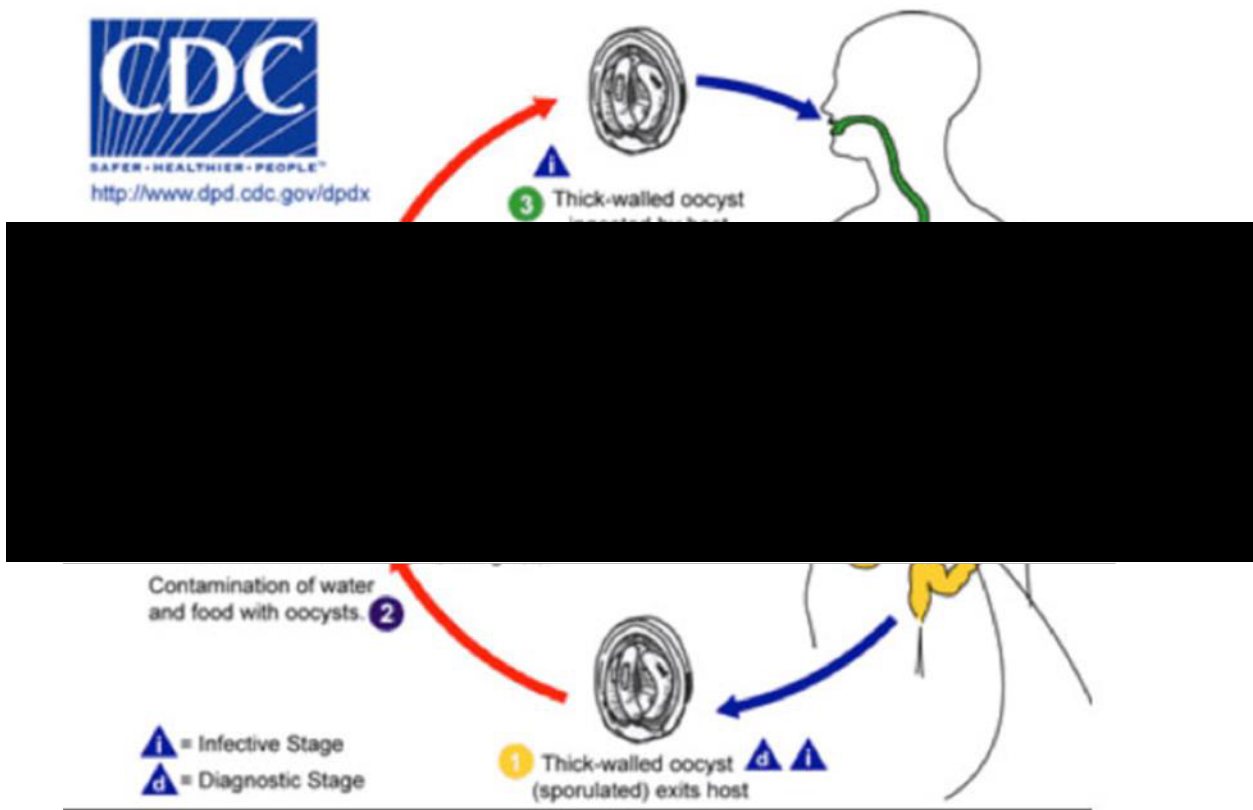
Swimming is a beneficial activity for all, for various social and biological reasons (National Health Service (NHS), 2019). With that in mind, swimming should not pose adverse health consequences, such as drowning or contracting a swimming-related illness. Controls are in place by swimming pool operators to reduce the risk from adverse swimming-related incidents (Health and Safety Executive, 2018), but swimming pool users themselves have a role to play in ensuring health and safety. This thesis focuses on swimming-related illnesses, specifically cryptosporidiosis. Although cryptosporidiosis can pose significant health risk to people who are immunocompromised, and there is no specific treatment (Leitch & He, 2011), there is no specific regulation governing swimming pools in the United Kingdom (Chalmers et al., 2016).

This chapter introduces the thesis, including the context which has guided the research. An explanation of swimming-related illnesses and cryptosporidium is provided, followed by a section outlining the purpose of the research and an orientation of the layout of the thesis.

## 1.2. Introduction to Cryptosporidium

Cryptosporidium is a protozoan parasite which causes a gastrointestinal illness called cryptosporidiosis (Leitch & He, 2011). The most common species of cryptosporidium to cause infection in humans are *Cryptosporidium parvum* and *Cryptosporidium hominis*. The *parvum* species can be acquired from animals, such as calves, and humans, while *Cryptosporidium hominis* can only be acquired from humans (Chalmers et al., 2016). Transmission of the parasite occurs via the faecal-oral route, as those infected with cryptosporidium shed oocysts in their faeces (Chalmers et al., 2016). Figure 1a below shows the life cycle of a cryptosporidium oocyst (Centers for Disease Control (CDC), 2017).

Figure 1a: Life cycle of a cryptosporidium oocyst



This figure is useful to aid understanding of how cryptosporidium can spread. Oocysts can be found in soil, water, food or contaminated surfaces. The mode of transmission is through the faecal-oral route (direct person-to-person transmission or indirectly through contamination of food or water: i.e. ingestion of the oocysts). It has been identified that ingestion of fewer than 10 oocysts can cause illness (Chalmers et al., 2016). The time from being exposed to the parasite to becoming ill, known as the incubation period, is between one and 14 days. Symptoms of cryptosporidiosis usually include watery diarrhoea and abdominal pain, and occasionally vomiting, nausea and fever. Cryptosporidiosis can cause severe illness in people who are immunocompromised, and there is no specific treatment (Leitch & He, 2011). A faecal sample is needed to diagnose this infection (CDC, 2017).

Reservoirs of infection include humans, cattle, sheep and other domesticated animals. As such, there are often outbreaks of cryptosporidiosis due to contamination of faecal matter from the various reservoirs (Hawker et al., 2012). For example, outbreaks have been associated with

drinking water supplies, petting farms, contaminated salad and swimming pools. Outbreaks of cryptosporidiosis are commonly associated with swimming pool settings, with research identifying leisure centres as the most common premises for outbreaks in the United Kingdom between 1992 and 2012 (Chalmers et al., 2016).

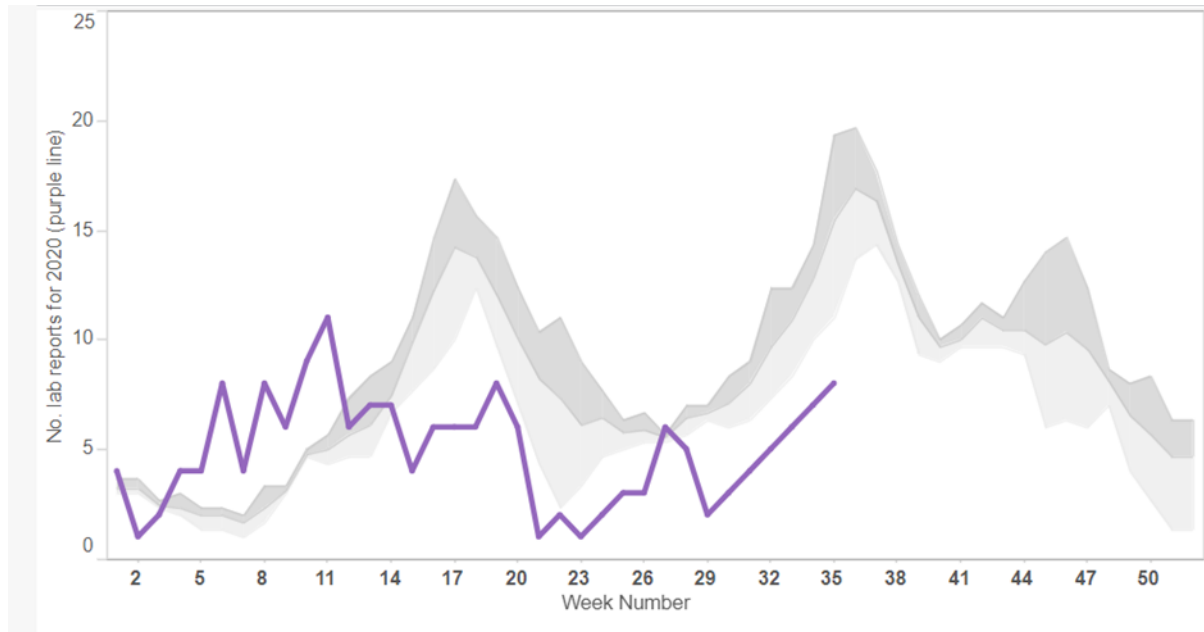
Prevention of cryptosporidiosis relies on good hygiene behaviours, including hand hygiene. Other preventative measures include avoiding childcare facilities, school, work, swimming pools and other settings until symptoms of diarrhoea and vomiting have stopped. It is recommended that individuals avoid frequenting any such settings until 48 hours after the symptoms have ceased; however, in the case of a confirmed infection with cryptosporidium, it is advised to extend this period to two weeks. To avoid illness caused by cryptosporidium, it is also advised to avoid consuming food that may be contaminated, such as salad that may have been rinsed in contaminated water, and to avoid the consumption of untreated water (CDC, 2019).

### 1.3. Prevalence of cryptosporidiosis in the UK

Since October 2010, laboratories are required under *The Health Protection (Notification) (Wales) Regulations 2010* (Wales) to notify the health authority of the detection of cryptosporidium oocysts in a stool sample. This forms the basis for national surveillance of cryptosporidium, while local authorities also gather risk factor data from cases and identify whether or not cases are part of a cluster/outbreak. However, it is evident that many cases of cryptosporidiosis go unreported, as not all those who are suffering from sickness and diarrhoea will provide a stool sample to their GP for diagnosis.

Surveillance is conducted in Wales by the Communicable Disease Surveillance Centre, Public Health Wales, which provides epidemiological data for cryptosporidiosis.

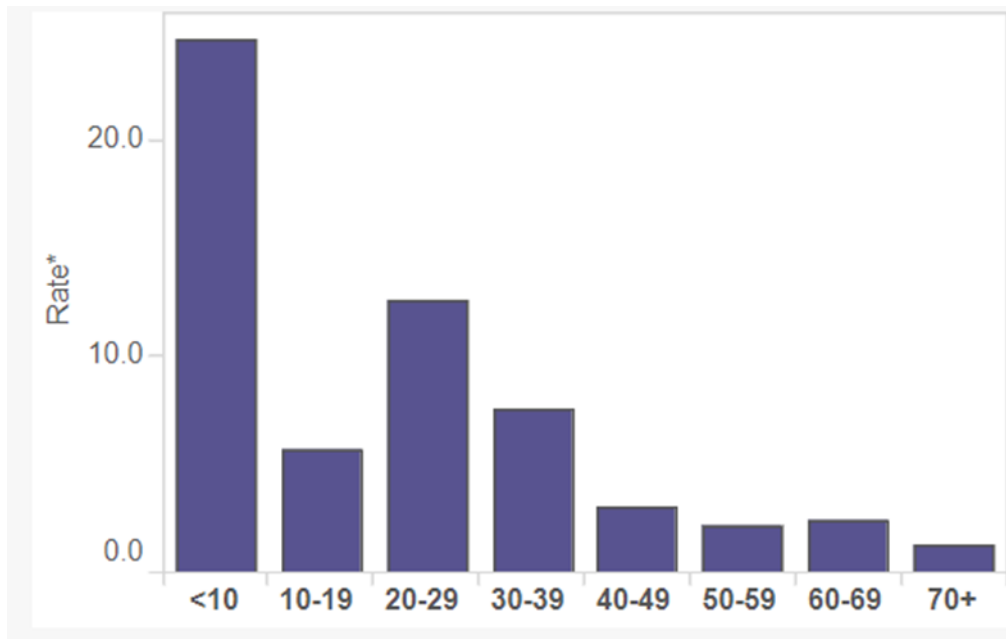
Figure 1b: Laboratory reports of cryptosporidiosis per week for 2020 (purple) and three-week moving average of laboratory reports over previous three years (grey)



(Public Health Wales, 2020)

The figure above demonstrates that there are peaks in cases of cryptosporidiosis in the spring and late summer and autumn. This may be due to an increase in the use of swimming pools and visits to petting farms during school holidays (Easter and Summer) (Chalmers et al., 2016).

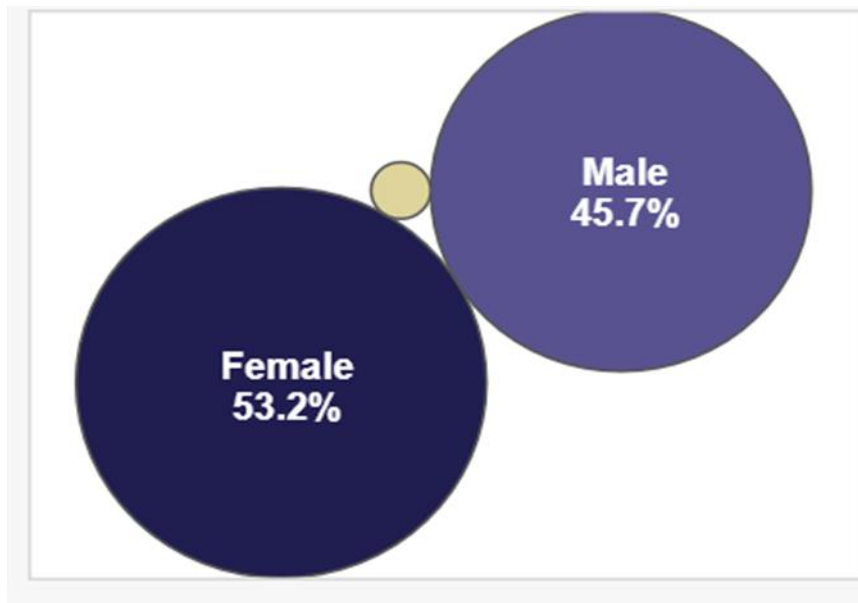
Figure 1c: Rate of laboratory reports of cryptosporidiosis by age group in 2019



(Public Health Wales, 2020)

The rate of laboratory reports of cryptosporidiosis is highest in those aged under 10 years old. This may be due to young children being more susceptible to infection but can also be linked to risk factors such as swimming lessons, contact with animals at petting farms and lack of hygiene practices at these settings by children (Chalmers et al., 2016). However, there does not appear to be a difference in the percentage of males and females who have been diagnosed with cryptosporidiosis, as demonstrated in Figure 1d. The yellow circle in the figure represents the 1.1% where sex is unknown.

Figure 1d: Percentage of laboratory reports of cryptosporidiosis by sex in 2019



(Public Health Wales, 2020)

In addition to surveillance of cases of cryptosporidiosis, Public Health England conducts surveillance of cryptosporidiosis outbreaks in England and Wales.

Table 1a: Outbreaks of cryptosporidium reported in England and Wales, 2017

<b>Agent</b>	<b>Total Affected</b>	<b>Laboratory confirmed</b>	<b>Hospitalised</b>	<b>Deaths</b>	<b>Setting</b>	<b>Food Description</b>
Cryptosporidium parvum IIaA17G1R1	9	8	1	0	Open/petting farm	No food identified
Cryptosporidium spp.	5	5	0	0	Open/petting farm	No food identified
Cryptosporidium spp.	4	4	0	0	Open/petting farm	No food identified
Cryptosporidium parvum	11	11	0	0	Open/petting farm	No food identified
Cryptosporidium spp.	3	3	0	0	Open/petting farm	No food identified
Cryptosporidium spp.	4	4	0	0	Open/petting farm	No food identified
Cryptosporidium parvum IIaA17G1R1	5	5	1	0	Open/petting farm	No food identified
Cryptosporidium spp.	3	3	0	0	Swimming pool	No food identified
Cryptosporidium spp.	6	2	1	0	Swimming pool	No food identified
Cryptosporidium hominis IbA12G3	5	3	0	0	Swimming pool	No food identified

Published data identified that there were 10 outbreaks reported to the surveillance system in 2017, of which seven were associated with a petting farm and three were associated with swimming pools (Public Health England, 2019).

Table 1b: Outbreaks of cryptosporidiosis reported in England and Wales, 2016

Agent	Total Affected	Laboratory confirmed	Hospitalised	Deaths	Setting	Food Description
<i>Cryptosporidium spp.</i>	3	3	0	0	Swimming pool	No food identified
<i>Cryptosporidium spp.</i>	3	3	0	0	Swimming pool	No food identified
<i>Cryptosporidium spp.</i>	4	3	0	0	Open/petting farm	No food identified
<i>Cryptosporidium spp.</i>	5	4	0	0	Other	No food identified
<i>Cryptosporidium spp.</i>	5	5	0	0	Other	No food identified
<i>Cryptosporidium spp.</i>	4	4	0	0	Swimming pool	No food identified
<i>Cryptosporidium hominis</i>	9	9	0	0	Swimming pool	No food identified
<i>Cryptosporidium parvum</i>	17	14	5	0	Commercial farm	No food identified
<i>Cryptosporidium parvum</i>	9	9	0	0	Open/petting farm	No food identified
<i>Cryptosporidium spp.</i> IBA10G2	4	4	0	0	Swimming pool	No food identified
<i>Cryptosporidium spp.</i> IIAA15G1R2 and IIAA17G1R1	54	37*	0	0	Open/petting farm	No food identified
<i>Cryptosporidium hominis</i> IBA10G2	13	13	0	0	Swimming pool	No food identified
Mixed <i>Cryptosporidium hominis</i> and <i>Cryptosporidium parvum</i>	8	8	0	0	Swimming pool	No food identified

\*Mixed outbreak, 33 cryptosporidiosis cases and 4 VTEC O157 cases.

*Note, the \* represents outbreaks where more than one pathogen has been identified to have infected individuals associated with that particular outbreak. In this example, there were individuals who were infected with cryptosporidium and Verocytotoxigenic E. Coli O157.*

However, data for 2016 show that the majority of outbreaks were associated with seven swimming pools and three petting farms (Public Health England, 2018). For both years, no foodborne outbreaks were identified (Public Health England, 2018, 2019).

Data published up until the end of 2012 demonstrate that leisure centres are the most common setting for cryptosporidiosis outbreaks associated with swimming pools.



Table 1c: Settings of outbreaks of cryptosporidiosis linked to swimming pools reported to national surveillance 1992-2012

<b>Setting</b>	<b>Number of reported outbreaks</b>
Leisure centre	53
Holiday centre	9
School	5
Hydrotherapy pool	4
Sports/health club	4
Hotel	2
Caravan park	2
Baby swimming facility	1
Shower	1
Combined sports club and leisure centre	1

(PHE eFOSS data taken from Chalmers et al., 2016, p. 14).

These data highlight how leisure centres can pose a risk for swimming-associated cryptosporidiosis. In addition, it is evident that children under the age of 10 have the highest rate of cryptosporidium infection. However, it is important to note that the source of one's infection with cryptosporidium can be difficult to ascertain (Chalmers et al., 2016): therefore cases and outbreaks may be underreported. Nevertheless, these data help to understand that efforts may need to be focused in swimming pools and petting farms to reduce the burden of cryptosporidiosis.

#### 1.4. Cryptosporidium and swimming pools

As demonstrated in the previous section, leisure centres are commonly associated with outbreaks of cryptosporidiosis. This may be due to the fact that the oocysts excreted by an individual infected with cryptosporidium are thick-walled, which allows them to resist the normal chlorination levels at swimming pools, and therefore they are not killed by chlorine (Pool Water Treatment Advisory Group (PWTAG), 2017). The oocysts are infective as soon as they are excreted by the host and as a result can cause immediate infection in other swimmers who consume the parasite whilst swimming (CDC, 2017). It takes very few cryptosporidium oocysts to cause illness (Chalmers et al., 2016). Issues regarding asymptomatic shedding and young children being likely to have toileting accidents at swimming pools present the opportunity for cryptosporidium to enter the swimming pool water (PWTAG, 2017).

Removal of the oocysts relies on good operating and management procedures in swimming pool settings, including backwashing of the filters and emergency action plans to manage faecal accidents (PWTAG, 2017). However, even when these policies are in place and are being managed effectively, *Cryptosporidium* oocysts can still be identified in swimming pool water (Chalmers, 2000).

Correct filtration processes include the use of medium rate filters at leisure centres and the use of coagulation. Coagulation is a process which helps to bind small particles together within the water to make it easier to capture these newly formed larger particles within the filter media (PWTAG, 2017). Although control measures are in place at commercial swimming pools, outbreaks are still being identified, with some due to failings in controls being implemented and some due to poor swimming practices by swimming pool users (Pond, 2005). For that reason, ensuring that *cryptosporidium* does not enter the pool in the first instance is the best way to control the transmission of cryptosporidiosis in swimming pool water (Chalmers et al., 2016).

A faecal accident in a swimming pool may or may not lead to the closure of that pool. If the faecal accident is of solid matter, then swimming pool operators are advised to remove the matter as soon as possible. However, in the case of a loose stool, pool operators are advised to close the pool for precautionary reasons in case the loose stool contains pathogens (PWTAG, 2017). There can be considerable cost to pool operators and swimming pool users of pools having to be closed due to faecal accidents. PWTAG (2017) also highlights the fact that swimming pools will be closed for long periods of time (eight hours, in some cases) to allow for adequate filtration of the water to remove any potentially harmful pathogens. Therefore, swimmers are not able to swim and pool operators are not able to carry on business. In addition, it has been identified that infection with *cryptosporidium* can be severe and sometimes life-threatening in people who are immunocompromised (Hunter & Nichols, 2002), thus highlighting the role that pool operators and swimming pool users have in protecting the health of the varied demographic of people who go swimming, from babies to older people, competitive athletes and those who are using the pool as a rehabilitation process.

In addition to faecal releases, swimmers should not urinate in the swimming pool water. Disinfection by-products are created when urine reacts with the chlorine in swimming pools which creates a potent odour in addition to by-products which can cause red-itching eyes of swimmers (PWTAG, 2017).

## 1.5. Hygienic swimming behaviours

To reduce the number of people who become ill from swimming-pool-associated cryptosporidiosis, it is recommended that swimmers follow hygienic swimming behaviours to reduce the risk of introducing oocysts into the pool (PWTAG, 2017). These behaviours include:

- Not swimming whilst ill with diarrhoea and vomiting;
- Waiting 24 hours after symptoms of diarrhoea and vomiting have stopped before returning to swimming;
- Waiting 14 days after symptoms of diarrhoea and vomiting have stopped following diagnosis with cryptosporidiosis before returning to swimming;
- Showering before swimming;
- Washing hands after using the toilet;
- Encouraging the use of proper swim nappies;
- Taking children for regular toilet breaks and ensuring that no one uses the pool as a toilet;
- Informing a member of staff of any faecal incidents as soon as possible.

Guidance from the Pool Water Advisory Group strongly recommends that swimming pool users shower before swimming to remove make-up, faecal matter and other bodily matter, as these can affect the quality of the pool water. This guidance suggests that swimming facilities should encourage parents to take care when changing their child's nappies to ensure that all faecal matter is removed to avoid contaminating the pool water (PWTAG, 2017). The use of swim nappies is also encouraged, but their efficacy is questioned in relation to their effectiveness in containing loose stools. Nonetheless, the guidance encourages their use, as they are the most suitable option to contain faecal matter in comparison to nothing at all (PWTAG, 2017). Swimmers should also be advised not to swim for 14 days following illness with cryptosporidiosis and until all symptoms have ceased. In addition, this guidance encourages parents to take their child to the toilet before entering the pool and to take regular toilet breaks. This is to try and avoid toileting accidents in the pool (PWTAG, 2017). However, there is no specific regulation to state that swimming facilities must provide this information to swimming pool users, and in practice facilities do not all provide users with information regarding the recommended hygienic swimming behaviours.

## 1.6. Cryptosporidium and public policy

Cryptosporidium is classed as a communicable disease and falls under the sustainable development goals to improve health and to ensure water sanitation (United Nations, 2019). The World Health Organisation (WHO) provides guidelines for swimming pools and similar water environments (WHO, 2006). This document aims to ensure that all swimming pools follow a set of standards relating to potential hazards in swimming pools, including pathogens and drowning, and take measures to protect against those hazards, including education of swimming pool users.

The *Well-Being of Future Generations Act 2015* (Wales) aims to provide a healthier Wales. Therefore, ensuring the reduction of transmission of communicable diseases, such as cryptosporidium, is important for health authorities to achieve this priority. Yet, there are no specific regulations in Wales, or the UK, for swimming facilities. The *Health and Safety at Work etc. Act 1974* (UK) and the *Management of Health and Safety at Work Regulations 1999* (UK) do apply to swimming pool settings, where employers are required to protect the health of the public so that they are not exposed to risks to their health or safety. However, they do not require swimming pool operators to educate users on risks such as pathogens in pools and how to minimise those risks. However, The Health and Safety Executive (HSE) have guidance (HSG179 Managing Health and Safety in Swimming Pools) that provides the standard to which swimming pools should be operated and managed (HSE 2018). In addition, there are two British Standards which require swimming pools to be designed to be safe; however, they do not provide standards for cryptosporidium.

PWTAG have developed guidelines which address the management of swimming pools, including control of cryptosporidium. This document does highlight and provide guidance on swimming pool users being a source of transmission and the need to promote hygienic swimming behaviours (PWTAG, 2017). Yet, these are only guidelines and do not impose a requirement on swimming pool operators to provide information to their pool users regarding hygienic swimming.

## 1.7. My interest in the topic

My interest in cryptosporidium began during my final year undergraduate studies. I have a BSc (Hons) Degree in Environmental Health, and during this degree I undertook a placement year as a Student Environmental Health Officer, where I spent time with two local authorities in Wales to gain experience of working within an environmental health role.

During my placement at one local authority within the health and safety and communicable diseases team, I was asked to support the team at an event organised to raise awareness of communicable diseases and their control amongst nursery organisations. An element of the forum included an interactive educational intervention to promote adequate handwashing at nursery facilities. It was my responsibility to run the intervention with nursery staff members. I asked participants to cover their hands with fluorescent gel before washing them with soap and water to remove the gel. Participants were then asked to present their hands into a black box with a UV light to identify whether any of the fluorescent gel remained on their hands. This was to identify whether participants had correctly washed their hands. This was an interesting experience and my first involvement in any public health intervention to improve hygienic behaviours. My first impression of this particular hand hygiene intervention was positive, in that all participants appeared to be excited and eager to take part. This made the whole experience very enjoyable and rewarding for me.

While on placement with this particular local authority, I was offered a place as part of a team conducting research into the management of cryptosporidium within public swimming pools in Wales. As I was required to complete a final year research project following the placement, as part of the degree, I jumped at the chance to be involved in this project. My involvement in this research was to input, clean and analyse the data collected by Environmental Health Officers across the 22 local authorities in Wales. For my undergraduate final year research project, I specifically looked at the management of swimming pool filters within 423 commercial swimming facilities across Wales. My study identified that overall, the swimming pool water filters were being managed effectively in Wales. The study recommended that training and education of pool operators needs to be undertaken in pools that do not have an adequate backwashing procedure. Further research would have been beneficial to evaluate whether the advice given to pool operators has had a positive impact on improving the overall management of pool water filters. This should be linked to the prevalence of cases/outbreaks of cryptosporidiosis in Wales to evaluate the All Wales Cryptosporidium Project's aim of

improving the control of cryptosporidium in swimming pool settings. However, my study, and the wider study conducted by the research team, did not consider the hygienic swimming behaviours of swimming pool users as a means of controlling outbreaks of cryptosporidium in swimming pool settings. Nevertheless, the study did identify that many swimming pools were not providing information to users regarding hygienic swimming: therefore, the research team provided posters to try to raise awareness of hygienic swimming.

The behaviours of swimming pool users to reduce outbreaks of cryptosporidiosis within swimming pool settings really interested me after this first research project, and I wanted to explore this further. Therefore, I decided to apply for an MSc Public Health and Health Promotion degree. I was lucky to gain a place on this degree and expanded my knowledge already gained from my undergraduate degree in relation to public health. Health promotion, however, seemed foreign to me to begin with. An Environmental Health Officer holds an authoritative role, with regulations and policies for all aspects of environmental health. Therefore, studying health promotion opened up a new view for me with regard to public health. As such, I wanted to put a health promotional spin on the research I had already conducted relating to the control of cryptosporidium within swimming pools. As part of my MSc, I undertook a qualitative questionnaire study to explore awareness of hygienic swimming behaviours amongst a sample of 22 parents of swimmers. There was a varied response from participants in relation to their knowledge about hygienic swimming behaviours. Most of the parents surveyed did not know what cryptosporidium was, which highlighted the need to raise awareness of this topic amongst swimming pool users. A high number of responses alluded to the fact that providing health information through the swimming pool settings would be the most convenient way for parents to receive information. I hoped that I could conduct further research into this topic on a wider scale in future. Following on from this study, I was approached by Swansea University's marketing department to use the findings of my MSc study as a means to promote the MSc in Public Health and Health Promotion course. The animation included a summary of the main findings of my study, and in addition provided advice regarding the recommended hygienic swimming behaviours. The animation is available on YouTube by accessing this link: <https://www.youtube.com/watch?v=E3KiEE4J990>.

Following my MSc, I worked as an Information Analyst for Public Health Wales, which allowed me to analyse and identify trends in communicable diseases in Wales. One piece of work that I conducted during my time in this role was to analyse questionnaires conducted by Environmental Health Officers regarding cases of cryptosporidiosis in Wales. The purpose of

these questionnaires was to collect demographic and risk factor information to inform preventative action. However, during my time in this role, I often wished that I was the one collecting this information from individuals who had acquired cryptosporidiosis. An opportunity arose for me to work as a Communicable Disease Officer for the local authority, where I was responsible for the investigation of cases and outbreaks of communicable diseases. This gave me the opportunity to ask those questions relating to cryptosporidium risk factors, which really interested me.

I found from my discussions with individuals or parents of children who had been diagnosed with cryptosporidiosis that many of them were not aware of the importance of not swimming whilst suffering from cryptosporidiosis, and especially for 14 days after their symptoms had stopped. This took me back to my MSc project and how I had wanted to be able to conduct more research into hygienic swimming behaviours. That wish came true when I was fortunate to gain a scholarship for a PhD at Swansea University. This thesis presents my research journey.

## 1.8. Rationale for the study

Chapter 2 will provide a comprehensive literature review which identifies that there is a lack of studies in the UK which have addressed hygienic swimming behaviours. It is evident that outbreak investigations have identified that swimming pool users' behaviour may have contributed to the source of outbreaks associated with swimming facilities. Studies reviewed regarding hygienic swimming behaviour research from outside the UK provide an insight into current swimming pool users' behaviours in the swimming pool setting. However, there is a lack of studies that evaluate interventions that are used to change swimmers' behaviours. Hand hygiene intervention studies are reviewed and provide an insight into the important aspects of an intervention carried out in UK settings, to ensure that the intervention is successful at changing behaviour. Reviewing these studies highlighted the importance of exploring barriers and motivators for intended hygiene behaviours.

There is a need to explore swimming pool users' awareness of hygienic swimming behaviours in the UK, particularly using qualitative research. It is also evident that current interventions to improve hygienic swimming behaviours need to be assessed to help complement the exploration of swimming pool users' awareness. An opportunity to develop and evaluate a UK-

based intervention within swimming pool settings relating to hygienic swimming was identified. The next section will provide the aims and objectives to address the gaps in knowledge identified.

### 1.9. Aims and objectives

Informed by the shortfall in current knowledge, the aims of this study were to explore awareness of hygienic swimming behaviours and to develop and evaluate a public health intervention to reduce the transmission of cryptosporidium. The thesis aims are focused on raising individual awareness of hygienic swimming behaviours for various reasons. Behaviour change models and theories highlight how successful behaviour change involves different stages, with the first stage addressing perception that a behaviour change may be needed. Therefore, it was considered important to raise awareness of hygienic swimming behaviours, to allow individuals to consider whether there is a need for them to change their behaviours whilst at the swimming pool setting. For example, the Health Belief Model (HBM) (Rosenstock, Strecher & Becker, 1988) discusses perceived susceptibility and perceived severity, perceived benefits and perceived barrier, which involves individual perceptions. Thus, highlighting how focusing on raising individual awareness would be a logical place to start for a public health intervention addressing hygienic swimming behaviours, a topic that lacks previous consideration in the UK literature. In addition, the scope and feasibility of a PhD study was taken into consideration.

In order to address the aims, the research was conducted in three phases. The first phase explored swimmers' and parents of swimmers' awareness of hygienic swimming behaviours and cryptosporidium. In addition, this phase explored how swimmers and parents of swimmers would like to receive health information. This first phase also gathered information on public health measures currently in place at swimming pools and explored swimming pool operators' views about a public health intervention. The views of health care professionals, who have a direct involvement in the investigation of cases and outbreaks of cryptosporidium, were also explored to enhance the data gathered on this public health intervention.

The second phase sought to verify and expand on the findings from the first phase by gathering data from a larger sample of swimmers and parents of swimmers using a quantitative approach. A further exploration of swimmers' and parents of swimmers' awareness of hygienic



swimming behaviours was carried out in this phase. In addition, this second phase identified how a sample of the swimming population preferred to receive information regarding hygienic swimming behaviours. An intervention was developed as part of the third and final phase of the research. The intervention was piloted and evaluated amongst a sample of the swimming pool user population.

#### 1.10. Organisation of thesis

This section provides an orientation for the reader to the layout of this thesis. Following this first introductory chapter is the literature review (Chapter 2). This chapter critiques and synthesises the findings from studies relating to hygienic swimming behaviours to gain a better understanding of hygienic swimming behaviours as a phenomenon and to identify the methods use in previous research into this subject. Chapter 3 provides the methodology adopted to conduct this study.

The methods for phase 1 are presented in Chapter 4. In addition, this chapter sets out the overarching framework which informed the interpretation of the findings from phase 1 and which then guided the development of phases 2 and 3.

The findings and discussion from the first phase of the study are also provided in section 4.4 of this chapter. Following the fourth chapter, the methods, results and discussion of the second phase of the study are provided in Chapter 5. Chapter 6 reports how the third and final phase of research was carried out, including the development of a public health intervention. The methods used to evaluate the intervention are also provided in this chapter, as well as the phase 3 results and discussion. The thesis concludes in Chapter 7 with an overview of all the results, limitations of this study and recommendations for future practice and research.

#### 1.11. Summary

This chapter provides a background to the research and puts into context the issue that this study addresses: reducing the transmission of cryptosporidium in swimming pools by raising awareness of hygienic swimming behaviours. It is known that cryptosporidium is resistant to the normal chlorination levels used in swimming facilities, therefore, keeping the parasite out of the swimming pool water is the best control method.

In the following chapter, a comprehensive and critical review of the literature on hygienic swimming behaviours is presented. As there is no published research in the United Kingdom which has specifically explored hygienic swimming, the literature review contains research regarding hand washing interventions undertaken in the UK, as this is a recommendation to reduce the transmission of cryptosporidium and other diarrhoeal diseases.

## 2. Chapter Two: Literature Review

### 2.1. Introduction

The aim of the literature review is to identify previous studies focusing on hygienic swimming behaviours, and to identify any gaps in the existing body of literature. This literature review provides a critique of the methodology, methods and theoretical perspectives of previous studies.

From reviewing the literature, three themes resulted from previous research into hygienic swimming behaviours. The first theme discusses awareness of hygienic swimming behaviours amongst swimming pool users, while the second theme explores interventions to raise awareness of these behaviours. As this literature review will highlight, there is a lack of research in the United Kingdom about hygienic swimming behaviours. However, a third theme emerged whereby interventions in the United Kingdom to raise awareness of hand hygiene were critiqued.

This review is thematically organised, providing a description of the literature search strategy in the next section, followed by a discussion and critique of the studies under the three themes. A methodological critique and a theoretical critique are provided, followed by a summary at the end of this chapter.

### 2.2. Literature search strategy

A narrative literature review was conducted adopting a systematic approach. This approach allows for the appraisal and summary of the literature relevant to hygienic swimming behaviours (Paré, Trudel, Jaana & Kitsiou, 2015). Narrative reviews do have some weakness in that they do not adhere to rigorous standards, as does the systematic literature review (Rhoades, 2011). The systematic literature review is the most comprehensive type of literature review; however, it requires extensive resources and time (Paré et al., 2015). As this literature review will highlight, there is a lack of previous studies focusing on hygienic swimming behaviours: therefore, a systematic review would not have been possible. This was also true when considering a meta-analysis. A scoping review was considered inappropriate, as this type

of literature review provides an initial scope of the current literature instead of an ongoing review (Daudet, Van Mossel & Scott, 2013). It was considered important to update the literature periodically during the PhD research journey to identify new studies that could add to the current understanding of hygienic swimming behaviours. An integrative literature review was not undertaken, as they are usually guided by a theory or a set of competing models (Torraco, 2005). This was not believed to be appropriate for the under-researched topic of hygienic swimming behaviours. The aim of the literature review was to explore hygienic swimming behaviour studies and therefore it was not considered appropriate to be guided by theories or models. It seemed more appropriate to explore what models and theories were used by previous researchers to investigate hygienic swimming behaviours. However, the narrative review carried out adopted a systematic approach to reduce bias in article selection.

Two search strategies were applied in this literature review. The initial search strategy identified that there were no previous studies in the United Kingdom that considered interventions to promote hygienic swimming behaviours. Due to this, a supplementary search strategy was implemented to identify previous literature regarding hand hygiene interventions in the UK. The databases used to search for published literature were ASSIA, CINAHL, Cochrane, PsychINFO, PubMed (indexed for MEDLINE), Scopus and Web of Science. These were chosen because they represent Public Health and Social Science databases. Grey literature was explored using Google Scholar, and reference lists of the final retained articles were scanned for any additional publications.

The inclusion criteria adopted for articles on all topics were that they were required to be published in the English language, which may introduce bias by excluding some articles of interest. Different restrictions on the date of publication were applied, which will be discussed for each search strategy later in this chapter. All types of studies were included in the literature review. The population under surveillance was the swimming population, which included athletes, general swimmers and children. It was required that the studies looked at the phenomenon of hygienic swimming behaviours in its broad sense. The outcome of interest was any lessons learnt from outbreaks, observations of hygienic behaviours or evaluations of hygienic behaviour interventions. Titles and abstracts from the database search were screened and those that did not meet the inclusion criteria were excluded. The remaining full texts were screened for eligibility. The framework used to help critique each article was the Critical Appraisal Skills Programme Tool (Singh, 2013), which can be found in Appendix 1a.

### 2.2.1. Initial search strategy

This section will describe the initial search strategy adopted to identify literature and aid understanding of cryptosporidiosis outbreaks and their prevention in the UK and to explore previous research looking at hygienic swimming behaviours.

The key words used to search the literature in this first search strategy were as follows:

1. To identify articles relating to cryptosporidiosis outbreaks in swimming pools in the UK:
  - Cryptosporidium OR cryptosporidiosis
  - swim\*
  - outbreak\* OR incident\*
  - UK OR United Kingdom OR Britain OR Great Britain OR Wales OR Scotland OR England OR Ireland
  
2. To identify articles relating to Hygienic Swimming Behaviours:
  - hygiene OR hygienic OR clean
  - swim\*
  - behaviour\* OR knowledge OR aware\* OR habit\* OR practice\*

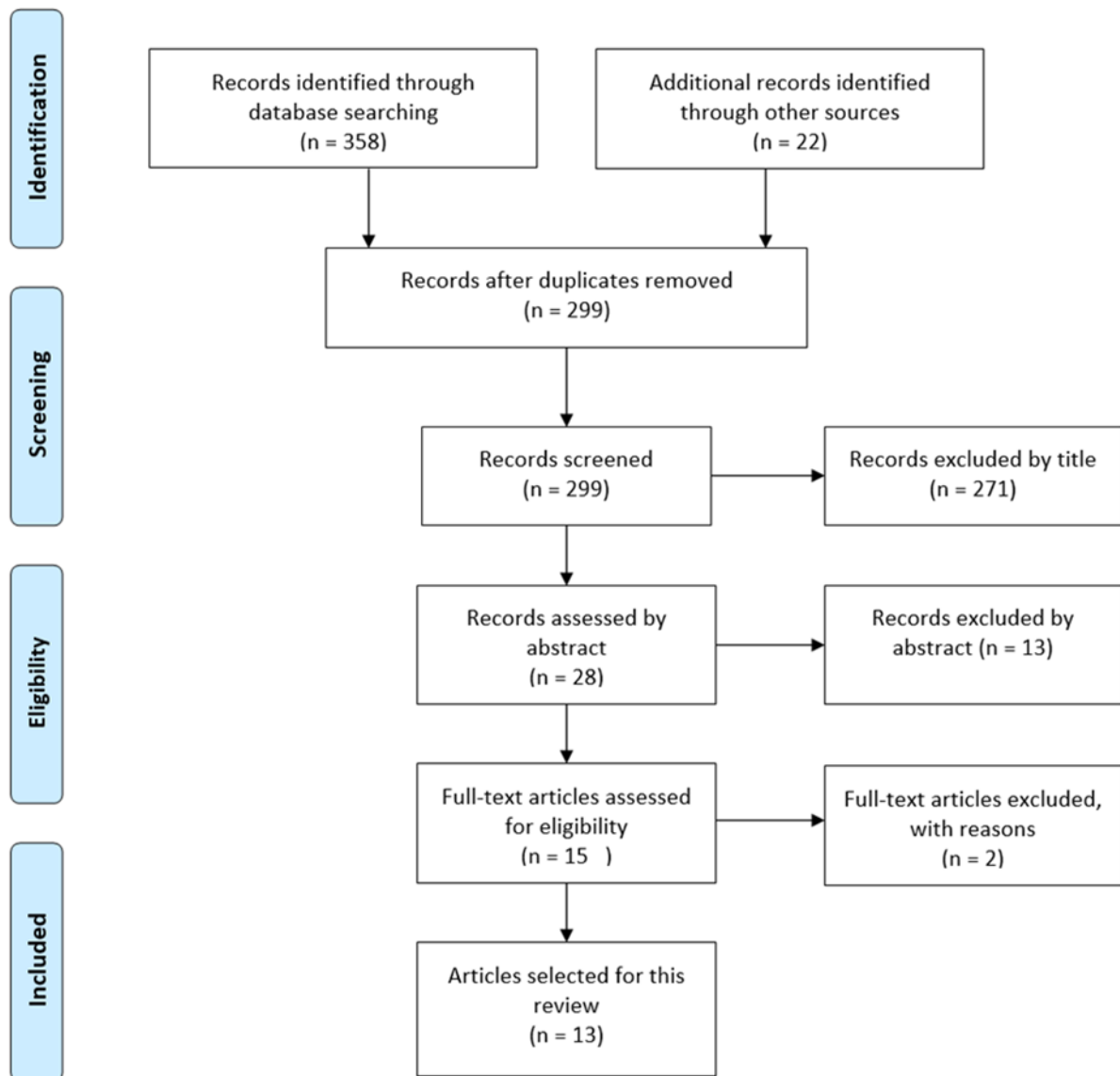
The specific inclusion criteria for this initial search strategy were that articles needed to provide some insight into hygienic swimming behaviours in order to be included in the review. Articles related to outbreaks of cryptosporidium were required to show evidence that the outbreak was associated with a swimming pool and needed to consider swimmers' hygienic behaviours during the investigation.

The date of publication was initially restricted to five years, which did not yield any relevant articles. Therefore, the parameter was set to 10 years for articles relating to cryptosporidiosis outbreaks in swimming pools and then widened to 20 years in order to try to identify articles related to hygienic swimming behaviours. As there was no published literature relating to hygienic swimming behaviours in the UK, the search was widened to include any westernised country. Peer reviewed articles were included, along with Masters' and Undergraduate theses (n=4). These were identified from other sources and were included because there was a significant lack of published articles focusing on hygienic swimming behaviours.

Articles were excluded if they were not focused on swimming pool associated outbreaks. A number of articles were excluded due to being focused on outbreak investigation from a molecular angle. The aim of the literature search was to identify articles relating to hygienic swimming behaviours; therefore, only studies looking at hygienic behaviours during the outbreak investigations were included. Many articles were excluded from this search because they focused on swimming as an exercise rather than on hygiene at swimming pools. Articles were not eligible for this review if they did not focus upon swimming pool users' behaviours. For example, a small number of articles focused on the regulation of swimming pools and did not explore education of swimmers.

Thus, the total number of publications identified from this initial search strategy was 358 articles through database searching and 22 articles from other sources. Following the removal of duplicates and the exclusion of those that did not meet the inclusion criteria, 13 articles were eligible and were thus included in this literature review. Please see the adapted PRISMA flow diagram (Moher, Liberati, Tetzlaff & Altman, 2009) for details (Figure 2a). Two full text articles were excluded following assessment for eligibility, as they did not focus on outbreaks of cryptosporidiosis or hygienic swimming behaviours, which was not clear when assessing their abstracts for eligibility in this literature review.

Figure 2a: PRISMA flow diagram of initial literature review strategy



This initial search strategy promoted the need for an additional search strategy due to the lack of publications that focused upon hygienic swimming behaviours in the United Kingdom and westernised countries. Publications about hand hygiene interventions in the United Kingdom were reviewed, as hand hygiene is one of the recommended hygienic swimming behaviours. This was to supplement the lack of research addressing hygienic swimming behaviours interventions in the United Kingdom.

### 2.2.2. Supplementary search strategy

The aim of this search strategy was to supplement the lack of studies found on hygienic swimming behaviour interventions. Hand hygiene is one of the hygienic swimming behaviours recommended: therefore, it was deemed useful to explore previous interventions to improve the hygienic behaviour of hand washing.

The key words used to search the literature in this search strategy were as follows:

- Hand\*
- hygiene OR wash\*
- intervention\* OR campaign\* OR promote OR promotion\* OR education\* OR programme\*
- UK OR United Kingdom OR Britain OR great Britain OR Wales OR Scotland OR England OR Ireland

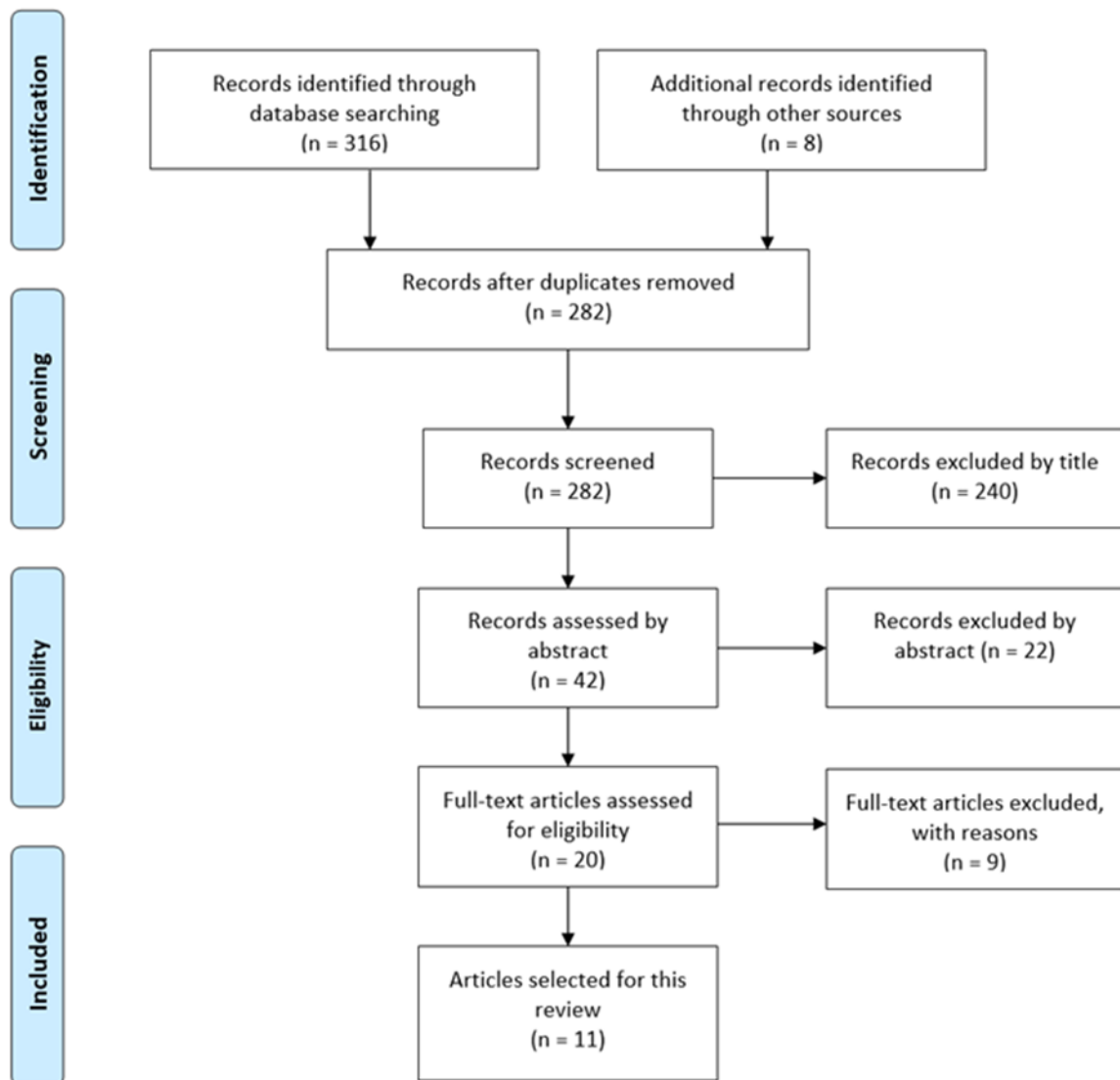
Many articles focused on hospital hand hygiene: therefore, the parameter (NOT nursing OR nurse OR medical OR hospital OR healthcare OR patient\*) was added to exclude these types of study.

The search parameters for hand hygiene intervention research papers were set to include research conducted in the United Kingdom in the last ten years and had to include an intervention to improve hand hygiene behaviour. Articles were excluded if they were conducted in a hospital setting or involved educating health care workers, as the aim was to understand interventions that targeted the layperson rather than health care professionals whom it can be assumed understand the importance of hand washing in infection control. Articles chosen were required to be peer reviewed.

The total number of publications identified was 316 articles from database searching and eight from other sources. Following removal of duplicated articles and exclusion of articles that did not meet the inclusion criteria, 11 articles were eligible and included in this literature review. This selection process is detailed in Figure 2b. Two full text articles were reviewed and subsequently excluded, as it was not clear from their abstracts that the articles did not relate specifically to hand hygiene interventions in the UK.



Figure 2b: PRISMA flow diagram of supplementary search strategy



A summary of the critique of all studies included in this literature review is provided in Appendix 1b. The next section will provide a review of the literature in light of the first theme: Awareness of hygienic swimming behaviours.

### 2.3. Awareness of hygienic swimming behaviours

Following a review of the literature, it was evident that a main theme that emerged was swimming pool users' current awareness of hygienic swimming behaviours. From the studies reviewed, it appears that awareness of hygienic swimming behaviours varied amongst the study participants. This section also highlights how a lack of awareness of these recommended behaviours can lead to outbreaks of cryptosporidiosis.

Results demonstrated that awareness of hygienic swimming behaviours varied amongst swimming pool users. For example, McClain, Bernhardt, and Beach (2005) identified low levels of awareness amongst 256 parents of children under 12 regarding prevention (hygienic swimming behaviours) of recreational water illnesses. Their cross-sectional study, using a self-administered questionnaire conducted in the UK, suggested that swimmers needed to be aware of the hazard to know they are at risk of recreational water illnesses before they are able to adopt preventative behaviours. As an example, this study identified that parents may already recognise that swim nappies are not effective in containing loose stools, as they are more actively engaged in preventative behaviours (McClain, Bernhardt, & Beach, 2005). However, this study focused solely on parents of children under 12, and results might have differed if a more diverse sample of the swimming population had been recruited.

Nett et al. (2010) also conducted a cross-sectional study that focused upon children and their parents/guardians. Their observations of 145 children at a splash park in Idaho, USA identified that normal nappies were being worn (38%) instead of recommended swim nappies, which are more likely to avoid any leakage of faecal matter into the swimming pool water. Their study also collected questionnaire responses from 551 parents or guardians, which demonstrated that there was a lack of understanding amongst the respondents with regard to hygienic swimming behaviours. The authors reported that 564 supervisors were asked to take part in the study, of whom 551 agreed to take part, giving a response rate of 98%, which is a strength of this study. Nevertheless, this study did not explore the awareness of hygienic swimming behaviours amongst a more diverse sample of the swimming population: i.e. those who were not children or their adult supervisors.

In contrast, the study by Chan and MacLeod (2014), conducted in the Netherlands, recruited a convenience sample of 167 respondents (response rate = 84%) that included a more diverse sample of the swimming population, and did not focus solely on recruiting parents or guardians.

Their study focused on the influence of frequent swimming on hygienic swimming behaviours. Chan and MacLeod (2014) concluded that there was no observed difference in the mean knowledge scores between people who swam more frequently and those who swam less. Their study showed that swimming pool users can be aware that there is a risk of illness from swimming pool water; however, the respondents demonstrated that knowledge regarding hygienic swimming and avoidance of illness remained low. Chan and MacLeod (2014) reported that respondents were often surprised by the length of time recommended following illness with sickness and diarrhoea before returning to swimming. The study was conducted by an Environmental Health undergraduate student studying at a University in Canada; however, it was included in this review because it does add insight into hygienic swimming behaviours. The author identified the limitations of the study in terms of a small sample size and the exclusion of those who did not understand English. They identified that many swimming pool users were Chinese, and could not read English, and therefore were excluded from taking part in the study. This highlights the importance of considering the varied population who attend swimming pools in terms of different ethnic backgrounds for whom English is not their first language. This study may not be generalisable to some groups of the population for this reason, and awareness of hygienic swimming behaviours may differ within different swimming sub-populations.

A lack of understanding of the importance of not urinating in swimming pool water was highlighted by a cross-sectional study conducted in Italy in 2016. Galle et al. (2016) identified that 16.3% of 184 adults surveyed reported urinating at least once in swimming pool water. This demonstrates a lack of understanding amongst their sample of swimming pool users of the effect that urine has upon chlorine in pool water. As discussed in Chapter 1, urinating in the swimming pool can cause a reaction with the chlorine, resulting in disinfection by-products. These in turn can cause red, itchy eyes for swimmers. Thus, highlighting that if parents or guardians may not be aware of hygienic swimming behaviours themselves, they therefore cannot influence their children to follow recommended behaviours. Similarly, a study by Amodio et al. (2014) found that 24 of the 498 respondents to their self-administered questionnaire reported that they sometimes or always urinated in the swimming pool.

Galle et al. (2016) also identified that age had an influence on hygienic swimming behaviours. They also surveyed 184 children/adolescents (a total sample size of 368, with a response rate of 61%), and found that those aged between 14-17 and 18-39 years showed the worst compliance with hygienic swimming behaviours. Although this study adds to the body of

knowledge about hygienic swimming behaviours, they excluded occasional swimming pool users (less than at least once a week) from their sample. It would have been interesting to understand whether frequency of swimming influenced hygienic swimming behaviours.

Both Lowe et al. (2010) and McCann et al. (2014) reported that there might be a lack of knowledge amongst study participants regarding the importance of not swimming whilst symptomatic and avoiding swimming for 48 hours after symptoms of sickness and diarrhoea have stopped. There were 106 confirmed cases of cryptosporidiosis identified from outbreak investigations and recruited to the cohort study conducted by Lowe et al. (2010). Of those, one child was hospitalised due to their illness, highlighting the potential severity of cryptosporidiosis infection. A total of 57 individuals took part in Coetzee et al.'s (2008) study. They identified that six confirmed cases were admitted to hospital, again highlighting how severe cryptosporidium infection can be in some people.

The outbreak investigations by Lowe et al. (2010) highlighted the poor management of the swimming pool setting, as there was an interactive water feature (the mushroom feature) which was fed unfiltered water. A faecal accident on the toddler slide was the likely source of contamination identified from Lowe et al.'s (2010) investigations. This, along with the incorrect management of the interactive water feature, allowed for contaminated water to infect other swimmers. This study demonstrates the need to educate swimming pool users on not swimming whilst suffering with sickness and diarrhoea and avoiding swimming for 48 hours after symptoms have stopped. In addition, raising awareness of the need to inform a member of staff of a faecal accident in the swimming pool water is also highlighted. This research demonstrates the important role that both parents with young children using pools and pool operators have in reducing the risks from cryptosporidium transmission. Although this study was conducted in the UK and gives an insight into the hygienic swimming behaviours of a small sample of the swimming community in South Wales, its focus was upon outbreak investigation rather than specifically exploring awareness of hygienic swimming behaviours.

The study by McCann et al. (2014) also highlights how swimmers' behaviours can lead to an outbreak of cryptosporidiosis. Investigations at the swimming pool setting in England found that there was a satisfactory level of cleanliness and pool management. The findings identified that swimmers and coaches had a lack of knowledge in relation to the transmission of cryptosporidium within swimming pools. They also showed that swimmers and coaches did not know the importance of not swimming whilst suffering with sickness and diarrhoea and

adhering to the two-week exclusion period. The outbreak investigations by McCann et al. (2014) found that parents and coaches were reluctant to follow exclusion recommendations, as they believed this could adversely affect swimming performance. Unfortunately, the article does not provide any supporting statements as evidence to support their claims. It would have been beneficial to explore this further with swimmers, parents and coaches to better understand and document evidence of why hygienic swimming behaviours may not be followed as recommended by authorities. On a positive note, this study by McCann et al. (2014) reported the initial number of people they had contacted (n=129) as part of their outbreak investigations. Their reported response rate was 78%, with 101 individuals recruited to the cohort study. However, although the response rate was good, this is a small sample size.

Coetzee et al. (2008) identified swimming parties at Pool A in England, along with poor management of the swimming pool water, as the most likely cause of the outbreak. However, in contrast to the studies by Lowe et al. (2010) and McCann et al. (2014), they did not identify any faecal accidents at the swimming pool as part of their investigations. Coetzee et al. (2008) highlighted how swimming parties may be a means of introducing cryptosporidium into the swimming pool and the possibility that children may be following unhygienic swimming behaviours. However, this was not investigated further in the study, suggesting the need for further exploration of this phenomenon.

Investigations into outbreaks are of benefit to public health in identifying likely sources of transmission, risk factors and demographics of cases (Chalmers et al., 2016). This can help to identify target groups or areas in which a public health intervention may be needed (Naidoo & Wills, 2016). These studies are useful to begin to understand how swimmer behaviour can result in outbreaks of cryptosporidiosis associated with swimming pools. However, these retrospective studies that focus upon outbreaks have their limitations, as identified. They do not explore hygienic swimming behaviours specifically: therefore, studies from outside of the UK which addressed hygienic swimming behaviours were critiqued. As mentioned previously, there were no studies in the UK which specifically addressed hygienic swimming behaviours.

Nett et al.'s (2010) study, conducted in the United States of America (USA), focused on the influence of signage and hygiene attendant presence on rates of non-hygienic behaviour among children at splash parks and highlighted the lack of awareness amongst parents/guardians of the risks associated with faecal contaminations. They observed children exposing their buttocks to the splash park water feature (46%, n=67/145), which could lead to the introduction of

pathogens into the water. Parents were also observed changing nappies in close proximity to the splash park water, again showing the potential for faecal contamination from non-hygienic swimming behaviours.

From reviewing the literature, the hygienic swimming behaviour of showering before swimming was a specific focus of four of the studies. Pasquarella et al. (2013) found that 58.1% of their 4356 participants from Italy had read the 'pool rules' and that compliance with showering before swimming was higher amongst those who had read these rules. Interestingly, this study reported that only a low percentage (5.2%) of participants knew why showering beforehand is beneficial. The main reason given from the respondents of this study for pre-swim showering was 'to wash oneself' (50.5%) or 'to get used to the temperature of the water' (44.3%), while 5.2% of respondents answered, 'for both reasons'. This demonstrates how there may be a lack of awareness amongst swimming pool users of the benefits of showering before swimming in terms of keeping the swimming pool water clean and healthy. Pasquarella et al.'s (2013) cross-sectional study also identified characteristics of those who were less likely to have a pre-swim shower. This included being female (odds ratio (OR) 1.37), being aged between 14 and 17 years old (OR 5.09) and not reading the swimming pool rules (OR 1.24). They also found that where respondents lived and previous or current attendance of a swimming course were significantly associated with lack of pre-swim showering. These results highlight the need to further explore why these factors may influence pre-swim showering to better understand how to improve the number of swimmers who do shower before swimming. However, the data collection for this study took place in five Italian cities and may not have captured respondents from more rural areas, and therefore the findings may not be generalisable to rural areas.

In contrast, a study conducted in Italy by Amodio et al. (2014) reported that 96% (n=478/498) of respondents stated that they always took a shower before swimming. Nevertheless, the authors themselves identified that respondents may have provided socially desirable answers, leading to social desirability bias in this study. The characteristics of respondents provided by the authors demonstrated that most were males (n= 319, 64.1%). 51% (n=253/498) of respondents were reported to be 30 years of age or older, while 17% (n=86/498) were less than 20 years old and 32% (n=159/498) were aged between 20 and 29. Therefore, the results may not be representative of all ages which visit swimming pools, and may be more generalisable to males aged 30 and older.

However, Galle et al. (2016) identified from their self-administered questionnaire survey of 368 adults, children and adolescents that the hygienic behaviour of showering before swimming had the lowest reported compliance amongst respondents (86% of children/adolescents and 69% of adults). It is important to note here that the true level of compliance may be lower than this, as respondents may have provided the socially desirable answer that they always shower before swimming.

Another study, conducted in the Netherlands by Zwilling (2014), found that the main reasons reported by respondents for showering before swimming was due to hygiene (34.8% of 69 respondents from two swimming pools and two soccer clubs). This preliminary study also identified how social influences seemed to affect whether respondents showered before swimming. In total, 10.1% (no raw numbers provided) of respondents reported that they did not take a pre-swim shower because they were in a hurry, while 8.7 % (no raw numbers provided) reported that the reason was due to the showers being too cold (Zwilling et al., 2014). This highlights some barriers that influence hygienic swimming behaviours, specifically pre-swim showering. However, this preliminary study had a very small sample size and results should be interpreted with caution, as percentages with no raw numbers reported can be misleading.

Another study included in this review also had a small sample size of 78 participants; however, the findings do add to the evidence relating to hygienic swimming behaviours. The study, conducted in Canada as part of an undergraduate degree, found that only 47% (n=37/78) of respondents reported that they 'almost always take a pre-swim shower', while 31% (n=24/79) of respondents reported that they 'rarely/never take a pre-swim shower' (Low & Heacock, 2018). This cross-sectional study, conducted in Canada, used a self-administered questionnaire to identify factors that are associated with a higher frequency of pre-swim showering. Most (n=53/78, 67.9%) respondents were female. Positively, respondents did represent the majority of the different age groups, from 20 years old to over 60. Their study suggested that there was no association between having read the pool rules and pre-swim shower frequency. The study also reported that frequent users of swimming facilities were found to rarely/never take a pre-swim shower. Unfortunately, this study did not explore the possible reasons behind this. A limitation of this study was that the survey was conducted online, with recruitment conducted through Facebook, texts, email and word of mouth (Low & Heacock, 2018), and therefore may not have captured a true representation of the swimming population in the area where data collection took place.

The studies discussed in this section examined awareness and knowledge of hygienic swimming behaviours; however, they did not explore public health interventions to raise awareness of such behaviours. The following section provides a critique of studies which have addressed interventions to raise awareness of hygienic swimming behaviours.

#### 2.4. Interventions to raise awareness of hygienic swimming behaviours

Five of the studies in this review discussed interventions to raise awareness of hygienic swimming behaviours. Nett et al. (2010) concluded that their study showed that signage and attendants do not make a difference in terms of influencing children's and adults' hygienic swimming behaviours. In addition, Amodio et al. (2014) also found that rules and regulations do not always influence behaviours. They stated that at least one unhealthy behaviour might occur in more than 50% of their 498 participants. Self-reported knowledge of rules and high-risk perception of illnesses associated with swimming pools were good predictors for healthy behaviours, according to Amodio et al. (2014).

In contrast, the main study conducted by Zwilling (2014) involved different interventions to try to understand whether signage can influence pre-swim showering. The first intervention, called the 'routing game', was based on a simple instruction, with a game element added to it. Zwilling (2014) stated that this involved different signs with different messages at different locations in the swimming pool, and the use of footsteps to encourage swimmers to take a pre-swim shower. The second intervention, named 'information', was a sign that contained icons with the message: 'No irritated eyes? Then take a shower before swimming!' The third intervention was norm-based, consisting of a sign with the message: 'Most swimmers also take a shower before swimming. This is cleaner for you and for the other swimmers' (Zwilling, 2014, p. 18-19).

In total, 3188 participants were observed during Zwilling's (2014) main study, of whom 993 participants were observed at the 'routing game' intervention, 1193 subjects were observed at the 'information' intervention and 1002 participants at the 'social norm' intervention. The post-intervention questionnaire, which was conducted on the same day, was completed by a total of 22 participants for the 'routing game' intervention, 29 participants for the 'information' intervention, and 11 for the 'social norm' intervention. Zwilling's (2014) main study found that one of the interventions had increased the number of people who showered before swimming;



however, the other two interventions had not. Zwilling (2014) does report, however, that the effect size was minimal and results should be interpreted with caution. The number of respondents completing the post-interventions questionnaire was low for all interventions and especially so for the social norm intervention.

The 'routing game' intervention was reported to not have an effect: in fact, even fewer subjects took a shower (25.3% pre-intervention and 24.4% post-intervention). However, for the intervention titled 'information', the percentage of recreational swimmers who took a shower rose from 23.5% to 28% and Zwilling (2014) reported this effect to be significant:  $\chi^2(1, n = 1192) = 3.24, p < .05$ , although the effect size was low:  $\Phi = .052$ . With the intervention titled 'social norm', no significant effect was found:  $\chi^2(1, n = 1002) = .56, p = .247$ . In response to the questionnaire relating to the 'information' intervention, only 31% of respondents (no raw numbers reported) said that they had seen the intervention, which was the lowest reported across all the interventions. Interestingly, this intervention had the greatest effect: significantly more recreational swimmers took a pre-swim shower after its implementation. This study identified that several respondents reported that they had not seen the interventions, which is a limitation. However, this can be viewed as an opportunity to better understand how to develop successful interventions to raise awareness of pre-swim showering.

The study by Ribbers (2016), a Master's thesis conducted in the Netherlands, also found that interventions could increase pre-swim showering, which in turn reduces the pollution in swimming pools. Ribbers (2016) used four conditions to try to increase the number of swimmers who showered before swimming. The four conditions were 'no eyes and no symbol' (control condition – no poster), a watching eyes poster, a shower symbol poster, and a poster with a combination of both watching eyes and a shower symbol. These were displayed in the shower rooms.

A total of 596 swimming pool visitors were observed during this study. There were 116 visitors observed during the control condition, 137 during the 'watching eyes-only'. 181 swimming during the 'watching eyes and shower symbol' condition and 162 swimming observed during the 'shower symbol-only' condition. Subsequently, 125 respondents filled out a questionnaire (29 respondents filled out the questionnaire during the control condition, 31 during the 'watching eyes only' condition, 30 during the 'watching eyes and shower symbol' condition, and 35 during the 'shower symbol only' condition).

The poster with a shower symbol led to the highest increase in pre-swim showering. Ribbers (2016) reported that the pre-swim shower rate in the control condition was 35.3%. The rate for the 'watching eyes only' condition was 45.3%, for the 'watching eyes and shower symbol' condition was 45.3%, and 49.4% in the 'shower symbol only' condition. Thus, Ribbers (2016) reported that pre-swim shower behaviour is likely to increase with an intervention.

From the questionnaires completed by participants post-intervention, in total 76.6% of the participants stated that they had taken a pre-swim shower before entering the swimming pool. Ribbers (2016) reported that observations were conducted over a period of four weeks, with observations being conducted following installation of the interventions. The post-intervention questionnaire was distributed on the fourth day following observations each week. It was reported that both the control condition and the three intervention conditions were relatively equal to each other in terms of effectiveness; however, there was at least a 10% increase in the pre-swim shower rate following each of the interventions. This study adds to the body of knowledge regarding hygienic swimming behaviours, but the results may not be generalisable to other swimming facilities, as data collection took part in a holiday park. The type of swimmer observed at this type of facility may be different to those found in leisure centres (e.g., competitive athletes may not be present at holiday park swimming pools). Therefore, consideration must be given as to where data collection is conducted to include the varied types of swimming pool users.

The CDC's (2014) study also found that an intervention to raise awareness of hygienic swimming behaviours could result in an increase of intended hygienic behaviours reported by participants. This intervention in Utah involved healthy swimming messages via a website, two television advertisements, public service radio announcements and posters in swimming pools. There were also targeted messages provided to schools, water sports teams and licensed child-care facilities. There was also a press conference conducted during the national Recreational Water Illness and Injury Prevention Week.

The CDC (2014) undertook two studies to understand whether these efforts had increased awareness of hygienic swimming behaviours. They contacted 642 adults, of whom 499 (78%) completed telephone interviews. A postal survey was also carried out in which a questionnaire was sent to 7,004 households, with 4,556 (65%) questionnaires being returned, giving a good response rate for this survey. The telephone interviews found that 91.3% of respondents reported being aware of the 2007 state-wide cryptosporidiosis outbreak. A greater percentage

of women (36.2%) than men (16.7%) recalled seeing healthy swimming campaign posters at pools, and those with children in the household were more likely to have sought information following the outbreak. On the other hand, a greater percentage of those without children recalled seeing television advertisements (51.4%) compared with those with children (34.1%). It was reported that 96.1% of participants correctly indicated that 'It is not OK to swim if you have diarrhoea', and 70.4% correctly indicated that 'Chlorine does not kill germs instantly'. The postal survey found that 100% of Utah residents correctly indicated that 'not swimming when you have diarrhoea' protects others from recreational water illnesses. This was only true for 78.4% of residents in other states in the USA. The researchers found that 85.8% of Utah residents compared with 65.9% of residents of other states correctly indicated that 'Chlorine does not kill germs instantly'. Nevertheless, the cross-sectional design of these studies cannot identify the cause-and-effect relationship between the intervention and respondents' awareness.

Other studies included in this review did help to identify some important factors when considering public health interventions to raise awareness of hygienic swimming behaviours. Coetzee et al. (2008) found that the incidence of infection in confirmed cases was highest amongst younger swimmers, aged 0 – 19 (n=27/39). This is useful to note in order to understand where efforts may need to be targeted in order to raise awareness of hygienic swimming behaviours. They also found that swimmers may use more than one swimming pool, raising the question of whether different swimming pool settings provide consistent messages regarding hygienic swimming. None of the studies investigated in depth why swimmers may or may not follow hygienic behaviours at swimming pool settings, which reduces the likelihood of outbreaks. Additionally, Galle et al. (2016) found that adherence to the rules was related to age, with those aged 14-17 and 18-39 being found to have the worst compliance. McCann et al. (2014) found that most respondents had reported attending a swimming gala on the 6<sup>th</sup> of September 2010 at a swimming pool in Manchester. Multivariate analysis showed there was a cryptosporidiosis infection had a strong association with attendance at the gala (OR 28,  $P < 0.0001$ ). This again highlights the potential for targeted public health interventions.

The studies included in this section of the review highlight that there is a lack of research about hygienic swimming behaviours in the UK. Three studies included in this review have established how cryptosporidiosis outbreaks can occur and can have a significant effect, with the potential for hospitalisation following infection. It is evident from the studies in this theme

that there is a lack of awareness of hygienic swimming behaviours amongst swimming pool users outside the UK. It would be useful to understand the awareness of hygienic swimming behaviours in the UK to understand whether a hygienic swimming behaviours intervention would help to reduce the likelihood of cryptosporidiosis outbreaks. The review highlights that no published studies were found that aid understanding of how to develop an intervention that would be successful at raising awareness of hygienic swimming behaviours in the UK.

## 2.5. Interventions to raise awareness of hand washing in the UK

As highlighted in the previous section, none of the studies reviewed regarding hygienic swimming behaviour interventions were conducted in the UK. In order to supplement this, published studies in relation to hand washing interventions were included in this review, as previously discussed in section 2.2.2 of this chapter. The studies in this section focused upon hand hygiene interventions, with different types of interventions within different settings (excluding hospitals) being reviewed.

In a study conducted by Judah et al. (2009), wireless devices were installed in highway service station restrooms in England to record entry and soap use. The intervention was carried out in summer in order to capture the summer holiday travellers along with the usual weekday business commuters. Baseline measures were recorded before the intervention to assess usual restroom entry and soap use. Different messages were displayed as part of the intervention to encourage people to wash their hands in the restrooms. Example messages taken from the article are ‘Water doesn’t kill germs, soap does’ and ‘Don’t be a dirty soap dodger’. All messages were related to different domains of psychology, such as knowledge activation, knowledge of risk, cues, disgust, and status/identity. The researchers compared the effects of the different messages on the soap use. Data were collected on 198,000 restroom users over 32 days. Judah et al. (2009) found that in general, most of the interventions increased levels of hand washing compared with the blank control condition. Unexpectedly, they also found that men and women responded to health promotion messages in different ways. The knowledge activation domain was most effective for women, with a relative increase in soap use of 9.4% compared with the control condition ( $P=.001$ ). In contrast, Judah et al. (2009) found that disgust was the most effective domain for men, with an increase in soap use by 9.8% ( $P=.001$ ). Messages based on social norms and social status were effective for both genders. However,

only one-third of women and men reported having seen the messages, thus highlighting the difficulties in capturing the intended audience with public health interventions.

A similar intervention was conducted by Fleischman et al. (2011) whereby wireless devices were installed in highway service station restrooms in England to record the proportion of individuals washing their hands. This method of monitoring removed responder bias and the risk of people behaving in a socially desirable way. The data was collected during the Influenza A pandemic in the UK in April 2009. Hand washing, along with other preventative measures against influenza, was reported in the media and by government publications. This study does report that the sensors used to measure entry into the restrooms had failed at one point and highlights a weakness with the design and data collection for this study. However, they used proxy data from the other restroom, as there were sensors in both men's and women's restrooms. The number of studies published in the media relating to the pandemic was also recorded by the researchers. The article reports that data for this study spanned over one million restroom users (Fleischman et al., 2011) and concluded that hand-washing rates were positively related to both H1N1 coverage in blogs and the news.

Another study on the effectiveness of a poster intervention at increasing hand hygiene in restrooms within a university in the UK used an observational design (Lawson & Vaganay-Miller, 2019). They used observations using thermal videoing footage to measure hand hygiene practices. The poster displayed in restrooms had an image of a petri dish with bacteria in the shape of a hand, along with large text that read 'GERMS SPREAD EASILY! WASH YOUR HANDS! There was also additional text that explained that hand washing is important in illness prevention and indicated that it is recommended to wash hands for 20 seconds (the estimated time it would take someone to read the text).

Lawson and Vaganay-Miller (2019) conducted pre-observations that found that of the 685 people observed, 51.1% practised basic hand hygiene compliance, which was said to be washing hands with water and soap and drying afterwards. It was reported that 7.9% of those observed practised adequate hand hygiene compliance, washing their hands with water and soap for 20 seconds or more and drying them afterwards for 20 seconds or more. The observations of 464 people following the intervention found that 55.4% of them were observed practising basic hand hygiene compliance, and 7.97% practising adequate hand hygiene compliance. The authors concluded that the poster intervention had a limited effect on improving the basic and adequate hand hygiene compliance of the general population when

using public restrooms. However, the researchers were not able to determine whether those observed each day during both observation periods were not the same members of the university population: therefore, the sample size may have been smaller than reported.

Three studies reviewed identified that web-based interventions can be used to improve intended hand hygiene behaviour (Yardley et al., 2011, Miller et al., 2012; Little et al., 2015). A web-based intervention to improve hand hygiene to reduce respiratory illnesses, conducted by Yardley et al. (2011), recruited participants and randomly assigned them to receive the intervention (324 participants) or not (control group, 179 participants). The 517 participants were non-blinded adults recruited through nine general practices in England. The intervention involved four weekly web-based sessions. All four sessions contained new content, with various information provided. They also included activities for participants to encourage hand hygiene.

Planned behaviour was assessed by both groups using a questionnaire. Yardley et al. (2011) reported that intended hand hygiene rates after 12 weeks were higher in the intervention group compared to the control group (mean 4.45,  $n = 282$  and mean 4.12,  $n = 154$ , respectively;  $P < .001$ , Cohen  $d = 0.34$ ). Little et al. (2015) conducted a similar study whereby a web-based intervention was provided to an intervention group and a control group to assess whether the number of episodes of respiratory tract infections (RTI) had reduced following the intervention. For this sub-study, there were 16,908 (84%) participants, who were followed up with a 16-week questionnaire (8241 participants in the intervention group and 8667 in the control group). The authors reported that 51% of participants in the intervention group reported one or more episodes of RTI, compared with 59% in the control group (multivariate risk ratio 0.86, 95% CI 0.83–0.89;  $p < 0.0001$ ).

The other study (Miller et al., 2012) that used a web-based intervention recruited 102 people, who were recruited via email and advertisements placed around the campuses of 15 universities in the UK. However, 84 people (82.4%) completed the measures of intention, which comprised participants' reports of intended hand washing practice and frequency. Participants were randomly assigned to the type of intervention received. Four different interventions were used as part of this study: low-threat/no coping messages (32/34 responses), low-threat/coping messages (21/24 responses), high-threat/no coping messages (19/23 responses), and high-threat/coping messages (12/21 responses). The researchers stated that the response rates

indicated a trend towards selective dropout among those required to read more web pages. Miller et al. (2012) reported that hand-washing intentions tended to be stronger in those receiving high-threat/coping messages. They found that the group that received coping messages had a likelihood 2.44 times greater [95% confidence interval (CI): 0.96–6.18] of intending to increase their frequency of hand washing. On the other hand, those receiving high-threat messages did not report an increase in intended hand-washing frequency (odds ratio ¼ 0.93, 95% CI: 0.36–2.38).

In contrast to the other studies described in this section thus far, Schmidt et al. (2009) conducted qualitative research. The use of qualitative research allowed them to explore influences on hand hygiene behaviours. They identified barriers to hygienic behaviours and provided an insight into the reasons why participants did or did not follow hand hygiene behaviours. Semi-structured interviews were conducted with four head teachers, six class teachers, three school nurses and two to three children from each of the four schools. Group discussions and semi-structured essay questions were also used to collect data from children. Pilot trials were also conducted with the four primary school classes to assess the acceptability and feasibility of hand interventions by using liquid soap versus alcohol-based hand sanitiser, with follow-up interviews conducted post-trial.

Following thematic content analysis, the researchers identified many barriers to implementing intensive hygiene interventions: in particular, time constraints and competing health issues. Teachers' motivation to teach hygiene and enforce hygienic behaviour was primarily educational rather than immediate infection control. A finding from the study was that the children (of all age groups) had good knowledge of hygiene practices and germ transmission. The pilot study showed that intensive hand hygiene interventions are feasible and acceptable but only temporarily during a period of a particular health threat such as an influenza pandemic, and only if rinse-free hand sanitisers are used (Schmidt et al., 2009). However, the study stated that interviews with the teachers and nurses were not tape-recorded: only written notes by the interviewers were taken. This highlights a limitation of this study in relation to researcher recall bias.

A qualitative study was also conducted by Chittleborough et al. (2013). They carried out a qualitative process evaluation within a cluster randomised controlled trial. The original intervention was the 'Hands up for Max!' educational pack, developed for primary school aged

children. This pack was produced by the Health Protection Agency (HPA) in England as a low-cost educational intervention. A five-minute animation teaching how to wash hands correctly, lesson plans exploring ‘What are germs?’ and ‘Healthy hands, healthy school’, A4 posters demonstrating how to wash hands correctly, and stickers for pupils were all included in the pack.

In this process evaluation, focus groups were undertaken with 16 school children aged 6 to 11 years and semi-structured interviews were conducted with 16 teachers. The researchers also observed 57 hand washing facilities within the schools. From the thematic analysis conducted, the findings indicated that different themes emerged: Time, Facilities, Societal Norms, Encouragement and Reminders, Education and Information, Awareness and knowledge. Chittleborough et al. (2012) concluded that influencing through education can be sufficient but may not be enough on its own to guarantee good hygiene practices. An interesting finding from this study was that the intervention groups showed no differences in understanding when and how to wash their hands, compared to the control groups.

The study by Chittleborough et al. (2013) used a mixed method design, whereby qualitative and quantitative data were collected. This use of mixed methods is beneficial to evaluate an intervention, as it allows for the exploration of key factors that influence whether an intervention is successful or not. This study also evaluated the ‘Hands Up for Max!’ intervention previously discussed; however, it provided a different evaluation. The purpose of this study was to examine the reach, dose, fidelity, acceptability, and sustainability of the implementation of the intervention. It also explored views regarding acceptability and sustainability. Eight interviews were conducted with co-ordinators of the intervention (HPA and University Staff). Focus groups were conducted with pupils from one lower KS2 class and one upper KS2 class in each of the four schools that received the intervention. Quantitative work was carried out using observations and log sheets to record data.

This study concluded that the ‘Hands Up for Max!’ intervention was acceptable to schools. However, concerns were raised regarding the age-appropriateness of the resources, although teachers reported adapting them to suit. The findings from the study suggested that the model of delivery for this intervention might not be sustainable due to issues regarding co-ordination of the intervention outside of a non-research agency (Chittleborough et al., 2013), thus highlighting an important aspect to consider when designing public health interventions. In addition, these results may be limited to the intervention schools involved in this trial.



Crosby, Laird and Younie (2019) also conducted an intervention with children to try to improve their understanding of handwashing. They used a case study design with purposive sampling of six primary schools in rural and urban areas of England, using self-administered questionnaires, interviews and observations to collect their data. Questionnaires were conducted with 115 parents and 24 teachers. In addition, six teachers were interviewed and children from the six primary schools were observed during the study. The focus of the intervention in this study was to teach children about germs in order to improve their hand washing behaviours. Various resources were developed – a book, a website and a workshop – to help raise awareness of germs to encourage children’s hand hygiene behaviours.

The results from the questionnaires revealed that 100% of parents reported that children were engaged with the book, with 100% positive responses from the teachers also reported. In addition, the authors report that one child commented that they wanted to wash their hands after completing the book. Crosby, Laird and Younie (2019) found a large range (18.75%–97%) of parents opinions on the usefulness of the website dependent on location (similar with teachers). Across the four case studies, children were reported to be very engaged in the handwashing activity, particularly when seeing the glo-gel on their hands under the UV light. The teachers reported very positive feedback about the workshops. The findings highlight how interventions to engage children can help to interest the target audience in the resources. This study also demonstrates how teaching children about germs can help to improve intended hand hygiene behaviours of some participants. However, this study did not conduct pre- and post-intervention measurements to assess whether the intervention had increased children’s hand hygiene behaviours.

Similarly, a study by Rutter, Stones, Wood, Macduff and Gomez-Escalada (2020) aimed to motivate hand hygiene behaviour in UK primary school children. The intervention involved images and messages integrated into toilet facilities to encourage good hand hygiene behaviours amongst children. Twenty-seven primary schools were contacted to take part, with three schools agreeing to participate in the intervention. A children’s national museum also took part. To evaluate the ‘123’ intervention conducted in these four settings, document analysis was conducted with publicly available documentation to understand the demographics of those whom the intervention could have researched. The researchers used Ofsted reports and annual reports to estimate the characteristics of potential participants. For example, they used the museum’s annual reports to calculate the number of visitors aged between 0 and 11. This is a limitation of this study, as this information can only suggest who the intervention could

have potentially reached, and does not measure the demographics of those whom the intervention did reach.

Rutter et al. (2020) measured soap consumption as an estimation of hand washing frequency. Measurements were conducted in all four participating settings, with pre- and post-intervention measurements taken. The results showed an increase of from 41% to 60% in soap consumption in the schools following installation of the messages. With regard to the museum, the authors reported that proportionately more children washed their hands when the messages and images were present in the toilets. However, this data was collected by the staff in each setting and relied upon them reporting their measurements to the research team. In addition, different methods of soap dispensing and measurements were taken by each setting, making it difficult to compare the settings with each other and to generalise the results to other similar settings such as primary schools in the UK.

School 1 and the museum took part in an additional measurement to evaluate the intervention. Rutter et al.'s (2020) study measured the presence of microorganisms on the hands of a sample of children from these two settings. There were 139 children sampled pre-intervention and 133 sampled post-intervention in school 1, while in the museum, 64 children were sampled pre-intervention and 56 post-intervention. For school 1, the mean colony count decreased from 186 to 151 ( $t(270)$ , 1.861,  $p = 0.032$ ). However, the mean colony count increased from 220 to 260 (non-significant result) in the museum sample. Yet, different children participated in the pre- and post-intervention samples in the museum setting, whereas the same children were sampled in school 1.

The third aspect of the evaluation involved interviewing 134 children from the four settings. Sixty percent (81/134) of children reported that the intervention had changed their behaviour in the toilets, including now washing hands (26/134) and using soap and/or the dryer (35/134) (Rutter et al., 2020). However, two children reported a negative effect of the intervention, in that they wanted to avoid contact with surfaces. Importantly, the children might have reported the socially desirable answer, claiming that they now wash their hands following the intervention. This measurement also does not show the children's real-time behaviours, but only their reported behaviours, which may differ from what happens in reality.

The final part of the evaluation conducted by Rutter et al. (2020) comprised interviews and focus groups with 23 staff members. Content analysis was conducted, as well as quantitative analysis to count the responses to closed questions. The authors reported that those interviewed

alluded that children washed their hands more frequently following the intervention. They also reported that the images in the intervention were visually appealing. However, it was identified that it can be difficult for teachers to address children's hand washing frequency, as teachers are not always present to observe this behaviour when the children use the toilets. The study concluded that images and messages can help to increase reported hand washing behaviours of children following the intervention. Nevertheless, as previously discussed, many limitations have been identified.

None of the research discussed in this section was able to identify a direct causal effect as to whether interventions do cause a behaviour change. Some studies were able to provide a correlation between their interventions and a change in behaviour, whether that behaviour was observed or self-reported. However, the qualitative studies did allow for the exploration of barriers and motivators to hand hygiene behaviours, while also trying to assess the types of intervention that can produce an increase in intended hand hygiene behaviour.

## 2.6. Theoretical critique

Ten of the studies reviewed highlighted the importance of considering theories in relation to hygienic behaviours and health interventions when researching or raising awareness of such behaviours. Galle et al. (2016) acknowledged the utility of the Health Belief Model (Rosenstock et al., 1988) in their literature review and emphasised how someone's perceived risk is important when considering protective behaviours. They stated that it could be concluded that swimming pool users are more likely to adopt hygienic behaviours if they are aware of the health risks from non-hygienic behaviours: therefore, it can be assumed that Galle et al. (2016) used the HBM to help interpret their findings. Although the HBM helps to guide research and interpret findings in relation to healthy behaviours, it is focused on the individual and may not take into account wider influences on behaviour (Carpenter, 2010).

The Protection Motivation Theory (Rogers, 1975) was discussed by McClain et al. (2005), who used this theory to develop their questionnaire based on the four constructs of the model: perceived vulnerability, perceived severity, response efficacy, and self-efficacy. A review of this theory identified that the model was useful to predict existing behaviours; however, it was believed to be less effective at predicting future behaviour (Milne, Sheeran & Orbell, 2000). This is an important consideration when using this model to develop health behaviour

interventions, as the model focuses upon perceived severity, likelihood of the hazard occurring, preventative measures and an individual's ability to enact those measures (Rogers, 1975). Again, this does not take into consideration wider environmental influences on hygienic behaviours.

The interventions developed by Ribbers (2016) were based on the Social Impact Theory (Latané, 1981) whereby the presence of others is believed to affect individuals' feelings, motives, cognitions and beliefs. Ribbers (2016) believed that their interventions would increase pre-swim showering, as this theory stated that people are more likely to conform to 'rules' when other people are present. Social norms were also discussed by Zwillig (2014), whose interventions to improve pre-swim showering were based on the theory of social norms, as people tend to do what is socially acceptable. Social Norms Theory (Perkins and Berkowitz, 1986) aims to help interpret the effect of environment and interpersonal factors, such as one's peers, on behaviour. However, the 'social norm' intervention developed based on this theory did not produce a significant increase in the number of swimmers who took a pre-swim shower, as reported by Zwillig (2014).

The study by Judah et al. (2009) focused on psychological theories of behaviour that can be explained by different domains such as knowledge, behavioural regulation and motivation. The authors argued that these theories and domains are important when designing studies and interventions for hand washing interventions (Judah et al., 2009). As discussed by other studies in this review, Judah et al. (2009) highlighted how disgust, social norms and habit can influence hand washing behaviour. They also discussed how education alone could be ineffective at changing hygienic behaviours, which Chittleborough et al. (2012) also found from conducting their qualitative study. This latter study highlighted how hygienic behaviours can be influenced by social interactions, rather than being solely the product of individual factors (Chittleborough et al., 2012).

Lawson and Vaganay-Miller (2019) developed their poster based on psychological concepts such as disgust. They also suggested that the use of behavioural theories, such as the Theory of Planned Behaviour (Ajzen, 1991), could improve the effectiveness of a poster intervention if these types of theories are considered during the design phase. Miller et al. (2012) also discussed how they had selected the Theory of Planned Behaviour to guide their study. They believed that this model is beneficial because it is flexible in terms of having the ability to be applied to different contexts. In addition, Miller et al. (2012) highlighted how the theory can

be combined with other models to understand health-related behaviours. They used the Theory of Planned Behaviour to develop the messages included in their interventions. The Theory of Planned Behaviour was also used by Yardley et al. (2011) as their guiding theoretical framework.

The above highlights the range of theories and models that can be adopted in order to guide and interpret research relating to hygienic swimming behaviours. However, the theories and models discussed here are focused upon the individual level and individuals' interactions with others, and do not take into account any wider influences on hygienic behaviours, such as external factors (for example, within organisations) and public policy, which can influence behaviours (McLeroy, Bibeau, Steckler & Glanz, 1988).

## 2.7. Overview of methodological critique

A total of 24 studies were included in this literature review, with 13 of those addressing hygienic swimming behaviours, and 11 studies focusing upon hand hygiene intervention in the UK to improve hand hygiene behaviour. All 13 studies in relation to hygienic swimming behaviours used quantitative methodologies, whereas five studies focusing on hand hygiene interventions used qualitative methodologies or a mixed methods design. A qualitative study allows the researcher to conduct an in-depth investigation that produces data on how participants feel and think about a subject (Saks & Allsop, 2013). As there is a lack of previous research with regard to hygienic swimming behaviours, qualitative research would allow for an exploratory study rather than an explanatory study, as there is a need to create theories and perspectives to better understand these behaviours (Bowling, 2002). Qualitative research would be beneficial for this topic, as it has its strengths in providing an understanding of participants' personal experiences of a construct (Saks & Allsop, 2013). Therefore, using this method could enable researchers to explore why people do or do not follow hygienic swimming behaviours. On the other hand, qualitative research has its limitations in that the findings may not be generalizable to other settings or populations (Denscombe, 2010).

Two of the studies reviewed were retrospective cohort studies, while 12 studies used a cross-sectional design. Both of these study designs allow research to be carried out quickly. These designs have limitations in terms of data only being collected at a specific time and do not consider any changes to a phenomenon over time (McClean, Bray, Viggiani, Bird and

Pilkington, 2019). For example, they cannot take into account any changes in the awareness of hygienic swimming behaviours over time. One study used a pragmatic trial design, whereas one used a randomised control trial design. These designs are beneficial in order to reduce any selection bias, given the nature of randomised sampling techniques.

Only three of the 24 studies reviewed used a random sampling technique; however, this technique would not have been appropriate for the qualitative studies. Of the quantitative studies, the majority employed convenience samples. Convenience sampling has the benefit of saving on cost; however, it may not be as representative as using randomised sampling techniques (Hohl, Priest, & Roberts, 2010). There are issues around non-probability sampling, such as bias, but this type of sampling technique can provide quick access to a sample with low costs (Denscombe, 2010). Three studies used purposive sampling to recruit their participants, which has similar benefits and weaknesses to convenience sampling. Two studies adopted a convenience sample approach to initially recruit their samples; however, these participants were then randomly assigned to intervention or control groups.

Thirteen studies used a self-administered questionnaire to collect the data, while four studies conducted questionnaires by interview. It is important to note here that a drawback to the questionnaire approach is that respondents might provide answers which they believe to be socially acceptable and may thus provide biased responses (Bowling, 2002). The questionnaires did not measure actual behaviour, which might have provided a better understanding of the procedures that swimmers follow to adhere to hygienic swimming behaviours. However, assessing behaviours would be difficult to carry out, as this would involve observing swimmers' behaviours, which might not be ethically acceptable (Denscombe, 2010). However, five of the studies reviewed did use observations during their research. Observational data collection tools can provide a true picture of a sample's hygienic behaviour, although participants may act a certain way if they are aware that they are being observed, which introduces bias into the research (Carlson & Morrison, 2009). The qualitative or mixed methods studies demonstrated the value of using focus groups or semi-structured interviews to explore influences upon behaviour.

Although some studies were published twenty years prior to this literature review, there is a significant lack of research that has explored hygienic swimming behaviours. None of the studies regarding hygienic swimming behaviour were conducted in the UK, highlighting a significant lack of evidence for the current level of awareness of hygienic swimming

behaviours of the swimming population in the UK. Three studies that were conducted in the UK were based on outbreak investigations of cryptosporidiosis: these studies did, however, highlight that there may be a lack of awareness of hygienic swimming behaviours amongst swimming pool users in the UK. Considering that swimming is part of the national school curriculum in the UK and the majority of children attend swimming lessons during their school years, there is no published literature to show the level of awareness of hygienic swimming behaviours amongst the swimming population in the UK.

## 2.8. Summary

Generally, the studies reviewed provided an insight into hygienic behaviours. The studies looking at hygienic swimming behaviours provided an insight into current swimming pool users' behaviours in the swimming pool setting. They provided important information on hygienic swimming behaviours, but none provided an evaluation on an intervention that was used to change swimmers' behaviours. The two masters' theses reviewed provided invaluable information on interventions that were used to raise awareness of hygienic swimming behaviours. However, these studies were conducted in the Netherlands, which could have a different swimming culture to the United Kingdom, and therefore the findings may not be generalisable. One of these studies, by Ribbers (2016), was conducted in a holiday park, and is thus not generalisable to leisure centre type swimming pools in the United Kingdom, which are used by a vast range of users such as competitive athletes, schools, older people, children and families. The hand hygiene studies provided an insight into the important aspects of an intervention carried out in UK settings, to ensure that the intervention was successful at changing behaviour.

However, there were no studies identified which had carried out research in the UK to understand swimming pool users' awareness of hygienic swimming behaviours. There were also no studies found which provided information regarding interventions to increase hygienic swimming behaviours in the UK. Reviewing the hand hygiene intervention studies highlighted the importance of exploring barriers and motivators for intended hygiene behaviours. These studies also showed the importance of assessing whether an intervention to change intended behaviour worked by conducting pre- and post-intervention studies.

Only a small number of studies reported the theoretical framework that guided their research. This review highlighted that only a small number (3/9) of the hand hygiene intervention studies discussed used the Theory of Planned Behaviours as their underpinning framework. They did not discuss other theories that could have been drawn upon.

This literature review has identified the need for an exploration of swimming pool users' awareness of hygienic swimming behaviours in the UK, particularly using qualitative research. It was also evident that current interventions to improve hygienic swimming behaviours need to be assessed to help complement the exploration of swimming pool users' awareness. No studies were identified that undertook evaluation of any interventions in the UK to increase hygienic swimming behaviours, highlighting an opportunity to develop and evaluate a UK-based intervention within swimming pool settings relating to hygienic swimming.

The next chapter provides a description of the methodology used to conduct research to address the gap in literature recognised from this review.



## 3. Chapter Three: Methodology

### 3.1. Introduction

The previous chapter highlighted the lack of research focusing on hygienic swimming behaviours in the UK. Next, a description is provided of the methodology adopted to address this gap in knowledge. This chapter describes the exploratory sequential design that was used during this study, which involved three phases of work. An explanation is provided as to why using a mixture of methods for the study was appropriate and necessary.

### 3.2. Aim and Objectives

The overarching aim of this study was to explore awareness of hygienic swimming behaviours and to develop and evaluate a public health intervention to reduce the transmission of cryptosporidium.

#### 3.2.1. Phase 1

This first phase intended to explore various stakeholders' awareness of hygienic swimming behaviours and to understand current efforts made by swimming facilities to raise awareness of these behaviours. In addition, this phase aimed to explore how best to develop a public health intervention to raise awareness of hygienic swimming behaviours.

The objectives for phase 1 of the study were as follows:

1. Explore swimmers' and parents of swimmers' awareness of hygienic swimming behaviours and cryptosporidium.
2. Explore how swimmers and parents of swimmers would like to receive health information.
3. Gather information on public health measures currently in place at swimming pools and explore swimming pool operators' views about a public health intervention.
4. Explore the health educational messages provided by Lead Officers in Communicable Disease, who investigate cases of illness, to avoid the transmission of cryptosporidium in swimming pools and explore their views on a public health intervention.
5. Explore the views of health care professionals who have a direct involvement in the investigation of cases and outbreaks of cryptosporidium, to enhance the data gathered on a public health intervention.

### 3.2.2. Phase 2

The aim of phase two of the study was to quantify and verify the findings of phase 1 by gathering data from swimmers and parents of swimmers from a larger sample.

Objectives for phase two were to:

- Explore swimmers' and parents of swimmers' awareness of hygienic swimming behaviours and cryptosporidium.
- Explore how swimmers and parents of swimmers would like to receive information regarding hygienic swimming behaviours.

### 3.2.3. Phase 3

The aim of this phase was to develop a public health intervention to raise awareness of hygienic swimming behaviours, to reduce the transmission of cryptosporidium. This phase also sought feedback on the poster developed for the intervention titled 'A Healthy Swimmer is a Happy Swimmer'.

The objectives for phase 3 were to:

- Draw conclusions on the type of intervention that would be most feasible and acceptable based on the results from phases one and two, including reference to previous literature and guidance documents.
- Develop a public health intervention to raise awareness of hygienic swimming behaviours, including the production of health educational material.
- Pilot the intervention amongst swimmers.
- Evaluate the acceptability of the intervention.

To address these aims and objectives, a mixture of methods were considered. A discussion of the mixture of methods is provided in the next section.

### 3.3. Methodological approach

A mixture of methods, both qualitative and quantitative, were adopted to address the overall aim of this study. The interpretive paradigm and the positivist paradigm are discussed next, with benefits of qualitative and quantitative approaches being highlighted throughout.

#### 3.3.1. Interpretive Paradigm

Qualitative research relies on non-numerical data, which is rooted within the interpretive paradigm (Punch, 2013). This paradigm allows researchers to understand a phenomenon from the perception and experiences of participants. The interpretive paradigm states that “humans interpret their world differently and may act differently based on their interpretations, hence understanding phenomena related to human and social sciences rely on methods which can explore these multiple interpretations” (Hammersley, 2013, p. 26).

Qualitative approaches are predominantly used under the interpretive paradigm as this approach can provide data to fully understand a phenomenon. Qualitative research is guided by a set of assumptions (Creswell, 1998). Conducting qualitative research can provide rich data in relation to a phenomenon where there is lack of previous research and further exploration is

needed to better understand the topic area (Saks & Allsop, 2013). However, transcribing and analysing qualitative data can be very time consuming (Drew, Hardman & Hosp, 2008). Qualitative researchers seek to provide enough explanation about how the qualitative study was carried out for the reader to make a judgement on the transferability of the research findings (Guba & Lincoln, 1989). This also relates to how qualitative data can help generate hypotheses as the study develops that would not have been known or evidenced without carrying out in-depth qualitative work (Drew, Hardman & Hosp, 2008). Therefore, qualitative research can help researchers to understand a public health phenomenon in detail (Creswell & Plano Clark, 2017). However, the findings from qualitative data may not be generalised to larger populations (Bowen, 2006).

### 3.3.2. Positivist Paradigm

On the other hand, quantitative research, which is rooted within the positivist paradigm, can allow for the study of a larger sample of the target population in comparison to qualitative research, but results can be general and may not apply to specific settings (Drew, Hardman & Hosp, 2008). The positivism paradigm is a philosophy that states that understanding a phenomenon related to human and social sciences must be measured and supported by evidence via empirical research (Hammersley, 2013).

Quantitative research, which begins with a hypothesis/hypotheses, can be argued to be more reliable, as participants' answers are recorded and analysed in numerical form, whereas qualitative analysis relies on the interpretation of what participants have said by the researcher (Drew, Hardman & Hosp, 2008). However, these numbers may not always give the reasons as to why a participant feels or behaves in a certain way (Drew, Hardman & Hosp, 2008). Creswell and Plano Clark (2017) argue that quantitative research often fails to aid in the deeper understanding of a phenomenon, which is particularly important when seeking to understand health behaviours.

### 3.3.3. Pragmatic Paradigm

Understanding the strengths and weaknesses of both qualitative and quantitative research can help to justify why a mixture of methods has been used in this research. This allows for the capitalisation of the strengths of both qualitative and quantitative research while reducing the limitations of each (Drew, Hardman & Hosp, 2008).

Although it has been argued that qualitative and quantitative approaches cannot be mixed (Sale, Lohfeld & Brazil, 2002), it is evident that using both these approaches can be beneficial in answering a complex research question (Creswell & Plano Clark, 2017). In addition, both qualitative and quantitative approaches consider it to be important for the research design to be rigorous (Reichardt & Rallis, 1994). Public health research has been identified to involve the study of complex phenomena (Greenhalgh & Papoutsis, 2018): therefore, in order to gain a complete understanding of this phenomenon, both approaches can be helpful (Creswell & Plano Clark, 2017).

Bowling (2014) argues that using a mixture of methods provides a greater understanding than research involving only one approach could produce. Within the pragmatic approach, it is argued that researchers should move away from solely deductive or inductive reasoning, and move towards abductive reasoning, which states that there is movement between both original forms of reasoning. Creswell and Plano Clark (2017) state that deductive reasoning involves the researcher working in a top down approach using quantitative methods, whereby the research is conducted based on theory and hypothesis/hypotheses to build data on existing theories. In contrast, inductive reasoning involves researchers working from the bottom-up, using qualitative methods by using participant views to generate theories (Creswell and Plano Clark, 2017).

Abductive reasoning is often used when qualitative and quantitative methodologies are combined in a sequential design, where the inductive qualitative approach can inform the deductive quantitative approach. This pragmatic approach also moves away from the subjectivity of qualitative research and the objectivity of quantitative research, by proposing an intersubjective approach. In addition, it is argued that combining both quantitative and qualitative approaches can help towards deciding whether the knowledge gained can be transferred to other settings or populations, rather than focusing solely on the context and generalisability of findings (Morgan, 2007).

A true mixed-methods approach was not adopted for this research. Mixed-methods research involves the combining of qualitative and quantitative approaches for understanding and corroboration (Johnson et al. 2007, p. 123). In order to address the overarching research aim, it was considered most appropriate to use a mixture of methods whereby individual qualitative and quantitative research were combined (Schoonenboom, Johnson & Froehlich, 2018).

This mixture of methods allowed for the exploration of swimmers' knowledge and attitudes regarding hygienic swimming as there was a limited existing body of knowledge on the topic, which highlighted specific views of the participants to be explored further using quantitative methods (Johnson & Onwuegbuzie, 2004). Successful public health interventions are founded upon the views of the targeted audience – in this case, swimmers and parents of young swimmers – using a bottom-up approach, by ensuring user engagement at an early stage (Naidoo & Wills, 2016). User engagement has been highlighted as vital to ensure research is relevant and acceptable (Condon et al., 2019). Therefore, using a mixture of methods facilitates the development of a more feasible and acceptable intervention by verifying the results of one phase with the results of another phase (Johnson & Onwuegbuzie, 2004). Table 3a, below, adapted from Johnson and Onwuegbuzie (2004, p.21), highlights the strengths and weaknesses of a mixture of methods.

Table 3a: Strengths and weaknesses of a mixture of methods

<b>Strengths</b>	<b>Weaknesses</b>
Narrative can be used to add meaning to numbers and numbers can be used to add precision to words.	Can be difficult for a single researcher to carry out both qualitative and quantitative research.
Ability to answer a broader range of research questions, as the researcher is not confined to a single method or approach.	Researcher needs to understand multiple methods and approaches and how to mix them appropriately.
Researcher can generate and test a theory.	More time consuming.
Phase 1 results can be used to develop and inform the purpose and design of the Phase 2 component.	Some of the details of mixed research remain to be worked out fully by research methodologists.
Stronger evidence for a conclusion through convergence and corroboration of findings.	
More insight and understanding that could be missed when only a single method is used.	
Increases the generalizability of the results.	
Qualitative and quantitative research used together produce more complete knowledge necessary to inform theory and practice.	

With the characteristics of both approaches in mind, it was decided that a mixture of methods using an exploratory sequential design would provide the most appropriate way of collecting data to inform the development of an appropriate public health intervention.

#### 3.3.4. Exploratory sequential design

An exploratory sequential design is usually employed in order to better understand an existing phenomenon (Schoonenboom & Burke Johnson, 2018). This design involves the combination of qualitative and quantitative research, whereby data collection and analysis are conducted in a sequence of phases. Qualitative data is collected in the first phase to explore a phenomenon. The data is then analysed, with the findings directing the next quantitative phase of work

(Creswell & Plano Clark, 2017). This design allows for a topic to be explored before measurable variables can be identified. This begins by consulting the literature and recognising what is known about a topic (Mihas & Institute, 2019).

Exploratory research was considered appropriate in order to understand the current awareness of hygienic swimming behaviours in the UK, and why or why not swimming pool users implement these behaviours. A sequential design allowed for qualitative, inductive research to be carried out initially. This approach was appropriate as the first phase of the study, as there is a lack of previous research in the United Kingdom looking directly at swimmers' awareness of hygienic swimming behaviours. This provided the basis for hypothesis building and further exploration through the quantitative stage in phase 2 (Saks & Allsop, 2013). A quantitative, deductive approach would not have been suitable as the first phase, as it was identified from the literature review that there was a significant lack of previous research looking directly at awareness of hygienic swimming behaviours to inform the development of a questionnaire (Walliman, 2001).

The sequential approach using qualitative and quantitative methods allowed for the limitations of each method to be overcome (Thirsk & Clark, 2017). For example, the qualitative data generated findings based upon factors that influence hygienic swimming behaviour, and the quantitative data gathered helped to quantify and verify these findings. The sequential design for this study is demonstrated below:

- Phase 1: Qualitative research conducted to explore hygienic swimming behaviours and inform the development of a quantitative questionnaire to use in phase 2 of this study.
- Phase 2: Quantitative research to verify and quantify the findings of phase 1 in relation to factors which influence hygienic behaviours and how to raise awareness of these behaviours.
- Phase 3: The development of an intervention based on findings from phase 1 and 2 of this study, with quantitative research carried out to evaluate the intervention.

The methods of each phase of the study are discussed in Chapter 4, section 4.2. (Phase 1), Chapter 5, section 5.2. (Phase 2) and Chapter 6, section 6.2. (Phase 3).



### 3.4. Summary

This chapter identified the benefit of using both qualitative and quantitative approaches to address the overarching aim of this study, which was to explore hygienic swimming behaviours and to develop and evaluate an intervention to raise awareness of these behaviours. An exploratory sequential design was explained, with three phases of work having been conducted in this study in order to address the aims. The next chapter will detail the methods that were employed to conduct the first phase of work, with the findings and discussion following in section 4.4.

## 4. Chapter Four: Qualitative study to explore hygienic swimming behaviours and how to raise awareness of them amongst swimming pool users (Phase 1)

### 4.1. Introduction

This chapter provides the methods of phase 1 of this study. The first section (4.2.) provides details on the aim of this first phase, with information on the location, sample, recruitment, data collection and data analysis procedure. Ethical considerations and rigour are discussed at the end of this section. The following section (4.4.) will provide the findings and discussion of phase 1.

### 4.2. Methods of phase 1

This section describes the methods, procedures and data collection tools used to obtain the data required to achieve the aims set out in phase 1 of this study. A description and justification of the samples, data collection tool and the process used for analysis of the data gathered is provided.

#### 4.2.1. Aim of phase 1

This first phase intended to explore various stakeholders' awareness of hygienic swimming behaviours and to understand current efforts to raise awareness of these behaviours by swimming facilities. In addition, this phase aimed to explore how best to develop a public health intervention to raise awareness of hygienic swimming behaviours.

The objectives for phase 1 of the study were as follows:

1. Explore swimmers' and parents of swimmers' awareness of hygienic swimming behaviours and cryptosporidium.
2. Explore how swimmers and parents of swimmers would like to receive health information.
3. Gather information on public health measures currently in place at swimming pools and explore swimming pool operators' views about a public health intervention.
4. Explore the health educational messages provided by Lead Officers in Communicable Disease, who investigate cases of illness to avoid the transmission of cryptosporidium in swimming pools, and explore their views on a public health intervention.
5. Explore the views of health care professionals, who have a direct involvement in the investigation of cases and outbreaks of cryptosporidium, to enhance the data gathered on a public health intervention.

As highlighted by the literature review, there were many different influences upon hygienic swimming behaviour addressed. This first phase of the research aimed to explore individual level awareness as there was a lack of research in the UK focusing on hygienic swimming. In addition, the overarching aim of the study was to develop and pilot a public health intervention. Therefore, in order to develop a public health intervention feasible for a PhD study, it was considered important to explore and then raise awareness of hygienic swimming behaviours as the first step in creating an original piece of work which addresses hygienic swimming behaviours in the UK. Thus then creating a platform for further research and interventions relating to influencing hygienic swimming behaviours in the UK in the future.

In consideration of these factors, the literature review and guidance documents relating to cryptosporidium and hygienic swimming behaviours, were influential in the design of this qualitative work. The literature review demonstrated that there was a shortfall in qualitative research focusing upon hygienic swimming behaviours in addition to a lack of research conducted in the UK. Therefore, it was considered to be most appropriate to conduct qualitative research first, as discussed in Chapter 3. The literature review provided guidance on what information it would be necessary to collect from this first phase, in order to ensure the adequate exploration of hygienic swimming behaviours. The next sections provide detail on how this first phase was designed and carried out based on these factors.

#### 4.2.2. Location

Local Authority structures for Local Authority A and Local Authority B were obtained through their official websites to access the relevant contact details to get permission to approach sample groups one and two. The relevant organisations' managerial structure was sought from their websites to obtain the relevant contacts for sample groups three and four.

Sample group 1: Data collection was carried out in six swimming pool settings: three in Local Authority A and three in Local Authority B. These settings were chosen because they were the main swimming pool settings in both Local Authorities and are widely used by a variety of ages. Local Authority A is located in a more rural setting than Local Authority B.

Each of the Local Authorities' Heads of Service for Leisure Activities or a relevant contact from the swimming facilities website, was contacted prior to applying for ethical approval to acquire permission to access participants at the swimming pools. The managers of the swimming pool settings were then contacted to explain that I had been granted permission to access these settings and to recruit swimmers who used the facilities.

Interviews took place in a private room at the swimming pool settings, at a time suitable for myself and the participant. The locations for all interviews with participants from each sample group were required to be quiet, with little disturbance, to allow the conversation to flow and for it to be successfully audio-recorded with permission from participants.

Sample group 2: The pool operators of the six swimming pools selected were also recruited to take part in the study. Therefore, Heads of Service for Leisure Activities or relevant managers were also asked for permission to contact the Pool Operators. Swimming pool managers were then contacted to clarify who was responsible for the health and safety of their swimmers in relation to controlling cryptosporidium. These individuals were then invited to interview. Interviews took place in a private room at the swimming pool setting at a time suitable for both the pool operator and me.

Sample group 3: Permission was sought from the Heads of Public Protection of both Local Authorities to contact the relevant Environmental Health departments to obtain contact details for the Lead Officers in Communicable Disease, who were invited to participate in the study. The interviews took place at a private room within the Local Authority.

Sample group 4: The appropriate manager was asked for permission to invite the health professionals to take part in the interviews. The interviews took place at the participants' offices.

#### 4.2.3. Sampling

A non-probability purposive sampling technique was used to recruit samples. As this was a qualitative study, it would be inappropriate to use a probability sample, as qualitative data usually consists of a small sample size, which is not suitable for random sampling (Saks & Allsop, 2013). Purposive sampling was most suitable for this type of research, as the study aimed to gather information from a group of people at a specific setting in order to be able to answer the research aim (Saks & Allsop, 2013). Although using a purposive sampling technique can introduce bias, it was considered to be the most appropriate, as it is easy, affordable and relies on participants being readily available (Jensen & Laurie, 2017).

Sampling to achieve data saturation was not practicable, as there was difficulty in recruiting participants due to the time commitment needed to take part in an interview. Therefore, a pragmatic approach was used with the aim of interviewing at least eighteen swimmers or parents of swimmers, with at least three from each swimming pool setting (Green & Thorogood, 2014).

Determining the sample size based on previous studies relating to this topic specifically was not possible, as no qualitative studies were found. As an alternative, guidance from published literature was used in relation to sample size in qualitative research. The sample size used was based on the aim of the study, which was to explore a topic that had not previously been explored in the United Kingdom. In terms of sample size, Morse's (1991) criteria for the appropriateness and adequacy of the data obtained were consulted. Following each interview, I assessed whether any new information was being provided to ensure that there were no gaps in the information being collected: thus, completeness was obtained (Morse, 1991).

As the aim was narrow, concerning a very specific experience, fewer participants were required (Malterud, Siersma & Guassora, 2016). Also, the inclusion criteria for each sample group were very specific, with participants needing specific criteria to be eligible to take part, again meaning that fewer participants would be required (Malterud, Siersma & Guassora, 2016).

The inclusion criteria for each sample group for this phase are set out below:

Sample group 1: Swimmers or parents of swimmers who were over the age of 18, who could express themselves in English and who used the swimming facilities selected as part of this study. They did not need to be regular swimmers, as long as they swam at one of the six facilities where recruitment was taking place.

Sample group 2: Pool operators from the six swimming facilities involved in the study. Pool operators were classed as anyone working within the swimming pool who had the responsibility for managing the health and safety of swimmers using their facilities, usually a duty manager or manager.

Sample group 3: Lead officers in communicable disease for the Local Authorities in which the swimming facilities selected as part of this study were enforceable. They were required to have the responsibility for investigating cases and outbreaks of communicable disease, which included cryptosporidiosis.

Sample group 4: Health professionals who play a significant role in the investigation and control of cryptosporidiosis outbreaks. Two professionals were invited to interview due to the nature of their job roles and their extensive expertise in their respective fields. Both professionals were selected based on their extensive knowledge in relation to the control of cryptosporidium. Both health professionals are experts in cryptosporidium / communicable diseases and work within the public health context to control the transmission of communicable diseases in Wales.

#### 4.2.4. Recruitment

Sample group 1: Recruitment posters (Appendix 2a) were displayed in the swimming pool settings inviting participants to take part in an interview, with the permission from the swimming pool managers. Gatekeepers were also asked to distribute invitations to their regular members through email correspondence (Appendix 2b) or word of mouth. One swimming pool helped to recruit participants by verbally informing them of the study at the reception area. Unfortunately, none of the swimming pools used the email correspondence. Those who wished to take part were asked to contact me directly via email or to complete a reply slip (Appendix 2c) provided with the recruitment poster and to hand it in to the reception of the swimming

pool setting. An information sheet was provided for potential participants to read so that they were fully aware of what the research entailed before consenting to take part (Appendix 2d).

It was evident that the recruitment posters were not creating sufficient interest in the study, as only three participants returned reply slips or emailed me directly expressing their interest in taking part in the interviews. To help with recruitment, I attended the swimming pools, with permission from the gatekeepers, to ask potential participants if they would like to take part in the study. Unfortunately, there was difficulty in recruiting participants for this sample group and this led to the timeframe for data collection being extended. Some potential participants did agree to take part and provided a convenient time and date to be interviewed, but then cancelled their interviews and did not want to reschedule. Participants were not coerced into taking part and were informed that they did not have to participate any longer if they did not want to.

All participants were provided with my email address and work telephone number to ask any questions before or after the interview. I also took email addresses and/or telephone numbers from all participants who did agree to take part in order to contact them at a later date, with their permission, if there was something on the audio recording about which I was not clear.

Sample group 2: Following permission to contact the relevant person within the swimming pool settings, as discussed in section 4.2.2. and section 4.2.3., pool operators were asked via email if they would be happy to participate in the research being carried out at their swimming pool setting. All agreed to take part and therefore a date was booked to interview each pool operator in their office at a time and date convenient to them.

Sample group 3: As discussed in sections 4.2.2 and 4.2.3., I was provided with contact details of the relevant Lead Officers in Communicable Diseases. I emailed the two participants to explain the aims of the study and to ask if they would be happy to take part. Both participants agreed and a date and time was set to interview both participants at their offices.

Sample group 4: Two health professionals were contacted via email to ask if they would like to take part in a study focusing upon hygienic swimming behaviours. The participants agreed to take part and interviews were scheduled with each at their respective offices at a date and time convenient.

The numbers of participants for each group were as follows:

- Group 1: 18 participants
- Group 2: 6 participants
- Group 3: 2 participants
- Group 4: 2 participants

#### 4.2.5. Method of data collection

Predominately semi-structured interviews with some structured questions, were conducted with participants from all sample groups. This type of data collection allowed an agenda to be set, using open-ended questions (Appendix 2e) to ensure that relevant topics derived from the literature were discussed, but allowing the participants to determine the kind of information produced. This approach allowed for data to be collected on what swimmers knew about hygienic swimming behaviours, their beliefs on the importance of pre-swim hygiene, their knowledge of cryptosporidium, their sources of knowledge and their preferred format for information. A disadvantage to this method was that there was a reliance on what participants said rather than observing what they did (Saks & Allsop, 2013). In terms of data generation on swimmers' knowledge and attitudes toward pre-swim hygiene, an observational study would not be appropriate in light of ethical considerations such as respecting privacy and dignity.

Focus groups were considered but were not deemed appropriate, as swimmers may not want to admit to following unhygienic practices and people may be made to feel uncomfortable when discussing sensitive topics such as faecal accidents with other swimmers who may or may not be their peers. For example, when asked about hygienic behaviours, participants could have felt pressured into providing the more socially desirable answer (Acocella, 2012). The use of focus groups could have led to a victim-blaming culture (Green & Thorogood, 2014) amongst swimmers and could have had the potential to cause segregation if, for example, a swimmer were to discuss their reasoning for not showering before entering the swimming pool.

Interview topic guides were developed based on guidance documents relating to hygienic swimming behaviours and cryptosporidium. My previous experience of working in communicable disease and previous research on cryptosporidium also informed how the interview topic guides were developed (Chapter 1, section 1.7).



The interview topic guides are provided in Appendix 2e. The first topic discussed with all participants was hygienic swimming behaviours. The second topic focused on faecal accidents, while the third focused specifically on cryptosporidium. The fourth topic focused on health information. During interviews with all participants from the various groups, all participants were asked how it would be best to deliver information regarding hygienic swimming behaviours to pool users.

Topic guides were reviewed by my supervisors and were piloted. To control for non-sampling error, interview guides were piloted in order to ensure that they were suitable to collect the relevant information from the relevant sample group (Saks & Allsop, 2013). One pilot interview was conducted with a swimmer and another with an Environmental Health officer, to ensure that the probes set out in the interview topic guides allowed for the necessary data to be obtained and to enable me to rehearse my interview technique. Following each interview, the interview topic guides were scrutinised, based on the information being generated, to check if they needed to be changed at all. They were not changed following the pilot interviews.

From piloting the interview schedules, it was envisaged that each interview would last no longer than 60 minutes to cover all required topics, with interviews with swimmers (sample group 1) generally taking less time.

All interviews began by telling participants that I was grateful for their time and for taking part in the interview and opened with a general question about how often the participant went swimming or took their child swimming. Prior to the interviews, I had a general idea about who was a parent of a swimmer (this included guardian such as grandparents) or who was just a swimmer and did not take children swimming. This was because during the recruitment process, participants would often talk about their swimming and we would have a general conversation about themselves or their child.

I considered rapport during the interviews, ensuring that I appeared non-judgemental and interested in the participants' perspectives. I ensured that my body language did not suggest disapproval or disagreement with a participant's perspective. For example, while discussing reasons for a participant not informing the staff of their child having a faecal accident in the swimming pool, I appeared neutral and non-judgemental, as any reaction could have stopped the participant from providing an open and honest insight into their knowledge and attitudes (Green & Thorogood, 2014).

Informed consent (Appendix 2f) from the participants was sought prior to conducting the interview by asking participants to read the information provided to them on the form and ask them to sign and date to confirm that they provided consent to take part in the study. I also gained permission to contact them at a later date in case I did not understand the audio recordings while transcribing.

Reflective notes were recorded after each interview, either in the car or at home following the interview, or the next day if there was not enough time. I aimed to reflect on the interview immediately after it finished so that no information was forgotten. Before interviewing the next participants, I would read over these reflective notes in order to understand where I needed to improve on my interview technique as well as informing the generation of relevant data in the interviews.

#### 4.2.6. Data handling and analysis

To begin, I listened to all the interviews and transcribed them during the data collection phase. This was very difficult towards the end, as I had many interviews booked within a short space of time and transcribing them was very time consuming. To transcribe the interviews, I listened and re-listened to interviews while typing them up on a laptop using the pause button and a tool to slow down the playback of the recording. Once all interviews had been transcribed, I listened to them again and checked the transcriptions for accuracy. All personal identifiable information was removed from the transcripts, including the names of the swimming pools.

Thematic content analysis (Braun & Clarke, 2013) was used to analyse the transcribed data, as it allowed for the identification of typical responses provided by participants. To begin and in accordance with the Braun and Clarke framework for thematic analysis, I listened to the interviews and re-read interview notes to familiarise myself with the discussion. Codes and themes were then identified in each segment of a transcript and coding was conducted manually. This was done on paper by using different coloured pens for different codes and then transferred to an Excel spreadsheet. I also noted down quotes in a table in one column, provided my interpretation of what the participant was alluding to, and in the next column I linked the interpretation to the literature and public health theory (Saks & Allsop, 2013). I also created an Excel spreadsheet of all my codes and themes which included their definitions, in addition to 'maps' which modelled how codes generated themes (see Appendix 2g for an example model

of my analysis to create themes). Software packages such as NVivo 11 (QSR International Pty Ltd, 2015) were considered for data analysis; however, manual coding allowed me to take a 'step back' from the data and understand what was being said, in contrast to an automated coding process.

Further analysis was undertaken to conduct refinement of the identified themes and to define the key themes. Final analysis of the data included drawing upon key examples of the themes identified and relating these themes to the research aim (Bowling, 2002).

Qualitative research relies on the interpretation of what participants say (Saks & Allsop, 2013); therefore, I have provided direct quotes from the interview transcripts to show how themes have been developed from what participants have said in the discussion that follows.

#### 4.2.7. Ethical Considerations

Ethical approval for this study was granted by the University's College of Human and Health Sciences Ethics Committee (Appendix 2h). As previously mentioned, consent was sought from managers of all swimming pools where recruitment took place prior to conducting data collection.

The risks to the researcher were considered prior to data collection and no physical risks were identified, as data collection was undertaken on private premises during the normal operational hours of the swimming pool setting (Bloor et al., 2001). The only risk identified was if I could not collect enough data (Saks & Allsop, 2013).

It was considered that there was a low risk to participants from this research and from the nature of data collection. A small risk identified was the potential for parents to become upset when recalling their child's illness (Denscombe, 2010). A contingency plan was prepared in order to be able to comfort individuals if this were to happen. The contingency plan was as follows: I would stop the interview if it was apparent that the participant was becoming upset or distressed. The participant would be offered time to think about whether they wanted to carry on with the interview or not. I could also ask a different question or change topic if it seemed as though the participant was not comfortable discussing a specific topic. It would be reinforced that participants could withdraw from the study at any time and they would also be offered the opportunity to resume the interview at another time. Participants would also be directed to

sources of support such as the NHS or Public Health Wales website where there was further information about cryptosporidium and infection control. All participants were given a debrief sheet with useful sources of additional information and contact details of sources of support (Appendix 2i). During the research process, it was not evident that any parent or other participants became upset as a result of this study.

No immediate risk was considered to the participants from groups two, three and four. As these were professional individuals with experience of infection control and were aware of faecal accidents and other controversial topics regarding swimming pool hygiene, it was not considered that they would become uncomfortable during the interviews. That said, the contingency plan mentioned above was in place during all interviews conducted.

The interview topic guide was designed in a way which participants would understand, (Bowling, 2002), such as using the word 'poop' instead of 'faecal matter' while interviewing participants from sample group 1. Participants were asked to confirm that they were over the age of eighteen while completing the consent form. They were also informed that they could leave the study at any time up until the transcripts had been analysed (Denscombe, 2010).

A non-maleficent, non-coercive approach was used to recruit participants to the study (Denscombe, 2010) to ensure that they participated on a voluntary basis (Bowling, 2002).

The interview topic guide was created in a way that tried to avoid putting people off swimming or scaring them about the risks associated with cryptosporidium while still collecting the data required. The section on awareness of cryptosporidium was purposely placed towards the middle of the interview guide to address this issue. Also, questions were worded in a way that did not aim to create a sense of blame or guilt in parents about children having faecal accidents while swimming or about not knowing what cryptosporidium was.

Researcher bias can influence the data produced and the way the data is interpreted: therefore, I was impartial as far as reasonably practicable during the study process (Bowling, 2002) while also acknowledging that my previous experiences and knowledge could have an influence (Koch, 2006). I also ensured professional conduct throughout the research process, particularly during the data collection process, while recruiting participants using non-coercive means (Bowling, 2002). I respected the rights of the potential participants to refuse to partake in the study and I was respectful of the views of those who were willing to participate (Denscombe, 2010).

Participants were also asked permission on the consent form, and verbally by me, to audio record the interviews. Following the interview, the participants were given a debriefing sheet (Appendix 2i) and an information leaflet about cryptosporidium and hygienic swimming behaviours for participants in group 1 (Appendix 2j).

The data collected were kept confidential and were anonymised for inclusion in this thesis to ensure data protection. Data were stored on a password secured laptop and in a locked filing cabinet to ensure that only my supervisors and I were able to see the data. This is important, as identifiable information such as the names, numbers and signatures of the participants were collected on the consent forms and reply slips.

#### 4.2.8. Rigour

The purpose of a rigorous research process is to ensure the production of data of a high quality (Given, 2008). To help achieve this, Lincoln and Guba's (1985) criteria for assessing rigour in qualitative research were followed throughout this phase of the study.

*Credibility:* During the interviews, I adopted a reflexive approach to conversation to generate the participants' ideas and beliefs. It was also important for me to remain open to new ideas and beliefs during the interviews (Jootun, McGhee & Marland, 2009). I will, however, acknowledge that it was difficult to remain detached due to my experience of the research area and my own beliefs on how the intervention to raise awareness of hygienic swimming behaviours should look. For example, posters and leaflets are already being used as a form of health education material at some pools and it is evident that these do not always work. I ensured that I did not influence participants' responses by providing my opinion on the best way to receive information. However, it can be argued that having a connection to the topic has allowed me to read between the lines and to construct meaning to what swimmers were alluding to, as I have experience of swimming myself and of being involved in the regulation of swimming pools but was able to adopt a critical stance to what participants said.

To ensure credibility of my research, my research journal allowed me to identify my own knowledge and beliefs and helped me to reflect on every decision I made in relation to the research process (Jootun, McGhee & Marland, 2009). Reflecting on each interview allowed

me to identify topics/areas that needed further exploration in subsequent interviews, as they were not initially included in the assumptions (as discussed in Chapter 1, section 1.5. and section 1.7.), prior to beginning the research, and therefore to adopt an iterative approach to the interviews (Jootun, McGhee & Marland, 2009).

During this thesis, I have made apparent my previous professional roles and interest in this specific topic. This allows anyone reading this thesis to see how my own values, beliefs and knowledge have influenced the entire research process (Davies, 2008).

*Transferability:* The information reported within this thesis about the context of this study and how the data were generated should allow the reader can judge whether the findings are transferable to their setting (Guba & Lincoln, 1989).

*Dependability:* An audit trail was produced during every stage of phase 1 to provide evidence for the decision-making process, including justifications for such decisions. An audit trail includes extensive, in-depth notes, audio-recorded interviews and justifications of methods used in the research process (Silverman, 2010). The audit trail also helped to produce transparent research as the process has been well documented (Darawsheh, 2014). All choices made throughout the research process, including methodological and analytical choices, have been recorded as part of a decision trail (Guba & Lincoln, 1989).

*Confirmability:* My supervisors were asked to analyse and code a sample of the interview data to assess inter-rater reliability and aid credibility in my coding (Graneheim & Lundman, 2004). Inter-rater reliability was conducted with two supervisors, with an 80% agreement in the coding of ten extracts from different interviews initially. Both supervisors were provided with ten different extracts from the four sample groups, in addition to the current coding framework that I had developed. The supervisors conducted independent coding of the extracts. I then met with my supervisors to discuss, following the independent coding. Following discussions, we agreed on the codes and interpretation of the sections of the extracts that had raised 20% disagreement.

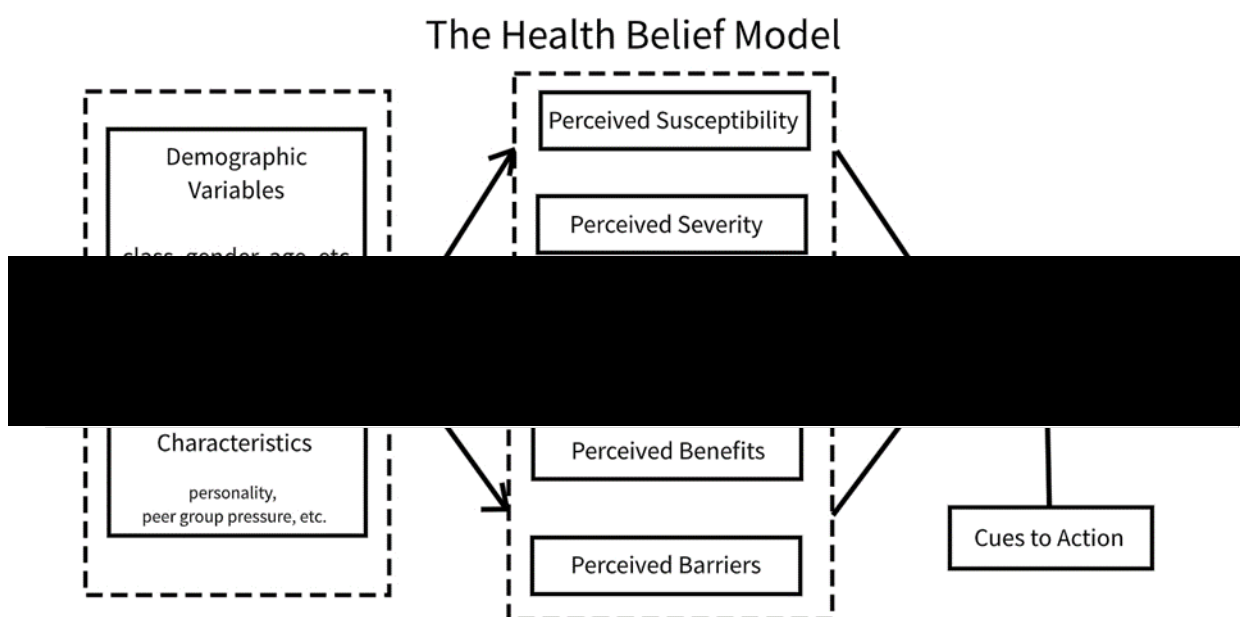
This section has provided the methods adopted to conduct phase 1 of this study. The findings from the qualitative, predominately semi-structured interviews undertaken are presented in the next section. However, an introduction to the models which informed the analysis of the data in phase 1 is presented beforehand.

### 4.3. Introduction to models which informed analysis in Phase 1

To aid understanding of the data in phase 1, a number of models and theories were drawn upon. However, two models have been extensively drawn upon. The Health Belief Model (HBM) (Rosenstock et al., 1988) aided understanding primarily of factors at the individual level which influenced whether hygienic swimming behaviours were adopted. The Socio-Ecological Model (SEM) (McLeroy et al., 1988) enables understanding of the findings at all levels from the intrapersonal to the public policy level and has been applied as an overarching model which informed understanding of all of the findings in Phase 1

During data analysis it became evident that application of the HBM (Rosenstock et al., 1988) could help to aid the understanding of many of the findings in all three themes. Thus, before the findings are presented, the HBM will be explained.

Figure 4a: The Health Belief Model



(Rosenstock et al., 1988)

The HBM conceives that health behaviours may be predicted by an individual's risk susceptibility, risk severity, benefits to action, barriers to action, self-efficacy, and cues to action. The model states that an individual is more likely to take a health-related action if they believe that the negative health outcome can be avoided. To do this, one must first understand an individual's perceived susceptibility to acquiring a negative health outcome. In addition, the model highlights the individual's perceived severity of the negative health outcome and what the consequences of acquiring a negative health outcome may be. An individual must then believe that the advised health behaviour to avoid the negative health benefit is beneficial to them, according to the HBM, and in addition the perceived barriers to following the recommended behaviour must be low. The model then advises that there need to be strategies to ensure that individuals are ready to act and follow the advised healthy behaviour, which can be done through promoting awareness of the recommended behaviours as an example. The final concept within the HBM involves an individual's confidence in their own ability to act on those advised behaviours (Rosenstock et al., 1988).

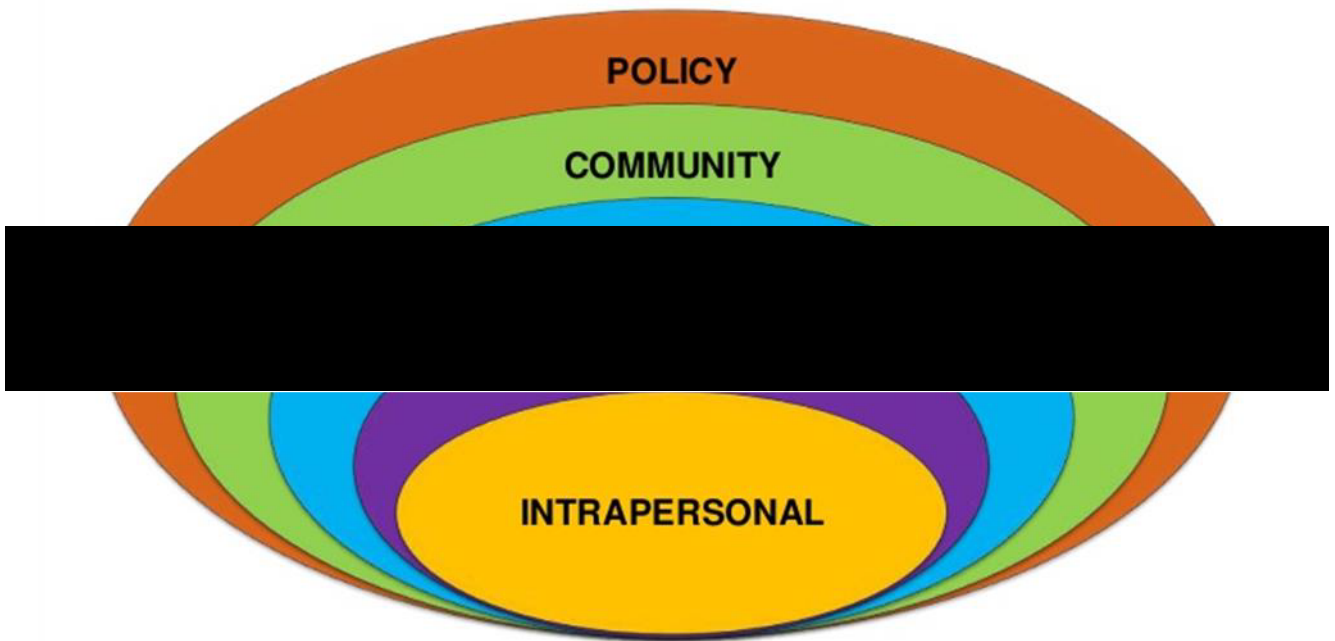
Although the HBM is useful in aiding interpretation of findings relating to healthy behaviours on an individual level, it is important to highlight its limitations. The model does not account for wider influences upon behaviour, such as environmental and social factors. In addition, the model assumes that all individuals have access to the same information about the health outcome in question, which is not always the case (Jones, Smith & Llewellyn, 2014).

Findings from phase 1 of this study demonstrated that there were many factors that influenced hygienic swimming behaviours. As such, the most appropriate model to aid interpretation of the results needed to consider more than individuals factors. The Health Belief Model (Rosenstock et al., 1988), in addition to similar models, was not considered appropriate to aid understanding of all the influences upon swimming pool users' behaviours identified. The reason for this is that these models are focused upon the individual factors that influence behaviour, whereas the findings from phase 1 identified external factors that can influence hygienic swimming behaviours. Therefore, the most appropriate model to interpret the findings was the Socio-Ecological Model (SEM) (McLeroy et al., 1988, p.355). The SEM does, however, highlight the importance of individual factors, in addition to external factors, in understanding behaviours (McLeroy et al., 1988).

McLeroy et al.'s (1988) model, which is based on Bronfenbrenner's (1979) theory, highlights how behaviour is influenced by various factors, and how these factors interact with each other.



Figure 4b: The Socio-Ecological Model



(McLeroy et al., 1988, p. 355).

The innermost level of the SEM, called the intrapersonal level, represents the individual. This level is then surrounded by four other levels that can be considered as environmental influences. It is said that all the levels influence behaviour, not solely the individual level (McLeroy et al., 1988). The various levels of the SEM are explained below:

1. Intrapersonal level: individual factors that have an influence on behaviour, such as age, gender, attitudes and knowledge. For example, are swimming pool users aware of the recommended behaviours to follow to help keep the swimming pool clean and healthy?
2. Interpersonal level: the influence family, friends, peer, coaches, and other people have on one's behaviour. For example, do swimming pool users routinely follow hygienic swimming behaviours because they had been taught them as a child by their parents?

3. Organisational level: the influence of settings in which individuals are present, such as schools, universities and workplaces. For example, do swimming facilities have policies to promote hygienic swimming behaviours amongst their users?
4. Community level: the influence of structures such as religious places and institutions within the community. For example, what are the social norms around hygienic swimming behaviours in the swimming community?
5. Public policy level: the regulatory policies, laws and procedures for health. For example, what are the regulations and guidance, at local and national level, which influence whether hygienic swimming behaviours are being promoted?

However, it is important to note that there are limitations to the Socio-Ecological Model in that if wider environmental factors such as policies are identified as being a barrier to hygienic swimming behaviours, the changes required can be time consuming and costly. In addition, it has been found that individual factors can sometimes be more influential than the wider level factors, which makes it difficult to motivate every individual to change their behaviour (Kelly & Barker, 2016). For example, providing pre-swim showers at swimming facilities may not mean that all individuals will shower before swimming. There may be a lack of awareness of the recommendation to shower before swimming, or there may be individuals who believe that a pre-swim shower is not necessary. Nevertheless, following analysis of the data in phase 1, the SEM was considered the most appropriate model as the overarching theoretical framework to this study due to the various factors identified that influence hygienic swimming behaviours. The SEM highlights how addressing these factors at multiple levels, through public health interventions, can help to promote hygienic swimming behaviours. Further detail on how this model guided these two phases is provided later in Chapters 5 and 6.

#### 4.4. Findings and discussion of phase 1

This section presents the findings from phase 1 of the study, as described previously in this chapter.

##### 4.4.1. Reminder of the aim and objectives for phase 1

This section addresses stakeholders' awareness of hygienic swimming behaviours and current efforts to raise awareness of these behaviours by swimming facilities. In addition, it explores how best to develop a public health intervention to raise awareness of hygienic swimming behaviours, as detailed in section 4.2. of this chapter.

##### 4.4.2. Characteristics of the sample

In total, 28 interviews were conducted with various stakeholders. Six participants were swimming pool operators within the swimming facilities where data collection took place. Four health professionals took part: two from a local authority and two from a national health authority. Eighteen swimmers or parents of swimmers took part in this first phase of the study. Their characteristics are provided in Tables 4a and 4b, below.

Table 4a: The number of participants in phase 1 (swimmers/parents of swimmers only) by gender

Gender	Number	Percentage
Female	12	67%
Male	6	33%
<b>Total</b>	<b>18</b>	<b>100%</b>

The majority of participants were female (n=12, 67%), with only 33% (n=6/12) of males represented in the sample.

Table 4b: The number of participants in phase 1 (swimmers/parents of swimmers only) by age group

Age Group	Number	Percentage
18-24	5	28%
25-54	10	56%
65+	2	11%
Unknown	1	6%
<b>Total</b>	<b>18</b>	<b>100%</b>

The age groups reflect standardised age groups for youths (considered 15-24; however, participants were required to be 18 and over to take part); working age adults (considered 25-64); and older people (considered 65+).

Most participants were considered to be of ‘working age’ – 25-64 years old (n=10, 56%). However, it is important to note here that 7 of those 10 participants were aged between 50 and 65. Thus, ages 25-50 were underrepresented. In addition, those of ‘retirement’ age accounted for 11% (n=2/18) of the participants.

#### 4.4.3. Overview of themes and categories

Following thematic analysis, three main themes emerged:

1. Influences on Hygienic Swimming Behaviours;
2. Design of Swimming Facilities;
3. Education for Swimming Pool Users.

The themes will be presented in the next section, with the categories within those themes being introduced when appropriate. Appendix 2k provides a codebook and thematic grid to show the development of these themes.

Quotes will be provided from participants from across the four sample groups. Identifiers are provided following each quote to provide an understanding of who is saying what. An explanation of the identifiers is provided below:

- S1, female, 18-24: The ‘S’ identifies that this quote is from a swimmer or a parent of a swimmer, and that they are a female aged 18-24. There were 18 participants: therefore identifiers will range from S1 to S18. Swimmers and non-swimmers have not been separated to report findings as it was found that most people had an experience of taking a child swimming at some point in time, even if they did not identify themselves as a parent or guardian of a swimmer. For example, some participants would discuss taking their child swimming previously, but did not identify as a parent of a swimmer currently as their child was now an adult. The experiences of those were also invaluable, and it seemed relevant to keep swimmers and non-swimmers grouped while reporting the findings due to the collective experiences and views of all participants.
- PO3: this quote would be representative of pool operator 3. Six pool operators participated in this study; therefore identifiers will range from PO1 to PO6.  
Pool Operator 1 works at Swimming Pool A;  
Pool Operator 2 works at Swimming Pool B;  
Pool Operator 3 works at Swimming Pool C;  
Pool Operator 4 works at Swimming Pool D;  
Pool Operator 5 works at Swimming Pool E;  
Pool Operator 6 works at Swimming Pool F.
- HP4: identifies a quote from a Lead Officer or Health Professional (as discussed in section 4.2.). Four ‘health professionals’ from the local authorities/national health authority were interviewed, and have now been grouped in this chapter to protect individuals from being identifiable, so identifiers range from HP1 to HP4.

Large age ranges have been used for the identifiers due to the small sample size and to protect individuals from being identified.

#### 4.4.4. Theme 1: Influences on Hygienic Swimming Behaviours

This section presents the findings for the first theme – Influences on Hygienic Swimming Behaviours – which are interpreted and discussed in light of health promotion and behavioural theories such as the SEM and the HBM, which emerged from analysis. No information was identified in the literature as to why swimming pool users in the UK behave in the way that they do; therefore, this section provides useful information to aid understanding of the influences on hygienic swimming behaviours. Two main sub-themes were identified, namely internal influences and external influences.

##### 4.4.4.1. Internal Influences

The first sub-theme to be presented comprises the internal influences on hygienic swimming behaviours. Within this sub-theme, three categories were identified. These include current awareness of hygienic swimming behaviours, habits/routines, and beliefs. The first category to be discussed is current awareness of hygienic swimming behaviours, followed by a discussion of the two categories of habits/routines and beliefs together.

##### 4.4.4.1.1. Current awareness of hygienic swimming behaviours

From thematic analysis of the data, it was evident that current awareness of hygienic swimming behaviours varied amongst swimming pool users. Most swimmers were aware of what they were required to do to help keep the swimming pool clean and healthy, but they did not know the specific reasons why these behaviours helped to keep the swimming pool clean. With one exception, all swimming pool users interviewed stated that they would not go swimming if they were experiencing diarrhoea and vomiting:

*It wouldn't bother me. ...Wouldn't think-- as long as I didn't need the loo then yeah I'd go anyway. ...I'd still go swimming. ...Whether I should or not is another thing. ...You know. It's not as if I'm gonna have a poo in the pool. ...You know, I've got control of myself (S14, male, 25-64).*

This participant did not seem to be aware of the risks associated with swimming whilst ill. The quote shows that there is a need to educate people on the importance of not swimming until

they are well to avoid the transmission of cryptosporidium and other pathogens. It is of concern that there is potentially a lack of awareness of the importance of avoiding swimming while suffering from diarrhoea and vomiting. As highlighted previously, the HBM can aid interpretation of this finding in terms of perceived susceptibility (Rosenstock et al., 1988), as this participant did not seem to know that this behaviour is associated with a health risk and did not think it relevant to him. If this participant was aware of the risks from swimming whilst suffering with diarrhoea and vomiting, this might change his attitude towards this behaviour. In addition, this quote highlights how Swimmer 14 does not perceive swimming whilst suffering from vomiting and diarrhoea to have any consequences, such as transmission of pathogens within the pool water. Furthermore, it is evident that he does not understand how transmission of pathogens can occur without a faecal accident (PWTAG, 2017).

On the other hand, most participants understood that it is recommended that they avoid swimming whilst suffering with diarrhoea and vomiting:

*...I would be very mindful of swimming if I have any illness or didn't feel well (S3, male, 65+).*

This participant reported that it was important not to go swimming whilst suffering with diarrhoea and vomiting, but also any other types of illness. There were various reasons why the other participants would not go swimming if they were symptomatic. Seven of the 18 swimmers/parents of swimmers specifically said that they would not go swimming to avoid transmission of the illness. Typical responses were:

*Yes. I do. Definitely. Because you know, if you, if you had some horrendous contagious disease, you wouldn't go shopping, so why take it to the pool because you're dirty...If you have norovirus, they tell you not to go to surgery. You don't go, "Oh, that's disgusting." You stay at home (S9, female, 25-64).*

*....And obviously wouldn't want to pass it to others (S18, female, 25-64).*

These example quotes demonstrate that seven of the participants understood the potential for illnesses to be passed on through the swimming pool water. Again, the HBM can be applied to interpret this finding, as it is evident that these participants perceive avoiding swimming whilst suffering from diarrhoea and vomiting to be a healthy beneficial behaviour to follow (Rosenstock et al., 1988). Swimmer 9 highlights how she perceives swimming whilst suffering

from diarrhoea and vomiting to be a serious issue, with potentially severe consequences related to this behaviour.

One participant said:

*No, definitely not. You know, again, um, your common sense will prevail if, you know, if you're ill you're not gonna be going anywhere like that...into that kind of an environment (S13, female, 25-64).*

This relates to the previous quote in terms of being aware that they should not go into a swimming pool environment while suffering from that kind of illness to avoid transmission. This suggests that Swimmer 13 believed that people do not need to be specifically educated on this matter, as it is 'common sense' not to swim whilst suffering with diarrhoea and vomiting. A study focusing on parents' attitudes to oral health in early years also found that people stated that such behaviours are common sense. Their study found that parents did not seek information on this type of behaviour and it was not information that they needed (Roberts & Condon, 2014).

In this instance, Swimmer 13 believes that the correct response to an illness involving diarrhoea and vomiting is to avoid swimming. Application of the HBM provides an interpretation that some swimmers may feel that cues to action, as described in the HBM, may not be necessary, as individuals should already be aware that swimming whilst ill is not a behaviour that should be followed (Rosenstock, 1988). However, although Swimmer 13 reported that it is 'common sense', her actions are likely based on various sources of information to reach the conclusion that swimming whilst symptomatic is not a desirable behaviour. This highlights the importance of promoting awareness of the recommended behaviours to all swimming pool users.

Swimmer 13 also stated:

*You know, they have – normally have, you know, signage that will say, you know, you are not supposed to be coming into this pool if you had anything like that... (S13, female, 25-64).*

Swimmer 13 usually swam at Swimming Pool A. While conducting these interviews, the swimming pool settings were visited to identify the current educational efforts, and during this fieldwork, Swimming Pool A did not have any signs on display relating to such exclusion. It is possible that this participant was remembering signs from a different pool or that there had been signs on display previously at this setting. This highlights that signage has the potential



to raise awareness of key hygiene messages, resulting in retention of information by some swimming pool users. This suggests that providing basic instructions to swimming pool users can result in healthy behaviours being followed (Tones et al., 1990).

One swimmer said:

*Yeah, I think so coz it's - if you go like to a place of work, they say you need to have like time off and make sure it's cleared...And I think it should be the same for anywhere, really...Especially, like swimming pools, where there's a lot of people about, lot of children at the swimming pools as well (S8, male, 25-64).*

This participant suggested that he had been informed previously by his place of work that he should not come to work until his symptoms had ceased. There may be an association between occupation and awareness of hygienic swimming behaviour and of the need to avoid swimming whilst suffering from diarrhoea and vomiting.

Two swimmers stated that they would avoid swimming because they would not feel well enough to swim whilst symptomatic:

*'Til I felt better. You're not gonna go swimming if you're feeling rubbish, are ya? (S2, female, unknown).*

*Just that it's the last thing you feel like doing anyway (S11, female, 25-64).*

It can be interpreted that some swimmers do not go swimming because they do not feel up to it and not because they are aware of the importance of exclusion to avoid transmission of any pathogens. This highlights the importance of making swimmers aware of the exclusion period in terms of avoiding swimming for 48 hours after symptoms have stopped, or 14 days after symptoms have stopped following a diagnosis with cryptosporidiosis. This relates to what Swimmer 6 said:

*Um, well I-I-I-I wouldn't really want to risk-- If I urgently needed the toilet and I was in the pool or something. I wouldn't want to risk...a disaster [chuckles] (S6, female, 18-24).*

Again, this highlights the importance of swimmers being aware of the exclusion periods to avoid any toileting accidents. Three participants did mention the 48 hour rule. A typical response from these participants is presented below:

*48 hours... Uh, I don't know, just common knowledge really... Um, I don't know really, it's just coz time for everything to sort of settle and any germs go away... Well, so everyone can get out and avoid any, uh-- avoid catching any germs or whatever (S5, male, 18-24).*

As discussed in the literature, it is important to avoid swimming for 48 hours after symptoms have stopped, or 14 days following an illness with cryptosporidium to avoid transmission of pathogens in the swimming pool water and the surrounding environment (Chalmers et al., 2016).

The findings presented here show the variation in swimming pool users' knowledge and the various sources of information which had influenced their swimming behaviour. Although, Pool Operator 2 believed that even if people are aware of the 48 hour rule due to their occupation, they do not connect this to the importance of following the same rule in a swimming pool setting:

*I think we're on the journey is letting-letting people know that if they have had an, um, upset tummy, then they-they shouldn't swim within 48 hours... Um, how far you go in terms of information as to why you're telling them that... Um, mm, that will evolve. It's-it's-it's just like foo-w-, it's long been known if you work in food and beverage and you work with food, you've had a bad tummy, you don't work for 48 hours... But I don't feel like that message has got through with kind of behaviours of the general public in terms of swimming quite yet (PO2).*

The quote indicates that whilst swimmers who work in catering are aware of the 48 hour rule the general public are not aware. This highlights that there may be a need for more cues to action, as stated by the HBM (Rosenstock et al., 1988), whereby promotion of the 48 hour rule is needed amongst the general public. Some swimmers said they would avoid swimming for 48 hours after symptoms had stopped due to pre-existing health conditions. Swimmer 16 stated:

*Yeah, I-I-- but for me as well, um, I've got Crohn's disease... so I'm very much aware, I've gotta be really careful and I've got an ileostomy... so I really don't want to make myself worse or make other people bad... or, you know, I'm just-- I'd rather play safe... and take longer... you know? (S16, female, 25-64).*

The participant is alluding to the fact that she feels she would be more likely to avoid swimming for 48 hours in order to ensure that she does not become more ill. This can be explained by the Health Belief Model in that some swimmers may be more likely to follow hygienic swimming behaviours because of their perceived risks from swimming whilst suffering from an illness

(Rosenstock et al., 1988). Swimmer 15 stated that her exclusion from swimming would depend on what illness she was suffering from:

*Depends on the bug, doesn't it? ...Because sometimes you have a 24-hour bug, and-- I suppose a couple of days? A couple of days...because if you got a stomach bug or something you just wouldn't want to go in the water, would you?...I think-I think it says 20-- 24 hours. I'm not sure to be...perfectly honest. It's 24 hours or 36 hour-- I can't remember but...(S15, female, 65+).*

This highlights that although this participant understood exclusion periods, she was not completely sure of the time period required.

Three participants stated that they would wait for an exclusion period, but time frames given varied from 24 hours to 72 hours:

*I think it's normally twenty-four hours (S8, male, 25-64).*

*?...I think-I think it says 20-- 24 hours. I'm not sure to be...perfectly honest. It's 24 hours or 36 hour-- I can't remember but- (S15, female, 65+).*

*To be honest, at least 72 hours (S18, female, 25-64).*

This again shows the variation in swimming pool users' knowledge around the correct exclusion period. This can be related to research pertaining to health literacy and adherence to medication. Health literacy relates to the individual's skills to access and understand health information and then actually use this information to improve their health (Nutbeam, 2000). What is understood by one person may not be understood by another, and this is an important consideration when discussing the findings in this section. Information must be provided in a clear, concise format for non-experts to understand (Tones & Tilford, 2001). It is also believed that health literacy can affect personal empowerment (Nutbeam, 2000). The element of empowerment is important when creating public health interventions in order to motivate actual behavioural change (Ewles & Simnett, 2003).

For example, evidence suggests that some instructions provided to patients by healthcare workers can be misunderstood, leading to medication not being taken correctly (Fan et al., 2016). In terms of hygienic swimming behaviours, if pool users misunderstand the information being provided to them, then they may follow unhygienic behaviours unintentionally. Therefore, it is important to provide the correct messages to swimmers, but also to ensure that this information is being understood and retained.

Swimmer 14, who reported that he would swim whilst suffering from diarrhoea and vomiting, also stated that he had not adhered to any particular exclusion period:

*It wouldn't bother me. ...Wouldn't think-- as long as I didn't need the loo, then yeah, I'd go anyway. ...I'd still go swimming. ...Whether I should or not is another thing. ...You know. It's not as if I'm gonna have a poo in the pool. ...You know, I've got control of myself (S14, male, 25-64).*

This quote shows there is not only a need to make swimmers aware of the 48 hour rule, but also to educate them on the importance of not swimming until they are well and on adhering to the 48 hour rule. This connects to a perception from one participant who stated that the exclusion timeframe would be dependent on how he felt or how his child felt:

*I'd probably just judge it on the way he is feeling...I wouldn't, I wouldn't give it a time. I'll just maybe look at him and assess it and see it for myself if he's feeling OK and I'd go swimming then, yeah (S12, male, 25-64).*

This again shows lack of awareness and how it is important for swimmers to be aware that there is a 48 hour rule for symptoms of diarrhoea and vomiting. As previously mentioned, there are different exclusion rules for different illnesses, but it is hoped that the GP diagnosing the patient will inform them of these rules. For example, it has been previously stated that cryptosporidium should have a 14-day exclusion period (Chalmers et al., 2016).

It is, however, beneficial for swimming pool users to follow the 48 hour rule for undiagnosed episodes of diarrhoea and vomiting. Therefore, providing swimmers with information to change their perceived risks in relation to swimming before the required exclusion period could result in a behaviour change (Rosenstock et al., 1988). This also suggests that in order to change behaviour, there should be an emphasis on susceptibility. Therefore, providing information regarding transmission through asymptomatic shedding may be enough to change people's behaviours in relation to exclusion timeframes.

Swimmer 5 and Swimmer 7 stated that it is common sense to wait 48 hours before coming back to swimming, which shows the differing level of awareness. It is also important to note here the importance of swimming pool staff being trained in this matter to provide specific information to swimming pool users:

*Well until they are better. I mean it's um, I wouldn't know of like a definite time scale...I'm not a doctor or whatever. But I mean they have to be a hundred percent better...I mean with, like, a bug you know it takes like 24 to 48 hours. But I, I'd say it's best not to come back for three whole days. It would have to be completely out of the system (PO5).*

This suggests that this pool operator was confused as to the exclusion period required following an illness with diarrhoea and vomiting. This shows the importance of pool operators and other staff members being knowledgeable in this area in order to increase awareness amongst their swimming pool users of the correct exclusion periods.

This also highlights the need for consistency within the swimming facilities in terms of the messages being provided. For example, it is important that all swimming pool settings are providing the correct instruction to wait 48 hours after symptoms have stopped following any illness with diarrhoea and vomiting. It is important for all swimming pool users to be given correct and consistent information. For health education efforts to be successful, it has been found that giving consistent information is a key variable (Gill & Boylan, 2012).

Health Professional 3 stated that it was possible to forcibly exclude someone who has been ill with diarrhoea and vomiting from attending a swimming pool:

*Yes. So we do have the-the powers, um, local authority powers to, uh, what we call a reg 8...Letter asking for cooperation, and in the worst-case scenario, if we thought there was, uh, a person in particular at risk, we could always go for part two A order...But that would be extreme cases (HP3).*

A Part Two A Order would be used to request that a symptomatic person cannot use a swimming pool until they have fully recovered and their symptoms have stopped for a certain amount of time, depending on the pathogenic organism (*The Health Protection (Part 2A Orders) (Wales) Regulations, 2010* (Wales)). As stated by Health Professional 3, this would only be used in extreme cases. In terms of encouraging healthy behaviours, this would not be something to rely on. It is evident that encouraging people to follow healthier behaviours is more successful when using positive messages (Economos et al., 2001).

Although no swimmers or parents of swimmers stated that the cost of missing a lesson could be a reason for them not adhering to exclusion rules, other stakeholders stated that this could be a factor:

*There could be. Umm. We have-- We've got some parents that it's catch twenty-two because you got some parents, well I took a phone call over the weekend to say you know, "This child is in lessons. Um they're unwell this morning so I'm not going to bring them. But we're also off a few weeks so we'll not see you for a few weeks" That sort of thing. But we'll have other parents that will say they can't come today because they're unwell, can we fit them anywhere else. And we've got over six hundred children in our lessons. So the chance to find-- trying to fit those into another lesson is impossible...Um. So it's unfortunate that if they miss a lesson, they miss a lesson. Unless it's an illness that takes them away from the swimming for a substantial amount of time and we can you know...memberships and things like that. But if it's a one off. Um. So for some people it would be money. I think generally it's probably a lack of understanding (Pool Operator 1).*

This potentially provides a reason why some parents may not want to follow exclusion recommendations, due to costs. Two pool operators and three health professionals also believed that the cost implications of missing a lesson could be a reason why parents do not exclude their children from swimming lessons. Please see section 4.4.4.2, which addresses the issue of parental influence. One pool operator did state that the setting in which they worked would refund a missed lesson in order to try to encourage parents to follow exclusion rules:

*No, it's not, it's not missed a lesson. If that's the case we would either credit them for the next lesson or uh, putting the credit on the back end of the lesson of the next enrolment (PO3).*

Health Professional 1 supported this view:

*There are things that-that-that we've done around that, in outbreaks where the pool has either added on an extra lesson...or, um, they've refunded one lesson and...you know, so there are incentives...that-that can be talked around for people not to (HP1).*

This highlights the importance of swimming pool facilities ensuring that hygienic swimming behaviours are easy to follow. Research has shown that making healthy behaviours the easy choice is the best way to encourage such behaviours (Volpp & Asch, 2017).

Pool Operators and Health Professionals stated:

*Yeah, I think people, um, it does happen and they may have become unwell and they don't always associate with perhaps more waterborne illness. They're thinking more along the lines of food poisoning and the like...Uh, and they don't appreciate the protocols that, uh, should be followed. So, I think, um, unknowingly, yeah, they do go swimming...um, as a result (HP4).*

As previously discussed, these participants are alluding to the fact that people may be adopting risky behaviours without being aware. They may not understand how transmission can occur in the swimming pool water and the importance of infection control procedures. An important point made by Health Professional 1 was:

*I think-I think the first thing that they should be encouraged to do is even before they leave home...um, are they fit to swim in terms of, have they had or have they got an infectious disease. Um, ob-obviously are they okay to, you know, swim?... But um, yeah, just thinking, just pausing and thinking, "Should I be actually using a swimming pool today?"..."Or my children, should they be using a swimming pool today?" Because I think the difficulty at the moment is we've got posters at the swimming pool, but some it's a bit late you know...mum's turned up, she's got all four children all ready, all excited, and you turn up at the pool going...Maybe we shouldn't go there at all, and if I say we're going home now it's going to coz...a riot. So, I think instilling in people that, you know, just pausing, thinking. So, that would be the first step for me (HP1).*

Health professional 1 highlighted that if someone has already arrived at the setting, they might be less likely to not swim if they become aware that they should not do so, as the information has reached them too late. This again highlights the need for health education to make following hygienic swimming behaviours the easiest option. This can also be interpreted using Rosenstock et al.'s (1988) Health Belief Model by assuming that some people may not be aware of the risks. For example, there is a need to provide cues to action to swimming pool users which promote the avoidance of swimming whilst suffering from sickness and diarrhoea. In turn, this health promotion may change swimming pool users' perception of the benefits of following this recommended behaviour to avoid transmission of pathogens in the swimming pool water and the surrounding environment, such as the toilet facilities in the changing rooms.

The importance of not swimming while suffering from diarrhoea and vomiting was emphasised by all six pool operators, as faecal accidents do happen in the swimming pool, and when they do, they often result in full closure of the swimming pool for a period. A typical response from the pool operators is presented below:

*We had a case last week where, um, when a school child had an accident and they had been ill and it resulted in we closed the pool...We closed the pool, we backwash, raised chlorine level. You know, we've got a procedure in place. If you know someone's ill like that and it's brought to your attention. We, we've got um a procedure in place to...Coz um the risk, obviously the risk then from the cryptosporidium—(PO5).*

This pool operator discussed backwashing, which is the process of cleaning the filters to remove any cryptosporidium oocysts from the filter media to ensure that they are not reintroduced into the swimming pool. Pool Operator 5 also mentioned raising the chlorine levels, which is another procedure that is used when a faecal accident occurs to try and kill any pathogenic organisms that may have been introduced into the water. As previously discussed in the introduction chapter, chlorine is not effective against cryptosporidium: therefore, there may still be a risk to swimmers. Consequently, pool operators will close the swimming pool to allow for filtration and backwashing to reduce any potential risks. These procedures take a significant amount of time, as there is a requirement for all the water in the pool to be circulated and filtered, resulting in the pool being closed for several hours (PWTAG, 2017).

All pool operators also highlighted the importance of people following exclusion rules to avoid transmission of cryptosporidium and other pathogens, along with avoiding any disruption to pool operations. If there is a faecal accident in the swimming pool, which subsequently requires closure, this disrupts scheduled lessons and general swimming – resulting in decreased opportunities to learn to swim and exercise. This is not desirable, as there are public health efforts to increase physical activity (Welsh Assembly Government, 2009). However, Pool Operator 5 highlighted the following:

*So it's closed like six hours...It is but...Um you, you can compare that against any repercussions from, you imagine like, you know, four or five classes of schools all going ill with the same thing...Because we've continued taking the lessons...That would be...Just not worth it (PO5).*

This shows the importance of avoiding swimming whilst suffering from diarrhoea and vomiting in terms of pool closures, but most importantly, the potential for large-scale outbreaks.

Another hygienic swimming behaviour discussed during the interviews was pre-cleansing. As described previously, pre-swim showers and hand hygiene are important in order to reduce contamination in swimming pools (PWTAG, 2017). Around half of the participants within the first sample group (swimmers/parents of swimmers) stated that they were aware that they needed to shower before swimming, but they did not know specifically why it is important to do so, as indicated in the following quote:



*I remove my makeup, if I haven't already done so. Um, I'll-I'll have a shower, like a-a rinse, before going into the pool-- With the showers.*

**Researcher:** *Yeah. And why do you do these things?*

*Not really sure, actually (S6, female, 18-24).*

This relates to the HBM model in terms of providing signage with basic instructions as a means of informing people of the recommended healthy behaviours as a cue to action (Rosenstock et al., 1988), thus highlighting how providing reminders and promoting the recommended hygienic swimming behaviours can help swimming pool users to adopt healthy behaviours. However, this quote suggests that some swimming pool users do not need to understand the perceived benefits of pre-swim showering: they just need to be aware that it is advised to shower before swimming.

Seven of the 18 swimmers/parents of swimmers interviewed, who swam at the six swimming pools, said that they showered before swimming to avoid introducing contaminants into the pool water. This included people not wanting to introduce foreign objects:

*Yeah. I feel like obviously when you wear socks and stuff like your feet can get a bit gross, so just to get all the bits off, really – anything that you won't want to take in the pool (S10, female, 18-24).*

One participant specifically said that he showered beforehand to avoid introducing 'bugs' into the water:

*But, yeah, I just thought you'd shower just to rid of, obviously, any germs or bacteria or whatever you've got on your body...whatever you're carrying in from somewhere else...you know, it just prevents the spread and-- (S5, male, 18-24).*

However, Swimmer 9 highlighted that some people may not shower because they feel that it is unnecessary, as chlorine kills all pathogens:

*...Chlorine does it and that's the end of that. They wouldn't think they had to be clean to go in (S9, female, 25-64).*

This suggests that there was a variation amongst swimmers as to why showering before swimming is important. Two other swimmers stated that they believed that other swimmers

were just not aware, along with two pool operators and one health professional who also mentioned this as a reason for not showering:

*And I think we've got a legacy in this country of calling them swimming baths...and it's having that 'bath' attached. And I know that some people have in their minds they still think, "Oh, I won't have a shower today, coz I'm going swimming later." [laughing] Swimming bath (HP1).*

*To be totally—They're just not aware of it, I think: they're just, um, they're not aware really of, um, how, how the pool filtration system works, and um, and no, it's treated with-with a disinfectant, chlorine will be known as the disinfectant we use in the pool...But most of the contaminates would actually lie in the top few inches of the pool...Um. That is where the contamination lies, which if you think that's where people swim (PO5).*

*So it's not a case of they wouldn't bother, I don't think people realise that they have to have a shower before they go into the pool (S7, female, 25-64).*

These comments highlight how swimmers' beliefs and knowledge can affect their behaviours in terms of hygienic swimming. Providing swimmers with information regarding the benefits of showering before swimming may change their attitude towards adhering to hygienic behaviours, as highlighted in the Health Belief Model in regard to changing an individual's perceived benefits of certain behaviours (Rosenstock et al., 1988).

Swimmer 3 stated:

*But as I said to you initially, I tried to make sure my hygiene is in place first before I get into the swimming pool. Like for instance this morning, before coming to the pool, I would have showered...at home (S3, male, 65+).*

As Swimmer 3 demonstrated, some swimmers may shower at home just before coming to the swimming pool setting, and therefore would not see the need to shower again before entering the water. This would make it seem as though Swimmer 3 is not following the hygienic behaviour of taking a pre-swim shower before entering the pool, but he believed that he was adhering to this recommended behaviour. By contrast, Swimmer 17 stated:

*I don't know: I just see it as I wash the chlorine off afterwards so I don't feel like there's anything to wash off before (S17, female, 18-24).*

For this participant, showering was viewed as a means only to wash away the chlorine and was not required prior to swimming. As discussed in Chapter 1, showering is important to reduce the amount of contamination in the pool, which allows the chlorine to work more effectively and target the harmful pathogens (PWTAG, 2017). Interestingly, Swimmer 17 swam at a facility where there were pre-swim showers at the pool side, in a conveniently located position. This shows that although it may seem that swimmers are being provided with easy ways to follow hygienic swimming behaviours, without the knowledge behind such requirements, it is unlikely that hygienic swimming will be followed (Arlinghaus & Johnston, 2017). The location of pre-swim showers and the influence on swimmers' behaviour are discussed in full under the second theme: design of the swimming pool facility (section 4.4.5.).

Pool Operator 4 stated that it was difficult to get children to shower due to excitement and eagerness about going swimming:

*Out of sheer eagerness... To get in... And have fun, yeah. Particularly with the younger children. They don't wanna go in the shower, they wanna get in and... Get on the slides, get in the waves... Yes, start having fun (PO2).*

This Pool Operator worked in a facility where there were interactive features such as water slides, which might be a reason for children not wanting to shower due to excitement. This identifies a potential difficulty in trying to get children to change their behaviours, depending on their age and how much influence the parents have over their behaviours.

Health Professional 2 reported that swimmers in the United Kingdom were generally poor at taking pre-swim showers:

*Yeah, I think one thing we're not very good at in this country, um, is pre-swim hygiene... As is it, having been to Norway where they religiously strip, they're totally naked and have a shower before you go into the swimming pool... Um, we are horrifically bad... Yeah, yeah. I would say so. I mean whenever I go swimming I do see signs but, I mean, if, I'd be brutally honest, even myself I'd quickly, I will have a very quick walk through shower... but it will be a very quick walk through shower. Um, I wouldn't even like to guess what percentage of people do actually bother doing that... but I think as a nation, we are particularly bad at that... to be honest with you (HP2).*

This health professional suggested that there is a need to change the culture of showering before swimming. This issue will be more comprehensively presented and discussed in section 4.4.4.2, titled External Influences, later in this chapter.

As described in the introduction chapter, the more swimmers who shower before swimming, the better the swimming environment for swimming pool users, and this reduces costs for pool operators. The cost savings attributed to swimmers showering prior to swimming were acknowledged specifically by one of the pool operators, as indicated below:

*The more, the more times we try to encourage people to um, shower and pre-cleanse before coming into the swimming pool, for us as pool operators it'll certainly be um, cost saving exercise for us on chemicals. Um, and also um, reduction in your backwashing as well (PO3).*

As explained previously, the process of backwashing is used to clean the filters. This requires a large amount of water and energy: therefore, the less often pool operators must do this, the lower the cost involved.

No swimmers or parents of swimmers identified hand washing as a hygienic swimming behaviour, but when asked if they washed their hands after using the toilet, they all said that they did. This can be linked to socially desirable answers, whereby participants may have stated that they do wash their hands because they believed it to be socially acceptable, and may have provided biased responses (Bowling, 2002).

All participants reported that the hand washing facilities were accessible, although one did believe that the condition of the hand washing facilities was not up to standard:

*Yeah. I suppose, I mean um, -- I suppose so but um, I think at the moment, I think we might be do-- But personally um, I might be doing more harm to the pool by washing my hands down there [laughs] than...than not washing my hands (S3, male, 65+).*

It would be beneficial if the hand washing facilities available at the swimming pool settings encouraged people to wash their hands, for the same reasons as showering before going into the pool. This can also help prevent the transmission of pathogens outside of the swimming pool water, such as the flu virus (Curtis & Cairncross, 2003). If facilities are not in correct working order or are not clean, then this is a barrier to hygienic behaviours, again connecting to theories around making healthy behaviours the easy options (Volpp & Asch, 2017).

This relates to the next hygienic swimming behaviour, namely using the toilet before entering the swimming pool to avoid any accidents and to ensure that no one uses the pool as a toilet. However, as reported by one of the participants, accidents do happen:

*We've gone on holiday and we used um, a pool, an outside pool. And um, she was potty trained and she was dry but chose to, actually, have an accident in the pool...In the little baby pool. Uh, I was absolutely mortified but she was of an age where she was older...and so I thought she didn't need to wear...a nappy. I was absolutely mortified (S13, female, 25-64).*

This suggests that this behaviour was not what she believed to be hygienic or acceptable, as she stated she was 'mortified'.

From the literature, it is evident that some swimmers do urinate in the swimming pool, which reacts with the chlorine in the pool (PWTAG, 2017). Therefore, it is important for all to know that they should use the toilet before, during and after swimming, not only to avoid faecal accidents but also to avoid urinating in the pool. It would be beneficial to teach children not to use the pool as a toilet and parents could be pro-active in asking if the child needs to go to the toilet before and during swimming. Only three swimmers mentioned taking their child to the toilet before swimming as a hygienic swimming behaviour. A typical response was:

*Um, just make sure he's been to the toilet or whatever before we go...He doesn't need to go (S12, male, 25-64).*

These three participants took children swimming. It is possible that they were more aware of this behaviour as a result, showing how different experiences may make people more aware of hygienic behaviours. Using the HBM to aid interpretation of this finding highlights how some swimming pool users may perceive that their child is likely to have a toileting accident in the pool if they do not adopt the behaviour of asking them to go to the toilet before entering the water.

All participants who had taken young children swimming used swim nappies. Six parents/guardians found them effective in order to avoid embarrassment for the child if an accident were to happen and also to avoid contaminating the swimming pool. Below is an example of a typical response provided by those who had taken young children swimming:

*It's a lot more hygienic, the pool, and um, it's a lot less embarrassing for the child as well if they did have an accident, obviously it's kept under control (S18, female, 25-64).*

This shows that some parents or guardians have an understanding that there is a purpose to using proper swim nappies in order to help keep the pool water clean and healthy. There is also

the element that the parent or guardian does not want their child to feel embarrassment, or to feel embarrassment themselves if an accident were to happen.

Three pool operators also reported that swim nappies were a good product, acting as a barrier between faecal matter and the pool water. All Health Professionals also stated that the use of a proper neoprene nappy was important, but they must be used correctly, and they did question how effective swim nappies would be at containing a runny stool:

*Um, obviously they're better than nothing and if they do contain the accident as it were, then we're good. But there must be some seepage, surely, when you think about it (HP3).*

Two swimmers/parents of swimmers also mentioned that they were concerned about the effectiveness of swimming nappies:

*You know? Like, I, I don't really trust them. I mean, obviously, they do their job to an extent, but how much to an extent? (S6, female, 18-24).*

This highlights that although parents or guardians are aware of the importance of using proper swim nappies, they are concerned as to their effectiveness. One participant also mentioned that swim nappies were costly:

*Um, just in case you had an accident before getting there, you wouldn't want to change her again coz they're a lot more expensive than normal nappies (S18, female, 25-64).*

Relating to the social determinants of health, the affordability of using swim nappies can have an effect on the behaviours of parents with young children using swimming pools (Baum, Newman & Biedrzycki, 2012). Access to job opportunities can indirectly affect the socio-economic factors associated with swimming (Naidoo & Wills, 2016). For example, parents with lower incomes may not find swim nappies affordable, and therefore may not use them.

Also related to this are inequalities in health and the wider implications that this could cause to the social determinants of health (Wilson & Mabhala, 2009). The social gradient and poverty may affect the feasibility of parents taking their child swimming or using swim nappies. In relation to health, the social gradient is used to describe populations who are of lower socioeconomic status and in return have worse health than those with higher socioeconomic status (Donkin, 2014). It could be that some parents are not able to use swim nappies due to the cost, and therefore present a risk of contaminating the pool (Wilson & Mabhala, 2009).

Children's health varies across different geographical areas due to inequalities in health and differences in families' socio-economic status (Graham, 2009). Swimming is a beneficial way of keeping active and healthy (NHS, 2014): therefore, parents should not face barriers such as affordability of swim nappies for their young child (Naidoo & Wills, 2016). Socio-economic inequalities must not affect children's opportunities to keep active and healthy such as taking part in swimming (Graham, 2009). A further issue that is related to using swim nappies and taking children on regular toilet breaks is the importance of informing a member of staff of any faecal accidents in the pool. Faecal matter can enter the pool if diarrhoea is not contained by a swim nappy or if a child who is not wearing a swim nappy accidentally defecates in the swimming pool. All participants said they would inform a staff member if an accident happened:

*We got out of the pool. Um, what did we do? We got out of the pool, cleaned him up and I think – I was with someone at the time, they went and told the person and then we left then...but we don't know what...if it was cleaned out or anything. I assume it would be, wouldn't it? (S1, female, 18-24).*

This participant and Swimmer 13 were the only ones to state that they had experienced a toileting accident with their child at a swimming pool setting, although Swimmer 1 discussed their child being sick in the pool rather than a faecal accident. If a child is sick in the pool, operators take similar procedures in terms of infection control as if it was a faecal incident (PWTAG, 2017). This shows that all swimming pool users interviewed were aware that they would need to inform a member of staff of any accidents in the pool water, including vomiting, to enable them to take the necessary steps to ensure the health and cleanliness of the water.

One participant stated:

*I would inform the pool supervisor...Straight away...I'd feel embarrassed but it's better than leaving people swim in poo (S9, female, 25-64).*

This may suggest that some swimmers would not alert staff to an accident in the pool due to embarrassment. It is important for swimming pool staff to encourage swimming pool users to inform them of any accidents, with there being no repercussions for doing this:

*It's just purely, maybe they're embarrassed. Maybe frightened of any repercussions – maybe, you know, they may think they're gonna be charged for closing the pool or...Could be one of those two reasons (PO5).*

The pool operator suggests that swimming pool facilities would not charge for an accidental faecal release in the pool and pool operators would be grateful if parents were to inform a member of staff so that the correct procedures can be carried out:

*Uh, it basically means, you know, we've, we're having to close the pool, whereas maybe, you know, if it was um, sort of, not related to an illness or anything, then perhaps we could have, you know, cleared the pool, circulated for a few hours and then re-opened (PO4).*

This quote shows how informing a member of staff allows the pool operators to follow the appropriate precautions, depending on whether the person who has had the accident is suffering from diarrhoea and vomiting, or whether it was an accident due to a non-infectious health condition. If someone has vomited in the pool because they had swallowed water, then the pool operator would not close the pool as long as the swimmer could confirm they had not been suffering from diarrhoea and vomiting prior to the swimming activity. Health Professional 1 also highlighted the importance of telling a member of staff about toileting accidents in the swimming pool:

*These days, um, we don't always manage to identify a faecal accident but we often suspect that there's been a faecal accident (HP1).*

This was in relation to outbreaks of cryptosporidiosis linked to swimming pool settings where there was an investigation to try to identify the source of cryptosporidium within the pool setting. As Health Professional 1 suggested, following investigations, it was deduced that a faecal accident in the pool water was the likely source of contamination. This shows the importance of swimmers and parents being aware of the benefit of informing a member of staff of a faecal accident in the swimming pool to protect the health of other swimmers in that water and to avoid the transmission of cryptosporidium as far as reasonably practicable. This finding can be better understood by applying the Health Belief Model in that the perceived benefits of informing a member of staff of a toileting accident in the pool outweigh the perceived costs (Rosenstock et al., 1988). For example, swimming pool users may benefit from being informed of the importance of alerting a member of staff to a toileting accident and being informed of the risks from non-identified faecal accidents in terms of outbreaks of illness. However, it has been identified that some swimming pool users may perceive risks associated with informing a staff member of a toileting accident, such as embarrassment and fear of repercussions such as being charged a fee. Understanding these perceived benefits and barriers, in addition to some



perceived risks (such as being charged), to informing a staff member of a faecal accident can help develop cues to action to change swimming pool users' perceptions that the risks outweigh the benefits of adopting this specific health behaviour. Relating to faecal accidents in swimming pools is the awareness amongst swimming pool users of pathogens and other microorganisms that can survive in the pool water. Seven swimming pool users, from 18 interviewed, reported that they were aware that there could be 'bugs' in swimming pools, but only one knew what cryptosporidium was:

*Well it's a parasitic organism and it's spread in water and it gives you diarrhoea among other things and it's spread. Um-- just ordinary tap water you can get it from it if it haven't been treated properly...Well it's transferrable and it can give people upset stomachs and diarrhoea and vomiting (S2, female, unknown).*

This shows how occupation can affect people's awareness of hygienic swimming behaviours and cryptosporidium. Three swimmers stated that they were aware that there could be 'bugs' in the swimming pool water, but they preferred not to think about it:

*Not, I don't know names but I know they're all bugs that live in there but I don't know the name of them...No, blissful ignorance...Don't need to know what's in there. I know there's chlorine in there and it keeps it clean (S14, male, 25-64).*

This participant talked about 'blissful ignorance', which could mean that he might take unnecessary risks. This connects to this participant's earlier quote about going swimming if he were suffering from diarrhoea and vomiting. Swimmer 14 had assumed that chlorine kills all the bugs so there is no risk to them from the swimming pool water. Rosenstock et al.'s (1988) Health Belief Model helps us to understand how their perceived risks affect their behaviour. It can be assumed that Swimmer 14 perceives the severity of swimming in water that may contain pathogens to be low. Again, this highlights how changing individuals' perceptions of the perceived severity of acquiring cryptosporidium, particularly for those who may be immunocompromised, may be beneficial to promote hygienic swimming behaviours.

Four participants mentioned that they tried to avoid swallowing the pool water, but they did not state that this was because of 'bugs' in the water. The reasons they gave varied:

[laughs] I-- You know really it's because-- I think because what's in the pool. Not so much the hygiene but it's, like, what, the chemicals are in the pool...right? To keep it clean (S5, male, 18-24).

Well you choke. Yeah, that's the only reason...I don't think about what's in the water (S14, male, 25-64).

Um, I don't like the taste...Um, I don't really like the idea of, you know hundreds, of thousands of people having been in the water before me, you know? (S13, female, 25-64).

Like you got the chlorine in there, you dunno like you dunno who's in there, you dunno what...could be floating around or what if the chlorine isn't up to uh, certain levels...you dunno what you could be catching, plus chlorine isn't good for you (S8, male, 25-64).

The quotes from Swimmer 5 and Swimmer 14 suggest that some people are not concerned about pathogens in the swimming pool water which can cause them to become unwell but are more concerned with the effects that chlorine has on their health or about choking. Also, Swimmer 14 highlights how some swimmers may be in a state of denial, as he did not like to acknowledge the bugs which may be in the swimming pool water. This again can be attributed to the Health Belief Model in terms of perceived risks (Rosenstock et al., 1988), with some participants perceiving chlorine to be more of a health risk than the pathogens in the swimming pool. However, Swimmer 13 and Swimmer 8 do highlight that high bather loads in the swimming pool water can introduce matter into the water with which they would want to avoid contact, particularly the avoidance of 'catching' illnesses. Therefore, their perceived risks would be different from those of Swimmer 14. This demonstrates the need to address swimming pool users' perceived risks of unhygienic swimming behaviours and perceived benefits of hygienic swimming behaviours. However, as mentioned, Swimmer 13 shows how swimmers may already be aware of the risks from pathogens in the swimming pool water but choose to perceive these risks with low severity and susceptibility, and therefore, addressing these perceptions may not always be enough to change an individual's behaviour.

Cryptosporidium is resistant to normal chlorination levels, and it is evident that many swimming pool users may not be aware that chlorine does not in fact kill all pathogens (PWTAG, 2017). It was evident that cryptosporidium was not a commonly known term amongst swimming pool users, which is of concern due to the parasite's public health significance. Many participants who were not aware of the term assumed that cryptosporidium

was either a “pool bug” or “something that could cause illness”. If they do not have the knowledge about public health implications and risks from cryptosporidium, then they may not follow hygienic swimming behaviours (Rosenstock et al., 1988).

As is apparent from the findings presented above, awareness of hygienic swimming behaviours varied amongst swimming pool users. There was some indication in this section that hygienic swimming behaviours are linked to routines, habits and beliefs. This will be discussed further in the following section.

#### 4.4.4.1.2. Habits, Routines and Beliefs

While exploring hygienic swimming behaviours, there were five participants who raised beliefs as an influence upon their behaviours, while 3 participants mentioned that following hygienic swimming behaviours were a part of their habits / routines.

One pool user suggested that following hygienic swimming behaviours was part of her swimming routine:

*Yeah, you know I did, I don't know, sound goody-goody because I have a shower every time, but it's just-it's just habit...It's just what I've always done...(S11, female, 25-64).*

This relates to theories around the persistence of healthy behaviours so that they become routines and part of everyday life (Aunger, 2007). Therefore, for hygienic swimming behaviours to be adopted, they must become part of the swimmers’ routine at the pool setting.

One participant suggested that it is the responsibility of swimming pool users to help keep the pool water clean and healthy:

*I don't know. You c-, at the end of the day you're always gonna get someone who is gonna say, "I don't care what anyone says. I'll do what I wanna do"...And it's a-and I suppose it's not law, is it?...So someone can quite easily turn around and say, "Sorry, no, doesn't matter what you tell me, I'm right. I'm not doing it"..Yeah, yeah, I think we've all gotta take a bit of responsibility for keeping the – keeping the pool as clean as possible... You know, and not just the pool itself but the whole building as well (S16, female, 25-64).*

This shows that she may have an internal locus of control (Rotter, 1966), such that she feels that her health is her own responsibility. An individual who is said to have an internal locus of control believes that they have control and responsibility over situations that affect them.

However, an individual with an external locus of control is said to believe that they have limited control and responsibility over situations that affect them (Rotter, 1966). Swimmer 14 demonstrates an external locus of control by suggesting that it is the pool operators' responsibility to ensure that the water is kept hygienic:

*I assume that whoever's running the pool is keeping it clean...Whether through chlorine and other chemicals and things (S14, male, 25-64).*

This could suggest that those with an external locus of control feel that they do not need to follow hygienic swimming behaviours, as it is the responsibility of the swimming pool operator to keep the water clean and healthy (Rotter, 1966). Indeed, this swimmer was the exception who said that he swam even if feeling unwell, demonstrating an external locus of control, as he did not perceive it to be his responsibility to reduce the transmission of potential pathogens within the swimming pool. Another participant attributed her immunity to swimming in a 'bacterial soup':

*But I've swam here for over 30 years practically every day...You know, I've- I've never had any illnesses from being in this pool and I don't think this pool is very clean... However, I don't think that's such a bad thing...In people who've got good immune systems...If you got um, a poor immune system through debility of disease or diabetes or something, it may not be quite so good... Well, no. I think something has got more benefits than dis--unbenefits in everything. You know the risk of cryptosporidiosis from this pool is pretty low...I think. You know I've never had it. I don't know anybody who's ever had it...Well, I've- I've never caught anything-- The only thing I've heard about is people with the ears that's immune infections from the pool...But that's something to do with the anatomy of the ear coz the ear canal isn't straight, you know, bugs get caught in there...But I --You know, I'm-I-I've always attributed my, umm, good immunity to kinda swimming in a soup with bugs...Like give me a nice, low grade vaccination to most things (S2, female, unknown).*

This participant suggested that it is beneficial to swim in an environment with bugs. This was based on her belief that she had developed an immunity to certain illnesses due to being exposed at a low level and had not developed any illness associated with swimming in the pool water. This belief can be explained by the HBM (Rosenstock et al., 1988) in relation to this swimmer's perception of the risks. She believed that it is of benefit to have pathogens in the swimming pool water, rather than believing that pathogens in the water present a health risk for those swimming in it. This swimmer was aware of cryptosporidium, as discussed previously, but it is evident that she did not fully understand its transmission in swimming pools, and therefore did not see a risk of contracting cryptosporidiosis from the pool water.

As discussed, the Health Belief Model is also important when seeking to understand internal influences on hygienic swimming behaviours (Rosenstock et al., 1988). This model helps to aid understanding that behaviours are dependent on the individual's interpretation of information (Jones & Douglas, 2012) and that perceived costs and benefits have an influence on health actions (Rosenstock et al., 1988). Although raising awareness of hygienic swimming pool users could be beneficial, this may not always result in the desired healthy behaviours. For example, swimming pool users must be aware that the benefits of following hygienic swimming behaviours greatly outweigh the costs involved (such as swim nappy costs, extra time to shower beforehand, etc.) In addition, it may be difficult to convince someone who thinks that swimming in a "bacterial soup" is more beneficial to them. In this instance, providing explanations as to why hygienic swimming behaviours are important may be beneficial to change the individual's perceived benefits and costs to result in a change in attitudes and behaviours (Rosenstock et al., 1988).

The internal influences discussed in the section can also be interpreted by applying the Socio-Ecological Model (McLeroy et al., 1988). This will be discussed in more depth at the end of the chapter.

The next section provides information on the second sub-theme developed from thematic analysis of the data.

#### *4.4.4.2. External Influences*

It was evident from the data that hygienic swimming behaviours were influenced by external factors. Two categories under this sub-theme emerged from data analysis, namely culture and current educational materials to raise awareness of hygienic swimming behaviours. The first category presented is culture.

##### *4.4.4.2.1. Culture*

Health may be viewed differently by various individuals, communities, or cultures (Bhopal, 2014). Therefore, it is important to understand that hygienic swimming behaviours can be interpreted differently in various communities and cultures. Culture may be defined as "the set of distinctive spiritual, material, intellectual and emotional features of society or a social

group... [which] encompasses, in addition to art and literature, lifestyles, ways of living together, value systems, traditions and beliefs” (United Nations Education, Scientific and Cultural Organization, 2001).

One Health Professional specifically mentioned that culture had an influence on hygienic swimming behaviours:

*I think your PhD should fund you to go to a Scandinavian country to -- It is actually quite -- it's a hell of a, you know, like I said I went to Norway, went to a public swimming pool there and you know, not a word of a lie, I did not see a single person go through that changing room without totally getting naked, proper, you know, shampoo, shower-- and, shower gel, shower, then in to the pool. They are very, very hygiene orientated...And then you come back...Well, and I would equate it to sharing a bath with someone, really...Would you want to share a bath with them?..[laughter] You can swim in a swimming pool with them? [laughs]. And I mean you know so, um, yeah, no, I think, it's interesting (HP2).*

It is evident that culture can influence people’s attitudes and beliefs, and, in turn, their behaviours. Stein and Rowe (1989) explain that culture is a learned behaviour conveyed from person to person and from generation to generation. This shows how hygienic behaviours can be learned from others. Parents’ influence on hygienic swimming behaviours was highlighted by five swimming pool users:

*Yeah. Like all like all children should be taught hygiene...um with my little girl now, when she goes to the toilet, I've taught her now she needs to wash her hands when she's been to the toilet...so she's now getting into that habit now that when she's been to the toilet, she'll automatically go and wash her hands...coz then they're gonna be brought up then um, it's not gonna be like a last minute....like have a shower before you go and explain to 'em why...you're like taking them into the shower before going in explain to them why they're washing their hands. So hopefully then they'll like get into habit of doing automatically (S8, male, 25-64).*

He suggests that if children are taught these behaviours at a young age, they are more likely to follow hygienic behaviours routinely.

Three pool operators believed that parents were not aware of hygienic swimming behaviours or cryptosporidium:

*Um, nine times out of ten it's possibly a child rather than an adult, but these accidents do happen, um, which as a swimming instructor I've experienced with mom or dad, not forcing, - their child to come to swimming lessons because their tummy is upset, but the child has complained of a tummy upset. Mom and dad doesn't wanna miss the swimming lesson for their child coz they've paid for it and that's their sort of time, I don't know, time away from child to read a book or do some shopping or whatever...And they've dropped off their child and lo and behold then that child is had an accident in the pool. Uh, however the, um, the initial, the initial illness was already given to the parent and child, uh, parent and, uh, before the lesson and...It's too late and it's already been introduced then into our pool (PO3).*

This suggests that parents can influence their children into following unhygienic swimming behaviour, such as attending swimming if suffering from diarrhoea and vomiting. This can then become a learnt behaviour in which the child believes that there are no health risks or consequences to swimming whilst symptomatic. Bandura's (1977) Social Learning theory suggests that children learn from observation and suggests that they can be influenced by individuals, especially 'role models'. Therefore, their parents' attitudes and beliefs towards hygienic swimming behaviours could in turn influence the child's behaviour in relation to hygienic swimming. However, if parents are not aware of hygienic swimming behaviours, then they cannot pass this information on to their children:

*So these are obviously certain things you've just told me now that I wouldn't have known today... And maybe in a few years my son could have been coming home and telling me (S12, male, 25-64).*

This suggests that Swimmer 12 would not be able to influence his child, as he was unaware himself. Interestingly, this participant also highlights the influence children can have on their parents in terms of hygienic behaviours. Health Professional 1 also mentioned this:

*I mean certainly having seen with my own children when they had the hand washing interventions at school...My-my kids were like the hand washing police when they came home (HP1).*

It can be seen that children can have an influence on their parents too. By contrast, Swimmer 1 suggested that their parent did not influence them regarding the behaviour of pre-swim showers, but that she did shower before swimming now, later in life:

*And like I never used to shower as a kid. I didn't know that it was important. My mum didn't used to make me shower (S1, female, 18-24).*

This suggests that although parents can have a positive influence on hygienic swimming behaviours, there may be other influences that encourage individuals to follow healthy practices. This can be explained using the application of Bandura's Social Learning Theory (1977) and the influence of role modelling. Social Learning Theory states that new behaviours may be learned by observing the behaviours of others. It is said that individuals will then imitate this new behaviour, purely based on observation, without other influencing factors.

Bandura (1977) suggested that there were four stages of behavioural learning, firstly by observing the behaviours of another person. The next stage involves remembering the behaviour that was observed and the third stage comprises imitating the observed behaviour. The final stage of the Social Learning Theory states that people must be motivated to imitate the observed behaviours (Bandura, 1977). Although the application of this theory is useful to aid understanding, it is important to note its limitations. This theory focuses on the environmental influences upon behaviour and does not take in to account the interaction between nature and nurture. Therefore, the theory cannot provide a full explanation for all behaviours (McLeod, 2016).

In relation to the influence of others on behaviours, a small number of participants suggested that if other swimming pool users showered, they would be more inclined to do so:

*Because I say, I- I know my peer group, eight or nine of us swim in the morning...Um, I know full well four or five us blokes walk into the changing rooms, we're chatting away, we change and head in the pool and we haven't showered...And I suppose if- if, if I were to say, you know, probably the next week or whatever because you spoke to [name] last week, didn't you?...If- if- if we walked in and said, "Listen, you know, we, we need to have a shower boys", the other boys would be like "alright, we'll do it."...I can't imagine there being an objection to it. It just, just something, it's a routine thing, isn't it?...If- if- if peer, if a person peer pressure -- and I'm not using pressure in an intense sense...Something simple like "come on boys, let's have a shower", people probably would...So I think it's, you know, uh, it's people would just influence people, wouldn't they now? (S4, male, 25-64).*

This can also be explained by Social Learning Theory, whereby encouragement from peers can influence one's behaviour (Bandura, 1977). However, in some instances, it is evident that peer influence does not encourage swimming pool users to follow hygienic swimming behaviours. For example, seeing others showering does not always result in others feeling that they should conform to social norms and shower themselves, as indicated in the following quote:



*Um, I see some people showering before going in, um, but I don't really take too much notice but I have seen some people showering. But then I also see people just walk in in front of me as well, so, um, I won't be able to say how many that is (S17, female, 18-24).*

As previously mentioned, Swimmer 17 did not shower before swimming, as she did not believe she needed to do so. This may be understood in relation to the HBM (McLeroy et al., 1988) in terms of swimming pool users having the information they require to make an informed decision about whether to shower before swimming and knowing that it is a healthy behaviour which should be followed. It also relates to social norms: informal understandings within a certain community about expected behaviours within that community (Bandura, 1977). It is believed that unhealthy or risky behaviours may be socially frowned upon, and therefore the healthy option is enforced by informal understandings (Cialdini & Trost, 1998).

One participant specifically stated that he would seek to influence his peers:

*I'd actually read it and then to any of my other friends then who go swimming I'd actually, say, give them a leaflet, get them to have a look as well (S8, male, 25-64).*

This shows how information regarding hygienic swimming behaviours can be passed from one individual to another. In the context of Social Learning Theory (Bandura, 1977), this individual would try to encourage his peers to read a leaflet to seek to encourage healthy swimming practices.

From discussions with participants regarding a toileting accident in the pool, it was evident that staff would be an influence upon whether someone would inform them of the accident:

*Yes, I do. I-I don't think you need to um, it's har-it's obviously an embarrassing enough situation as it is. And, you know, and it happens and it's not the end of the world. So, the way you react is very important. You know...you, you know, you must be professional...that's the thing. And you mustn't, you know, you be grateful the person has actually come up and told you, because, obviously, the other side of the coin is that they wouldn't bother and um, you know, it could be a hell of a lot worse...So yes, you – you definitely the way you – you react to that would ha-would have to be professional...Yeah, and then, you know, parents don't feel, you know, public don't feel then that they're embarrassed and they can feel that they can approach you, so your attitude is very important (S13, female, 25-64).*

Swimmer 13 was interviewed as a swimmer/parent of a swimmer; however, she did mention during the interview that she had worked as pool operator some years ago at a holiday park. She highlights how during her time as a pool operator, she was grateful if a pool user informed

her of a faecal accident within the pool so that the staff could carry out the remedial actions necessary in a timely manner. Swimmer 13 also highlights that staff can influence whether swimming pool users inform them of a toileting accident by reacting in a positive way and being understanding. This links to previous discussions in relation to swimming pool users' perceived repercussions of a faecal accident in the swimming pool, in terms of a fear of a negative reaction from staff members.

No swimmers said they were directly influenced by the staff at the swimming pool setting, but a high number of them reported that staff could have an influence on whether people informed staff of a faecal accident in the pool. Health Professional 1 highlighted how staff influence swimmers' experience:

*I've-I've been in a pool, excuse me, where there was an accident and it took an extraordinary amount of time for the operators to get the clean-up kit...It just seemed to take forever...And it was a solid stool...But so I was sort of in the pool trying to get, keep people away from it...while the pool operator vanished. Well how long does it take to get a scoop and a bucket? It's- No. They obviously couldn't find it (HP1).*

This suggests that staff need to react in a timely and positive manner in order to encourage swimmers and parents to inform them of a toileting accident in the pool water. All pool operators reported that staff can influence hygienic swimming behaviours:

*Yeah. Well, as part of the lifeguard training as well, th-they're asked to observe bathers when they come in...Um, and if they think that someone's got a nappy on, then there to question it with the member of the public...Um, because obviously the nappy isn't suitable...At all because it-it retains the water and the gel expands and it just bursts, really. So—(PO4).*

Social Learning Theory can be applied to interpret this finding, in that individuals may observe staff reacting unhelpfully to a faecal accident in the pool, and may learn that informing a member of staff would not be a positive experience (Bandura, 1977). On the other hand, staff can have a positive influence on behaviour if they are observed to be knowledgeable and helpful in relation to all hygienic swimming behaviours.

The next section will discuss the current educational materials identified from the interviews and from fieldwork in order to understand the current efforts to raise awareness of hygienic swimming behaviours.

#### 4.4.4.2.2. Current educational materials for hygienic swimming behaviours

The findings provided evidence of the influence of existing educational efforts provided in swimming pool settings on hygienic swimming behaviours. If swimming facilities are not providing information to their users, swimmers are not able to make an informed decision about following the required behaviours (Rosenstock et al., 1988). Seven of the eighteen participants stated that they had seen information of some kind regarding hygienic swimming behaviours in the swimming pool setting:

*I do remember reading it. There's a- there's a note on the door as you go into the, uh, the group changing room...So uh, yeah I have. I have seen that there actually (S11, female, 25-64).*

The quote above is a typical response from three participants who swam at the same pool. This specific pool (Swimming Pool E) had information in the form of signage in their changing room. All three participants stated that they had seen this signage, which shows that signage can work as a way of increasing awareness of hygienic behaviours.

From interviews with pool operators, it was evident that the current educational efforts varied considerably, from no information provided at all, to TV screens in reception, posters and leaflets. In some instances, there were signs in the swimming pool addressing hygienic swimming behaviours, but swimming pool users had not seen them:

*Um. And in all honesty, um, since, it's only from speaking to you that, thinking about meeting you today and what we possibly would discuss, that I was thinking, "Gosh, there's so much more we could do." Do you know, I think that we assume that people understand and we assume everybody's got common sense, but if you don't know something, you can't have common sense about it, can you? So I think that I think we're lacking substantially in the information that we give people, to be honest (PO1).*

Pool Operator 1 suggested that the swimming facility at which they are employed needs to do more to inform swimming pool users of hygienic swimming behaviours. Currently they were not providing any information in Swimming Pool A according to Pool Operator 1. Pool Operator 5 stated that there were signs in Swimming Pool C, but when I asked to see these signs they were not currently on display. The pool operator was not aware that they had been taken down.

Social norms would suggest that the swimming pool setting would benefit from a culture where swimming pool users help to keep the water clean and healthy. For example, if there is no indication that people should shower before going in the pool, it is less likely that this behaviour will be adhered to (Rosenstock et al., 1988).

As previously mentioned, there were no signs on display in Swimming Pool C encouraging hygienic swimming behaviours:

*There's no pool side, you know. Never-- In other places in Britain where I've been it says shower before you go into the pool...And it doesn't say that here (S2, female, unknown).*

This highlights that swimming pools are providing different levels of information to their users.

Interestingly, one pool operator did say that their current educational efforts included an attendant who asked people to shower before entering the swimming facility:

*Yeah, so a band control area, and that person would meet and greet everybody that comes in and check on their swimwear and the correct ratios entering...the pool to make sure that they've got the correct swimwear when they're entering in the correct ratios...We do ask everybody on the way in if they can, uh, just pop in the showers prior to going into the water and we check their swimwear (PO2).*

A band area is where the swimming pool user receives a band before entering the swimming pool to enable the staff to monitor how long they have been in the pool. This is to control the number of swimmers in the water at any one time. The pool operator explained that one of the responsibilities on this station is to check that all swimmers are wearing appropriate swimwear and to encourage them to shower before entering the pool. However, when I spoke to an individual who used this swimming facility, he stated that he had not seen any information regarding hygienic swimming behaviours and had never been asked by an attendant to shower beforehand. This highlights the importance of policies and procedures being implemented by all staff members.

Pool Operator 4 stated that they used the TV screen in the reception area of their swimming facility to display information regarding hygienic swimming behaviours:

*We've-We've got digital displays, um, there's one at reception, and that shows, um, like, the PWTAG um, poster...For hygiene, um. We've also got other various posters 'round the building, like in the changing rooms and on the entry to poolside...Yeah, it's mainly signs and all. Um, we have letters that go out, um, to pupils in swimming lessons...Um, and that's the start of every 10-week course. Just reminding them about, um, hygiene, um, and also, you know, refrain from use of the pool if they've been ill (PO4).*

This highlights the various means to deliver information to swimming pool users employed by some settings. The PWTAG poster mentioned in this quote provides basic information about steps to take to help keep the pool water clean and healthy. Although this was on display in Swimming Pool F, none of the three participants interviewed from this pool mentioned seeing the poster. As identified in the quote above, letters were being sent to swimming pool users when they signed up to lessons or to a class, and to schools who used the facilities. Three pool operators stated that this was a current practice:

*We have leaflets. We've, we've just put together now 5,000 leaflets. Uh, we cater for a lot of school swimming for national curriculum before they go into uh, comprehensive school. And were, um, our trainer, our-our swimming teacher now is um, in-in-in have the leaflets. Um, from, I don't know where they come from now. I did have them last year, and we've just revamped them for-for-for our facility, um, for this council, sorry. Um, we're-we're delivering them out to-to the primary school children to take home. One, I don't know whether they take them home to show their parents but we're um initiating it by hand-- actually hand delivering to the child when they leave the swimming lessons on this information. And, it's a fun sheet in a way. It's got like a cartoon-based type of character, um, stating about the pros and the cons and if you've got an iffy stomach don't swim 48 hours and all that sort of stuff. So um, it's quite a fun leaflet which hopefully they have taken home and their parents have, uh, have read it as well (PO3).*

This shows that some swimming pool facilities are trying to target parents specifically by giving information to those who have children in swimming lessons or attend through their school. It is evident that schools support the delivery of many public health interventions to improve children's health (Segrott & Roberts, 2019). Thus highlighting how schools could be utilised to raise awareness of hygienic swimming behaviours.

All the Health Professionals interviewed stated that information was given to swimming pool users on a reactive basis. This occurred when there was an outbreak at a swimming pool setting and a press release had been issued to inform people of the importance of not swimming whilst suffering from diarrhoea and vomiting, with an emphasis on exclusion periods too. Two Health

Professionals said that information is provided to swimming pool users when they have been ill with cryptosporidiosis:

*Um, for the full range of organisms we tend to have a-a batch sheet of records of, um, sorry not records of advice documents...Um, often now, they're-- they are Public Health England based, uh, typically, but they can't guarantee they all are. In the case of crypto, I can't think off the top of my head exactly what the reference source is but, uh...we tend to have our finger on the most appropriate document to hand and they are evolving all the time – you got to try and keep on top of that, but, uh, yeah, it's normally, um, public health body based, uh, yeah...Yeah, we would always give them, uh, the minimum the two-week, uh, exclusion period after, um, cease of, uh, symptoms cease. So yeah (HP4).*

This suggests that most people receive information regarding infection control on a reactive basis – once they have already contracted cryptosporidiosis and have been provided with a diagnosis from their General Practitioner. This shows that information is reaching people too late, potentially resulting in more people contracting cryptosporidiosis from contaminated swimming pool water. Rosenstock et al.'s (1988) HBM aids in the understanding that people may not perceive swimming whilst infectious as being a risky health behaviour, and therefore may not feel the need to avoid swimming while they are ill.

The influences on hygienic swimming behaviours discussed in this section can be understood by applying Social Learning Theory, whereby people learn from each other (Bandura, (1977)). Therefore, it is important to create a culture where hygienic swimming behaviours are the social norm (Naidoo & Wills, 2016). For example, it is hoped that showering before swimming will become a social norm.

It is evident that there are internal and external factors which influence hygienic swimming behaviours, as discussed under this first theme. During the analysis, it became apparent that there was a specific external influence which influenced hygienic swimming behaviours, namely the design of swimming facilities. This theme will be discussed in the next section.

#### 4.4.5. Theme 2: Design of Swimming Facility

The second theme which emerged from the thematic analysis was the design of the swimming facility, which included three categories: convenience, accessibility and cleanliness. It was found that these three aspects can each influence hygienic swimming behaviours. These are discussed as this separate theme, as they are related to the physical design of the swimming facility, which is outside the control of a swimming pool user.

##### 4.4.5.1. Convenience

While discussing awareness of hygienic swimming behaviours with participants, and why they are or are not followed, it became evident that convenience played a role. For example, the location of pre-swim showers could affect swimming pool users' decision to take a shower before swimming:

*The way it's constructed, the shower is at that end...So you'd have to go that way, you know, come back. The-the lockers are at that end...It's just inconvenient...People in a hurry, they're not gonna do it...You know what it's like, don't do anything unless they really have to (S2, female, unknown).*

This was the only swimming pool that was designed in this way (Swimming Pool C). The other five pools were designed so that the showers were either near the entrance to the swimming pool from the changing rooms or were at the side of the pool itself. The Pool Operator for Swimming Pool C also highlighted this issue:

*So I mean the difficulty for us is that the showers are at the opposite side of where you come in...So you literally, where you walk in, you know, the locker rooms the showers are the other end, at the opposite ends...Which isn't really good design...It would make sense the uh showers are by the entrance so you've actually got-you can jump in the shower before you get in the pool and...Shower on the way out, it's a bit of a-cause it was actually 19-1963 this one was built...And it's been tweaked around and updated, but unfortunately it's left us the showers in the wrong place...So it's always gonna be...A bit of a difficult one- [crosstalk]...it's not a natural process...To get changed, walk past the showers before going into the pool...The showers are the wrong end, the male and the female (PO5).*

As reported, the showers in Swimming Pool C are the opposite end to the entrance to the swimming pool itself, with a significant distance between the showers and the entrance to the

pool. This highlights the importance of making it easy for people to follow hygienic swimming behaviours (Volpp & Asch, 2017).

Nonetheless, it is evident that if even the design of the swimming pool is convenient to support hygienic swimming behaviours, this does not necessarily mean that they will be adhered to. For example, if pre-swim showers are conveniently located, this does not always result in a swimmer taking a shower before swimming, as evidenced in the following quote:

*Um, not really. Um, I know that there's showers by the pool, um, but I usually only use those afterwards (S17, female, 18-24).*

This suggests that pre-swim showers require signage to make swimmers aware of the need to use them. This can be understood by applying the Health Belief Model (Rosenstock et al., 1988) in terms of users' perceived benefits of having a pre-swim shower in comparison to the risks of not showering before swimming. If they are not aware of this information, then they will not know the perceived risks. In addition, the application of the HBM aids understanding that cues to action, such as signage to remind swimming pool users to shower before swimming, can help to promote this behaviour. On the other hand, Swimmer 3 highlighted that he was aware of the importance of showering beforehand and he did believe that the design of the facilities could affect why swimmers do not shower before swimming:

*And-um the only thing that I don't do in complying with instructions here is that I don't shower...But-- The reason I don't shower, and the reason others don't shower, is that if you're familiar with the set-up of the pool...that when you change, when you walk from the showers to the pool, directly below there's a gate...And that gate is locked...So it doesn't allow you access to the pool. So, all the men, and this morning it was about surely six of us...We, no, nobody showered this morning...But I do notice that, um, when the later swimmers come, and when the gate is open, they-they enter the pool via the showers, and I see quite a few people showering...The-the-the-the design of the place as well doesn't help it, but I'm not saying- I wouldn't be saying honestly that I would shower...if the gate wasn't open...and I-I can't speak for others but I doubt if they would as well (S3, male, 65+).*

This quote shows how swimming pool users can face barriers, and that the design of the facilities does not actively encourage swimmers to follow hygienic behaviours, again supporting theories regarding making the healthy behaviour the easy choice (Volpp & Asch, 2017). Swimmer 3 also reported that even if the gate in this instance was open when he was entering the swimming pool from the changing room, he would not necessarily shower



beforehand. However, he did mention that he did not shower at the swimming pool because he had already showered at home before coming to the facility.

This swimmer swam at Swimming Pool A. The Pool Operator for this pool also corroborated his comment in terms of the design possibly affecting people's behaviours:

*I think what doesn't help here is possibly the design of the change rooms in that there's a- the male and the female entrance but then- and changing areas, but then the lockers is sort of in the middle of both of those, and past the lockers there's the door that's open that leads on to poolside. So people put in their stuff in the locker and automatically walk onto poolside. Very few people that move back around, shower and come in the other way. It's always showering after you use the pool to get the chlorine off (PO1).*

This highlights again how the design of the swimming pool needs to be convenient to make it easy to follow hygienic swimming behaviours (Volpp & Asch, 2017).

#### 4.4.5.2. Accessibility

Another issue raised regarding pre-swim showers was that they were not very private. Although they were conveniently located, some swimming pool users stated that they would prefer them to be more private:

*It's purely because I feel like they're not very private and like if you have got children with you it's kind of difficult to shower them in front of like everyone if it's really busy...And I know children can be quite shy sometimes...I think the convenience is there, like you know they're on the poolside but like I don't know if it's was quite busy, um it's not really nice to have to shower on the side of the pool in front of everyone...No. Not particularly, so it's convenient but it's not private at all (S10, female, 18-24).*

This finding highlights the issues around accessibility of swimming pools. Two swimming pool users mentioned that sometimes the showers did not work at all, or did not work correctly in terms of being cold:

*Coz sometimes the showers aren't that great, you know, there's some-- the-the showers weren't working for a while...or the pump wasn't working for a while. Showers downstairs don't work at all at the moment...So sometimes showers aren't that great (S2, female, unknown).*

Swimmer 2 swam at Pool C and Swimmer 14 swam at Pool B. This can be interpreted in relation to the Health Belief Model in terms of perceived barriers (Rosenstock et al., 1988) and swimmers not following hygienic behaviours. If swimmers perceive the showers to be in poor working order, then they may not shower beforehand, as they do not think they work.

It is also important to note that the swimming facility should ensure accessibility to allow all swimming pool users, including those with disabilities, to follow hygienic swimming behaviours:

*They do say to have um a shower before hydro but I will say that we don't...go in the shower before hydro...Hydro's in [location].....Um, well the shower's on the other side of the pool...so you've got to walk past the pool and because of [name]'s walking...it's a long way to walk to the shower and then back to the pool...and it's a lot of hassle (Swimmer 1, female, 18-24).*

Swimmer 1 is highlighting here how important it is to make it easy for swimming pool users to follow hygienic swimming behaviours. The design of the swimming pool should facilitate pre-swim showers for all swimming pool users, ensuring that showers are in a convenient location for all types of user.

#### 4.4.5.3. Cleanliness

The cleanliness of the facilities was also highlighted as a barrier to following hygienic swimming behaviours:

*And the hygiene in the toilets here is poor...It's poor. It-- To be quite honestly, it stinks...It was stinking this morning... it is akin to a pub, a pub toilet...But the sinks here in gents are filthy...I don't think- I don't think they've been cleaned for weeks...Yeah in addition to that you'll find that twice I've reported it, whereby it's either the toilet system or the urinal is leaking...and even if you go back a fortnight ago, what happened whether it's the toilet, or whether it's the urinal and then the water seeps on...to where we walking in into the showers (S3, male, 65+).*

This highlights the potential for cross-contamination of pathogens from the toilet facilities into the swimming pool (PWTAG, 2017). The swimming facility, including the changing rooms, is required to be clean so as not to contribute to the contamination of the pool water (PWTAG, 2017). For example, if the changing rooms and toilets are not clean, there is a high risk of transferring pathogens from that area into the swimming pool. All facilities provided could be

presented in a way that encourages hygienic behaviours: for example, ensuring that they are clean, with no opportunity for cross-contamination, and encouraging hand washing practices. The Pool Operator for this setting was interviewed before the interview with Swimmer 3. Thus, the issue of who was responsible for cleaning the toilets was not explored.

Putting measures in place to assist with making it easy to follow hygienic swimming behaviours is important and should be considered at the design stage when constructing or renovating a swimming facility. As discussed, if swimming pool users face barriers to following hygienic swimming behaviours, it is unlikely that they will follow such behaviours (Volpp & Asch, 2017).

There is a focus upon ensuring that all individuals in our society can use swimming facilities without facing barriers and further widening health inequalities. Therefore, it is important to ensure not only that the design of the facility not only helps to facilitate hygienic swimming behaviours, but also that these behaviours can be followed by all swimming pool users.

This theme identifies the importance of planning policies that can influence hygienic swimming behaviours by ensuring that pools are designed to encourage and support hygienic swimming behaviours. To help promote hygienic swimming behaviours at these facilities, education for swimming pool users was identified as the third theme and will be discussed in the next section.

#### 4.4.6. Theme 3: Education for Swimming Pool Users

The third theme which emerged from thematic analysis was education of swimming pool users. Two sub-themes were identified from the analysis: means to raise awareness of hygienic swimming behaviours and credibility and trust in public health interventions.

##### 4.4.6.1. *Means to raise awareness of hygienic swimming behaviours*

This section discusses how participants would like to receive information regarding hygienic swimming behaviours. Within this sub-theme, six categories were identified: content of the intervention, cryptosporidium-specific versus general messages, formats for health interventions, means of delivering interventions, target audience, and intervention frequency.

#### 4.4.6.1.1. Content of the intervention

The content of the messages provided to swimming pool users and their delivery were discussed by many participants. Most stated that it would be best to keep the information clear and concise, and to be clear about what is meant by hygienic swimming behaviours, as illustrated below:

*I think it is actually really vital that you are quite clear, because everybody else is uh, you know, people's interpretation of an instruction is very different...And, you know, everybody's idea of a suitable level of cleanliness is different, as well...and, you know, no disrespect to anybody but obviously, I think if you think you can make it perfectly clear that this is what is expected before you enter the pool or, you know, should you be ill, this is what is expected, you know, this is what we recommending that, you know, you don't come um, before you're better, that kind of thing. You have to be really quite clear...You know, I'm not I'm not saying that people are um, yeah, some people do ignore it....so I think yeah, you would have to be quite clear and I think a detailed explanation as to why, is a good idea. Coz maybe they don't realise...you know, not everybody is-has got that common sense to think... "oh, you know, I might infect somebody else if I...come in" (S13, female, 25-64).*

For an educational approach to be successful, the information must be provided in a clear, concise format so that it can be fully understood by non-experts (Tones & Tilford, 2001). Three health professionals and three pool operators also mentioned that the information needed to be simple and easily digestible. A typical response from a Health Professional is included below:

*And again, I think it's language...how we talk. I mean, we talk about accidental faecal releases, but I really hope we don't use that message to the public...You know, need to talk about poop or...or whatever (HP1).*

While a typical response from the Pool Operators was:

*Um, no I think it would be good. So long as it can be put across, um, in a really sort of straightforward way...Yeah...That's simple to understand without lots and lots of information. I don't think people like to be bombarded with loads of information...So long as it could be put in – in a succinct kind of way, and yeah, to get the message across (PO6).*

Given the diverse range of people who visit swimming pool settings, it is likely that the swimming pool users will have different educational levels. Hence, a retainable message which is understood by all is important. Providing too much or too little information on hygienic swimming behaviours could disempower those receiving the message and might lead to an

unintended outcome – that the message is ignored (Naidoo & Wills, 2016). Health Professional 1 highlighted that using simple, non-scientific language is important when providing messages to the public. Two Health Professionals stated that the messages being provided should be consistent, especially across swimming pool settings in Wales:

*Yeah. On face value, I think, yes. Um, consistency is always best, um, certainly for the approach, you know, the-the-the public health protocols, obviously, they-they have to be consistent, I would say...In terms of disseminating and things like that it might come down to what people have available to them whether, uh, certain authorities and so forth are geared up socially, social media-wise, as others that may differ. But, um, yeah, I'm always one for consistency...I guess there could be differences in the- in the scale, could be a very small pool versus a very large leisure centre...so, I guess, you could take into consideration the operator themselves, their volume and so forth. But um, otherwise, I'd have to say, yeah...consistent is better, yeah (HP4).*

This supports what has been highlighted previously in this chapter in terms of the influence that health literacy has on hygienic behaviours. Three swimmers reported that it would be important to tell swimming pool users exactly what they needed to do:

*And just maybe like to tell people what exactly to do.... (S1, female, 18-24).*

As mentioned previously by Swimmer 13, providing explanations to swimming pool users was also highlighted as important:

*Like I didn't know about the chlorine, so if that was explained to me, then that would definitely change my view on showering before going in, yeah (S17, female, 18-24).*

As discussed previously, Swimmer 17 did not shower before using the swimming pool. Therefore, giving the reasons behind why hygienic swimming behaviours are important and how they affect the swimming pool users can potentially lead to a change in behaviour. Providing advice to encourage swimming pool users to follow healthier behaviours and become more conscious of their responsibilities to help keep the water clean and healthy will be beneficial in promoting behavioural change. Many participants reported that providing explanations as to why swimming pool users needed to follow hygienic swimming behaviours would be beneficial. Swimmer 2 stated:

*That's their rules, this is this rules. I don't know what -- I don't know if it actually makes any difference...to the bacterial load that goes into the pool if you shower or not? (S2, female, unknown).*

Connecting to what Swimmer 17 said previously, explaining the benefits and reasons to shower before swimming may result in more people having a pre-swim shower. This was also true for Swimmer 10 in terms of understanding the reasons for removing make-up before getting into the water:

*Yeah, definitely. Because you just said like with the grease and the makeup in the pool makes the chlorine work better. Whereas I only take off my makeup so it doesn't clog up my skin in the pool. But now thinking about it, like it's a lot cleaner too...I didn't think of the chlorine really. I just thought it kept it clean no matter what...So like yeah, I think just knowing little things like that really does help...Um. So giving them a reason to do it is-- I think that would help a lot (S10, female, 18-24).*

This also links to comments from Swimmer 2 and Swimmer 17 regarding giving explanations to help swimming pool users to understand why following hygienic swimming behaviours is important, which in turn could lead to them changing their behaviour to follow healthier practices. Swimmer 5 also mentioned that giving explanations could encourage people to follow healthy behaviours:

*Yeah, it's always good to know the reason why-- behind why you're doing something, cos if you're doing it without the reason, you're just thinking, "Oh, well, you know, why do I need to do it?"..."Is it important to do it? Do I have to do it?" But if you know, obviously, the benefits of doing it and the 'why' you're doing it, then I think it helps a lot then (S5, male, 18-24).*

Therefore, it is evident that participants believed that being provided with information regarding the benefits and reasons for hygienic swimming behaviours might change their attitudes and beliefs about them, which in turn could result in a behaviour change (Rosenstock et al., 1988).

Swimmer 15 reported that she would benefit from being provided with information regarding the swimming pool itself in terms of cleanliness of the water and procedures:

*Even how they-how they clean the pool would be useful...Yeah, because sometimes we talk about what-what is in the water, you know. Is it chlorine, is it something else? How do-How do they clean the pool and how often do they do it?..Yeah, I think-I think that's-- Yeah, I think it's-I think it's quite important...Yeah...P-People would find it more interesting than-than the other thing, the...Yeah. Yeah. That we clean our pool...so many times a week and yeah. Yeah. That sort of thing...Because I'm always-- I'm quite interested in how often they-- I mean they do it-- They clean now for an hour...But I'm not aware of them cleaning again...I'm sure they do other things. Because you often see them with little vials, you know, they put it in the water and test the water...They do that-that regularly. But I don't know what that's about (S15, female, 65+).*

Pool Operators are required to monitor the levels of chemicals in their water, and most submit samples for bacterial testing to ensure that all levels are within the required parameters (PWTAG, 2017). I explained this to the participant, and she stated that it would have been useful to know this information, as she was concerned as to why they were taking the samples. Swimmer 15 did question whether there had been an incident at the pool, rather than being aware that swimming pools routinely sample their water. Swimmers 6 and 3 also mentioned that they believed this information would be beneficial. Additionally, Pool Operator 6 stated:

*Um, yeah, it could be a sort of, I suppose you could have a reassurance part to information and this is the steps that we do, so that you're sort of putting across well, this is what we're doing, this is what we need you to do, and then if we're all doing something then we're improving that, you know, that swimming environment and, you know, hopefully lessening the likelihood of any contamination (PO6).*

Pool Operator 6 also stated that this would be a good way to highlight the pool operators' responsibility, along with the responsibilities of the swimming pool users. Furthermore, one pool operator highlighted how some swimming pool users are not aware of how the pools are operated:

*And there's also a lack of knowledge in the general public cos we often get asked, um, "How often do you change the water?" Well that- as- yo-you will know, we don't...It's constantly cycled...But if you haven't got that knowledge, we-well, wha- how are you gonna empty the pool to deal with the poo?..The thought of the same water's just gonna turn be turned over, you obviously you need to have a conversation with somebody...In order to educate them- (PO2).*

This can be understood in regard to the Health Belief Model (Rosenstock et al., 1988) in terms of providing participants with information so that they are aware of the risks and benefits associated with hygienic swimming behaviours. For example, if someone was to be educated on how the swimming pool water is not emptied, but is filtered and circulated, they might

understand the public health significance of cryptosporidium. They may be more aware of the risk associated with cryptosporidium entering the swimming pool, the fact that chlorine is ineffective, and the reliance on correct filtration and backwashing procedures to remove the oocysts. This in turn may change their perceived risks and benefits in terms of swimming whilst symptomatic.

Swimmer 18 reported:

*Yeah, I think that would be good, like little adverts on how to prevent like, you know, how to prevent bugs and things. But again like in a friendly kind of way rather than be like "You need to do this." (S18, female, 25-64).*

This is highlighted in health education literature, which finds that health education efforts work better from a bottom-up approach, rather than a top-down approach. The top-down approach would involve health authorities, for example, telling swimmers at a population level what they should do to prevent illness. However, a bottom-up approach aims to empower individuals to follow healthier behaviours: for example, providing information at an individual level of the benefits of following hygienic swimming behaviours (Marathe et al., 2011).

Three pool operators and one swimmer mentioned that messages should provide information regarding the benefits of hygienic swimming behaviours:

*No, I think it would help. I mean I think educating the, you know, all the reasons why would be beneficial um for them to understand that the pool quality would be better, the air quality would be better. Because as, for our pool we've got chlorine, we've got a residual disinfectant which is chlorine...And as that acts on, um, bacteria and pollutants it does form other chemicals which are by-products which aren't so pleasant. Um. And it means you have to put more chlorine in the pool to combat those, and also they're given off into the air as well...Um. It can reduce your utility bills, it can reduce the amount of water you need as well in terms of, um, backwashing, um and because you're not backwashing as much of course you know, you're not having to heat the pool or work so hard to heat the pool. And, uh, you use less chemicals as well, and obviously less pollutants, less chemicals in the water, you know, makes it a much much, you know, a nicer environment for the swimmer...Definitely. It's healthier for you in all ways, not just because of the bugs, but also, you know, helping the planet as well in terms of less energy, less chemicals. Yeah (PO6).*

By contrast, two swimmers reported that it would be useful to inform swimming pool users of the consequences of not following hygienic swimming behaviours, a typical response is provided below:



*And I would put logos then if-if that would be the case. Logos, like a funny logo of um how it affects the pool, before they-- uh when they have the shower...This is what's going to happen if you don't have the shower, this is when you have a shower, it's right...Yes. So you-you got these, sort of, funny things, logos, "This is what will happen, if you don't if you have a shower."* Yes (S7, female, 25-64).

Interpretation of this finding can be supported using the Health Belief Model in terms of increasing their perceived risks of unhygienic behaviours (Rosenstock et al., 1988).

Pool Operator 4 stated:

*Yeah, I think mainly the risks. Um, and obviously, you know, just a little bit on the prevention because the prevention is so simple really so—(PO4).*

The pool operator suggests that increasing one's perceived risks will help result in a behaviour change. A Health Professional also highlighted the usefulness of telling people about the risks of unhygienic behaviours:

*This is the problem. And I know some, um, of them are very keen swimmers and their swimming club may not want to, uh, lose a couple of weeks but, um, as I said on the whole I think it's giving information, advice and educating them...as to why they shouldn't and the risk, uh, spreading the infection... I think to concentrate on the risk of the spread of infections is the way that usually that tips people over. They think, "Oh yes."...You could say, to them, "You could be-- Your child could pass it on to other people", and then 99% of people respond to that (HP3).*

Health Professional 3 also suggested that changing swimmers' perceived risk will aid in the desired behaviour change of not swimming if symptomatic. This health professional believed that being aware of how pathogens can be transmitted through the swimming pool water will help change their beliefs and attitudes.

Three swimmers specifically highlighted that the messages being provided to swimming pool users should not scare people or put them off swimming. Swimmer 15 reported that people should not be put off swimming:

*Yeah. I think you should say about-- All this about the pools as well. That, um, i-i-i-it's a healthy thing to do..."Everybody should do it." You shouldn't put them off, you know...you should be-- Yeah. Positive, yeah. But...you should-- Obviously you shouldn't go in if you're ill but...but it is a good thing to do...Makes you feel good...And it's good for your immune system and all the rest (S15, female, 65+).*

Although Pool Operator 4 mentioned above that swimming pool users should be informed of the risks of unhygienic behaviours, this respondent agreed that it was important not to scare people:

*...Obviously but not to scare people away from swimming and stuff...So, but just, you know, highlighting the risks really (PO4).*

This is supported by the Health Belief Model (Rosenstock et al., 1988) in terms of providing information to swimming pool users about both the benefits of hygienic swimming behaviours and the risks and consequences of unhygienic swimming behaviours. It is evident that some participants reported that swimmers should be informed that the benefits of hygienic swimming behaviours outweigh the risks. For example, the benefit of not swimming whilst suffering with diarrhoea and vomiting will outweigh the risk of not progressing in terms of their swimming skills due to missing a lesson.

#### 4.4.6.1.2. Cryptosporidium-specific versus general message

There were varied responses amongst participants as to whether they wanted to receive information specifically about cryptosporidium or whether they preferred a more general message regarding hygienic swimming behaviours. Three swimmers/parents of swimmers stated that it would be beneficial to know information specifically on cryptosporidium, whereas 15 swimmers/parents of swimmers believed that it was not and 15 swimmers/parents of swimmers reported that it was more beneficial to know what behaviours they could follow to help keep the swimming pool water clean and healthy. Generally, participants reported it would be ‘too much information’:

*Well I don't think, like I say, I think a lot too-too-too much information obviously is dangerous...I think if- if it is coming back to the point I made earlier, if this signage with instruction which makes people aware that if they maintain you know that level of hygiene and cleanliness simply you know by washing before going in the pool, you can avoid you know many instances. But if you start explaining things in depth like that for argument sakes or...calling with the with the technical names, that might scare a few people off or almost that and it would just did uh switch people off anyway...I suppose it's the simplicity of it, specifically the message- (S4, male, 25-64).*

Swimmer 4 reinforced what has previously been discussed in terms of providing people with simple messages and not scaring them. As discussed in the introduction chapter, swimming is a beneficial activity, and any efforts to raise awareness of hygienic swimming behaviours should not discourage people from attending the swimming pool.

All pool operators reported that informing swimming pool users of cryptosporidium has the potential to scare them:

*I think it's a general message. I think, we don't want to. We want to encourage people to swim...Coz that's the nature of business. We don't want to frighten people...Um, so we start sort of, uh, going on about that you know they'll take it as oh there's superbugs in the pool...And-and the last thing obviously is to put people off. We want, we want people to come swimming, we want, we want people, we want there to be, you know, a healthier, cleaner environment for them to do it. But obviously we can do our side of it (PO5).*

One pool operator stated:

*...Um, yeah, if it's only from, sort of, our point of view, you know. Operating the swimming pool would be, the more that knew about it, the better, to be honest...Obviously but not to scare people away from swimming and stuff...So, but just, you know, highlighting the risks really (PO4).*

Therefore, it was apparent that many participants from the different sample groups stated that it was important not to scare people. As previously mentioned, health education aims to empower people to make informed choices about following healthier behaviours (Nutbeam, 2000). It is well established in theories of learning that fear does not always result in the intended behaviour (Leventhal, Singer & Jones, 1965).

One swimmer highlighted:

*Well that's an idea, but not everybody in [location] can read: I found this to my cost, they cannot read...And they can't read big words like cryptosporidiosis...At times coming in. And there's, you know, there's [special needs school] and all sorts of come in as well (S2, female, unknown).*

This relates to previous discussions around health literacy and the importance of simple, clear messages regarding hygienic behaviours (Nutbeam, 2000).

Swimmer 17 said:

*Um, I dunno I suppose it's -- it would be good to people out there to raise awareness, and maybe people might act differently... Um, I wouldn't wanna know the ins and outs but I think it would be good to maybe have the information out there. So I think if people knew about the uh cryptospu- ...yeah, then uh maybe, yeah people would act differently... If they knew what was actually in the pool if they would have an accident so- (Swimmer 17).*

On the other hand, Swimmer 14 stated:

*Yeah, you don't need to know all these bug things is a bit... Over the top these days it's we live around germs everywhere. Everything you touch is covered in germs... So just get on with it. Have a few germs in your body... Yeah you don't need to know what bugs are available because otherwise where you draw the line in this. There are bugs on all the floors, bugs on the seating, on the coat pegs... Where do you stop?... It would irritate me... Because all I want to do is go there and swim... If I cared about the bugs, I wouldn't be going swimming... So it would probably scare me and irritate me. It wouldn't stop me (S14, male, 25-64).*

This is important, as it has been found that there is lower adherence to healthy behaviours if individuals are in a state of fear, resulting in avoidance of these behaviours (Leventhal, Singer & Jones, 1965).

Two participants – one swimmer and one health professional – did raise the issue that providing a general message would cause issues around the difference in exclusion periods:

*Um. Yeah. Yes, it is. Um, obviously, there's a big difference between two weeks and 48 hours... Um. Is that something you'd be aware you had without going to the doctor?... Um, yes, it is. I think th-the only thing is, you know, you sort of said it if-if you don't really know if you've-- you know if you-- you'll sort of like shouldn't go swimming for 48 hours or two weeks... Um, you know, you may think you're being-being good in not going for 48 hours. But actually it's-it's very difficult to know, isn't it?... If-if-probably you shouldn't have gone swimming for another um fortnight... Um, so there's-there's sort of a fine line isn't it between people doing what they think is right?... Um, and doing what probably should have done... Um, so it's-it's-it's a balance between that isn't it? (S11, female, 25-64).*

However, Swimmer 15 did highlight that this could be avoided:

*So you probably would've gone to the doctor anyway, wouldn't you?... And the doctor would've said, "You've got this or whatever so don't... you know, go swimming," so--? Yeah (S15, female, 65+).*

However, from personal experience working as a Communicable Disease Technical Officer for a Local Authority, it is not always the case that the doctor has provided the patient with information regarding cryptosporidium and the recommended 14-day exclusion period. It cannot be assumed that those with cryptosporidiosis would be aware of the 14-day exclusion: therefore this needs to be taken into consideration when drafting messages for swimming pool users about hygienic swimming.

One Health Professional highlighted:

*I think it's always worth raising awareness -- I mean, Campylobacter, uh message-- sorry, campylobacter, cryptosporidium – the messages are very similar to giardia and cyclospora. So you've got three pathogens there which kind of lump in quite nicely together there's others obviously as well, those three sitting – sit together quite nicely I guess (HP2).*

This Health Professional suggested that having a general message about hygienic swimming behaviour would be more beneficial, as these messages would also target the transmission of other pathogens in the swimming pool, such as Giardia and E. coli.

The ways in which hygiene messages could be provided to swimming pool users were discussed with participants and various options were suggested. An important aspect to consider is how the message is reaching the audience (Lasswell, 1948). The ways in which the message can be delivered to swimming pool users were also discussed and many options were suggested. The type and means to deliver information to swimming pool users discussed by participants are presented next.

#### 4.4.6.1.3. [Formats for health information and means of delivery](#)

The majority of participants suggested signage as the best way to provide information to swimming pool users. Various types of signage were suggested, including posters, logos and signs in various places in the swimming pool setting:

*...Coz I've often thought, you know if you go and you are um-- If you go to the loo in the services that they-they're always advertising something on the back of the door...whereas I've often thought here that would be an ideal opportunity to-to you know, put posters or notices or something...just to-just to sort of just remind people-remind people, um, about some of these-these different things...And coz, you know, say-- say you spend five minutes changing just any-it's, um, you know, it's-it's plenty of time to catch someone's attention. And...um, just give them a little bit more information really (S11, female, 25-64).*

However, it is important to note that a small number of participants – swimmers themselves, pool operators and health professionals – reported that people can become ‘poster-blind’ and would not take notice of the information:

*Um, it could be, you know, because there are so many different posters in swimming pools...Um, with all sorts of different guidelines and rules and things that...You know, maybe they, sort of, you know, don't pick out or they're not as eye-catching maybe as some other posters. So...You know. But the posters we do display have got pictures on them as well so...You know, you, sort of, like to think that that would catch customers' eyes a bit more (PO4).*

This highlights the importance of ensuring that posters are eye-catching in order to reach their intended audience. The need for poster to be eye-catching, of a good size and in a good location was mentioned by Swimmers 5 and 6:

*Yeah, it'd be nice if they would, um, and, just put the posters and stuff in places people are actually gonna see as well-- (S5, male, 18-24).*

*Um, uh size and brightness, probably. If it was quite large...You know, like with, um, just a, uh, straightforward message on the top to kind of make you go-- Make you look back at it, sort of thing (S6, female, 18-24).*

However, Swimmer 3 highlighted some individuals do not always follow recommendations from signage:

*...I suppose the more posters that are out, the better – the more people will take notice of it, but [pause] not everybody bothers, do they...you can put as many posters...up as you like, you know what I mean? We had an incident here in the pool a few years ago where a man, an adult man, dived in the swimming pool and- do you understand, there's plenty of posters about...That you shouldn't be doing things like that, but people – people don't listen, do they?..They think they know – that they know best, they think the more posters, the better (S3, male, 65+).*

This suggests that people do not always conform to recommended behaviours on posters and signs.

Health Professional 1 highlighted:

*I think one of the problems with the posters, you know there's some great posters out there but the problem is if they're in the swimming pool, people are already there... You know, I wonder how many people have actually gone away having read the poster...and thought, "Oh, I better not go swimming". Do people read it and sort of carry on anyway? (HP1).*

This suggests that information may need to be provided to swimming pool users in other formats apart from signage at the swimming pool setting.

Additionally, Health Professional 2 raised the issue that posters are not permanent:

*You know the proprietor wants to put a different poster, it's something different this week, I don't know, wear pink trousers week, or something -- I don't know, as a -- as a, uh, there's a health week for everything, isn't there?...So -- I mean, I don't blame them -- you know it will go down after a few years, but that's the problem, because you've got this, um, you know -- the official view of premises where it's things will go (HP2).*

From these findings, the frequency of raising awareness became apparent, as discussed later in this chapter.

Many participants stated that leaflets could be used to raise awareness of hygienic swimming behaviours, but only two swimmers stated that they would prefer a leaflet:

*I think I'd be more inclined to read a leaflet than I would a poster because you tend to just focus on what you're gonna do and...Yeah. Especially if you've got children as well. The last thing you want to be doing is stopping and reading posters, really (S18, female, 25-64).*

*I don't know. I suppose if you-if you're doing perhaps a course or something like that it would be perhaps good to put um, and it-- cause we get uh, uh-- like a little wallet with our receipt on it...They could perhaps put a sheet of paper in...for you know just to say, do this, this and this and why (S16, female, 25-64).*

Swimmer 16 highlighted an opportunity to provide leaflets to swimming pool users as part of the information pack she received when signing up for a membership or classes at the swimming facility. However, four swimmers/parents of swimmers specifically stated that they did not feel that they would find a leaflet useful:

*I may have done but if I had I don't remember and I probably wouldn't have read it anyway...Because it would have been given to me there and I'd go get changed and I'm not gonna sit there and read it before I go swimming (S14, male, 25-64).*

Swimmer 14 highlighted the issue of the timing of when the leaflet is distributed, stating that he would not be inclined to read a leaflet before entering the pool. This was also supported by Swimmer 13:

*Um, I think it might not be as well absorbed simply because when you're in the pool, everything's getting wet. Paperwork gets wet, you know, if you're-if you shove it in your swimming bag or something and think, well, I'll read it later, more often they are not. You'll get home, you'll unpack it out, and it's all got all mangled up in there anyway. So, I don't know whether that would be effective....Um, and also people tend to get a bit funny about having um, leaflets given to them. You know, if you have them on display, perhaps you might, if you're-you might do, I don't know if you would but um, you know, you might have a little look along the window ledge and if there's lots of different things you might take one or two, but then more often than not I think, you know, paper just tends to get wet in the pool, you know when you -- [laughs] (S13, female, 25-64).*

This can be associated with the bottom-up approach where swimmers are empowered to change their behaviour and educate themselves regarding hygienic swimming behaviours, rather than being given a leaflet they did not want.

A video to play using various avenues was also suggested by eight out of the 28 participants:

*And I think, you know you're on about posters and all, we've mentioned earlier, when we come in the morning the staff here turn on the TV see...and there's a TV- it's a TV basically advertising the gym...and whether it will be good to put something up there, you know, visual there...on the- on the screen...We're all tempted to look at the screens sometimes when something's on, don't we?...So whether that would be a good idea to get the message across that way? (S3, male, 65+).*

The use of a video could be beneficial, as it can capture and maintain the attention of an audience (Kickbusch, 2001) and is particularly suitable for individuals who learn best by seeing (Prichard, 2014). Pool Operator 1 also mentioned this:

*And the other, umm, I don't know how feasible this would be but definitely here, [location] and [location] have the screens in the reception area...The information screens that we put posters up about, umm, you know what's happening and all that (PO1).*

Pool Operator 1's perception also relates to Swimmer 3's comment: this participant swam at Swimming Pool A, where Pool Operator 1 is employed. There were various discussions on the types of interventions that could be used in the reception area, which included posters, handing out leaflets and printing messages on the backs of receipts. Some participants also suggested that reception staff could verbally inform swimming pool users to follow hygienic swimming behaviours.

Swimmer 9 suggested that a video could be played in the changing rooms:



*Whereas if it's, you know, like I say you can't get away from it, because it's- while you're getting changed or whatever... You gotta listen to it... I think it would be a good idea because that's-- a lot of people don't take time to read stuff, so I don't think a leaflet would be any use. But why not have a screen in the changing rooms that is showing you in a novel way... What, you know, can happen if you don't do the hygienic things... Um, because you know, especially if you got the audio, you're listening to it anyway... (S9, female, 25-64).*

This links to the issues raised when discussing leaflets, as participants reported that they would not read a leaflet before swimming, but would merely participate in what they were there to do – swim. The majority of participants stated that the changing room within the swimming facility would be a suitable place to provide information to swimming pool users using mainly posters. Swimmer 5 highlighted:

*I don't know. I mean, do you know what would be good? If you could watch a video or if there's like a screen in the swimming pool, I suppose it could just play like a slideshow and stuff... coz it's more interesting than just looking at the same poster... Yeah, probably, if it's-- At least if it's moving, it'll sort of catch their eye and they can read it, and so, yeah (S5, male, 18-24).*

This supports a point that was previously identified by pool operators regarding users becoming 'poster-blind'. To increase engagement in public health activities to promote hygienic swimming behaviours, one Pool Operator suggested:

*I think something on that. Um, our schools come in three-week blocks when they swim, so before they swim maybe there would be a DVD we could send them that they could, you know, learn with the children why we do these things (PO6).*

This would be useful, as it links to the point made by Health Professional 1 about posters reaching their intended audiences too late. Providing information to the children before they come for their swimming lessons allows them to learn about the recommended behaviours, such as not swimming whilst suffering from diarrhoea and vomiting, and they might thus inform their parents that they should not be going swimming if they are ill.

Two swimming pool users suggested that the presence of an attendant to remind users to follow hygienic swimming behaviours would be beneficial:

*Yeah. I do but I also think like verbal communication...is a lot better because you could read something but you don't take it in...When you're talking about something, you take it in more...No. If somebody said to me you gotta shower, and those were the guidelines in the pool, I would certainly shower (S1, female, 18-24).*

*And like, you know, if you have got little ones, maybe if they approached you as you're entering the pool like you know, let us know if there's any problem sort of thing....I feel like sometimes they do just not interact with you...So like, maybe if they interacted a bit more, you might think, oh OK I'll just let them know as soon as it happens (S10, female, 18-24).*

However, this is not what the health education literature advocates, as authors feel that health education should encourage swimmers to make a more informed choice regarding the risks and benefits of healthier behaviours (Naidoo & Wills, 2016). Swimmer 10 demonstrates how interaction with staff may help to alleviate perceived fears, as discussed earlier regarding staff being approachable to encourage swimming pool users to inform them of faecal accidents in the water. These suggestions were supported by Pool Operator 2:

*Yeah, we need try and use our team...Encourage them to talk to our customers (PO2).*

As mentioned previously in this chapter, Pool Operator 2 stated that their swimming facility used a band station where staff asked swimmers to have a pre-swim shower. However, the three swimmers interviewed from this setting did not mention that they had been asked by an attendant to shower before swimming. One participant was asked specifically if he had been instructed by an attendant to shower and responded that he had never been asked. Therefore, it is important to note here that health education activities may not always be carried out by all staff members: there is thus a need for ongoing training and monitoring to ensure that health education procedures authorised by management are being implemented by other staff members.

On the other hand, three swimmers highlighted that an attendant providing information or instructions might not be appropriate:

*[pause] I question that one because go-- you know, some people don't take too kindly to somebody else telling them how to be clean. Whereas if it's on the screen, it's not per-- you know what I mean, it's not personal. It's there for everybody. Whereas if an attendant approached somebody and said, "Do you know you need to go and wash before?" That could end up with all sorts of problems I think...It's too personal (S9, female, 25-64).*

Whilst there is a need to promote healthy lifestyles and raise awareness of hygienic swimming behaviours, this must be done in a way that does not discourage or present a barrier to swimming (Volpp & Asch, 2017). By contrast, Health Professional 3 stated:

*...But then I still think that the actual swimming teacher or the manager has a big role to play in this because they could be asking them, "Are you alright today?", whatever. Now and again, not every time...But just as a prompt. And to parents to get to sign like a disclosure, saying, "If your child is unwell, you must inform us." (HP3).*

This suggests that asking questions of swimming pool users can help to raise awareness of hygienic behaviours and that prompts to inform parents that children should not be swimming whilst suffering from diarrhoea and vomiting would be beneficial. Two swimmers also reported that providing information verbally would be helpful, as it would allow swimming pool users to ask questions. A typical response included:

*Why you need a shower. "Because--" And if you say, "Well I'm not bothering with a shower today." Then, they can actually say, "Well," you know, "What have you got on your body?" You know, "Where have you been?" And...then it'd make them think, "Oh, my goodness. I'm really dirty today...let me shower." [chuckles] Yeah (S15, female, 65+).*

This highlights the need for health education that does not solely consist of leaflets and posters as the way of providing information, as this is not suited to everyone (Naidoo & Wills, 2016). Some people may be better able retain health information from verbal communication. Staff providing information would present the opportunity for swimming pool users to ask any questions about the health information they were receiving (McQuail, 2005). This could provide an opportunity to empower users to change their awareness and knowledge of hygienic swimming behaviours, with the intended outcome of a behavioural change (Jones & Douglas, 2012).

One Pool Operator suggested that staff could inform children of hygienic swimming behaviours in their interactive clubs:

*I think, um, in my mind. [chuckles] In my mind, I've now got somebody, picturing somebody dressed as a crypto bug...But I think-I think if we involve children...and it's practical, you know, we- we're-- it's-- we could tie in with our "Act-Active" club, which is our children's, um, holiday club...Um, at the moment this and we- we the-- particularly in the summer we theme it, so the-- the guys that run it theme it...And, um, this week it's countries...So, we've got a huge map of the world and- and [name] is asking the children where they've been on holiday. So, she's printed off this map and-and, you know, um, structures, you know, like the, um, Eiffel Tower and things like that...And the kids are looking, um, on the map where it is and with a piece of string, so everybody sees where-, so it's educational as well...So, there's something there, somehow off the top of my head, I couldn't even begin to say how...but we could introduce that into our interact-interactive club, into our children's club (PO1).*

Thus, children could then potentially influence their peers after receiving information from this club.

Many participants from different age groups suggested an online approach to providing health information to swimming pool users. These included the use of social media and websites:

*Um, [pause] I-I-I do use, um, social media and things like that but it's not something I use for swimming...So, you know, like I don't look at the, um, at the pool Facebook page or...Twitter, or anything like that. I do use the website quite often to look up um times at the pool (S11, female, 25-64).*

This presents an opportunity to provide information to swimmers through this avenue, as all the swimming pools involved in this study had websites. On the other hand, Swimmer 15 reported that social media specifically would be useful:

*Yeah. Yeah. Because I often look at the Facebook one...Yeah. Yeah. See what's happening when-- Whether it's closed, why is it closed, have they got an event on? So that-that would be quite good (S15, female, 65+).*

This presents the opportunity to provide simple messages regarding hygienic swimming through online sources, which could be located near the opening time information. Again, this would reach a captive audience, as they are already looking for information about opening times. Pool Operator 3 particularly stated that social media would be a good avenue:

*So, uh, yeah, I think that could be an excellent avenue to go on social media...Because bin-, instantly, subconscious, you're reading what-what's there...You may not take it all in, but if it's a topic that you're-you're interested in, or you-you're not aware at all for, you just want, need further knowledge..."Oh I'll read a little bit further on that."...Easy access (PO3).*

This resonates with theories that emphasise the importance of making hygienic swimming behaviours the easy option, which can also be applied to the ability to gain information easily (Volpp & Asch, 2017). One Health Professional also suggested social media as a useful avenue to provide information:

*Um, things that you see a lot of these days, and I'm thinking of examples of other, uh, with the local authority here, as an example, bathing water quality type stuff, you know...is-- What I'm alluding to, basically, is social media really is...a lot of stuff goes out on that these days. Um, be it a short feeds from-from Twitter or something or links from a Facebook to a-a-a more public website or something like that, you know...updates and things like that. That's the modern world so...you know, it's low cost and, uh, it's there to be utilized...So, I see no reason why they couldn't do that (HP4).*

Social media are becoming more powerful in current society, meaning that more people are accessing content through social media and online avenues (Ewles & Simnett, 2003). Therefore, it presents the opportunity to provide information to a wide audience at a low cost. Although the use of social media is a great way of targeting the younger generation (Jones & Douglas, 2012), it relies heavily on people seeking out the information, and on the population being able to access the internet in the first instance.

A survey estimated that 93% of households in Great Britain had internet access. It was also estimated that 87% of the adult population use the internet daily (Office for National Statistics [ONS], 2019). It is important to note that there are issues around this data and it is estimated and there is no specific breakdown for the countries within Great Britain. ONS report that the limitation to this survey which estimates population access to the internet uses a small sample size of 2,754 respondents. A reason for households not having access to the internet could be the lack of skills to understand how to connect and use relevant equipment. The high costs involved, such as equipment and access costs, are also barriers to accessing the internet (ONS, 2019).

Respondents made various suggestions of external avenues to raise awareness of hygienic swimming behaviours, which included schools:

*Definitely because that's where-- Yeah, that's where I learned about the-- You know, like, the basic, um, hygienic swimming behaviour. You know, like washing before going into the pool. So I feel like if you were to talk more about that within schools to all ages it-it would sink in better (S6, female, 18-24).*

There were many swimmers who suggested that schools could be involved. A small number of swimmers mentioned the GP surgery as a way or displaying posters to reach a wider audience. This was also suggested by some Health Professionals and Pool Operators. A typical response is provided below:

*With the flu jab you see posters, are you in this vulnerable bit group or whatever, isn't it?..Where surgeries put up the poster with regard to crypto, it's a step forward (HP3).*

Health Professional 3 also highlighted that Health Visitors could provide this information to parents. This was also mentioned by Health Professional 1 and Pool Operator 4:

*It is and very often a parent will pick it up. Um, so obviously the health visitor could explain about hand washing and all the rest of it there, couldn't they?..Um, and to be aware that if they-they would know whether their child is having diarrhoea or not. A mother would know. [laughs] Uh so, obviously the information to be passed on to a young mother or her-- A new mother I should say can only be of benefit...Yes. Yes. There's a relationship going. As long as it's always the same health visitor, coz that's the problem. I think sometimes they have different ones. If there was a way in the ideal world, wouldn't it? You would have the same one all way through your pregnancy until afterwards. You've developed a relationship. So obviously, the information coming from that person would be accepted...Um, but we're not in the ideal world. I think just to keep it highlighted really, isn't it? (HP3).*

*And, yeah, how -- I mean health visitors, I can't remember- it would-it would have to be with the timing with the health visitors I think. Because obviously when you've just had a baby, you get a lot of visitors from...visits from health visitors (HP1).*

*Yeah, I-I think-- Y-You know, I think maybe some information could be given, um, by-by, um, by sort of, uh, social workers or health visitors, um, with-with, you know, to parents with young children. Um, you know, it'd take a few minutes to mention, "If you go swimming and-and stuff--" ...Um, you know, the risks and all. And I think that would help to really, sort of, educate, you know, parents and stuff (PO4).*

These three participants suggested that health visitors usually build a rapport with parents and believed that it would be likely that information regarding hygienic swimming behaviours would be received more willingly from this source.

One pool operator suggested that nurseries could be involved in providing information regarding cryptosporidium and infection control:

*Yeah, I think-- I think it should be um, from um, nursery nurses from crèches. Um, my wife is a lecturer and she delivers child care development to up-and-coming nursery nurses. Now, when they finish their course, they're actually in charge of crèches, or nursing homes. Um, where, no doubt they'll be involved in changing some type of nappy...An adult nappy or a child's, a baby's nappy. Um, so, and also the equipment that they're using like soft play. You know, soft play can be exactly the same as a slide in a swimming pool...Um, the mats can be exactly the same as-as the water supply in a swimming pool. So, it's not just swimming pools. Yes, I know you-you can actually inhale it and digest it more in a swimming pool environment than what you probably would in a dry facility (PO3).*

Nurseries are also required to inform parents of infection prevention control and procedures, including exclusion periods while their child has diarrhoea and vomiting. Therefore, the infection prevention control measures can be transferable from one setting to another. Pool Operator 1 suggested the use of libraries:

*But we did do something recently and we worked with the libraries and they've put the information right across the libraries in the counties as well...So whether it's something that could possibly be linked to its, not its, not just pools its...been scattered across the board (PO1).*

This presented the opportunity to reach a wider audience through an avenue that is already in place. The next category to be discussed is the recommended target audience for interventions to raise awareness of hygienic swimming behaviours.

#### 4.4.6.1.4. Target audience

Before a behavioural change can take place, the message must reach the intended audience (Jones & Douglas, 2012), which in this case is anyone who uses a swimming facility. This can be a vast and varied population, encompassing older and younger people, students, or any adult who either swims themselves or takes a child swimming.

There was a varied response in terms of who should be targeted by the health educational messages. Two swimmers/parents of swimmers and one pool operator thought it would be beneficial to provide the message to a wide audience, as they believed that most people, or their children, are involved in a swimming activity at some point:

*But, um, you know, there's nothing to stop health information on the television (S9, female, 25-64).*

*Yeah, the wider public, I would say. Within doctors, uh, schools, any-any public areas, really. Because at some point or other, people are going to go swimming (S6, female, 18-24).*

*Um – to be honest, you know, I think most people, at some point, do go swimming and, you know, like, on holiday and things like that as well. So, I think, yeah, everyone, I think the wider public...I think the more people out there targeted, the better (PO4).*

This is evident through the school curriculum, where most children will be taught to swim during their school years.

By contrast, some believed it would be beneficial to only target those in the swimming facilities themselves:

*...When you're talking about hygiene in the swimming pool, you're only sort of- you only sort of want to target those people who use a pool...You know, yeah, swimming activity I mean, you can only target those people who are involved in the swimming about the hygiene of the pool isn't it?...I mean, people who don't swim wouldn't care would they?...Unless something happened to their family and then you bring somebody...you know, that's life isn't it? (S3, male, 65+).*

This view can be understood by applying the Health Belief Model in terms of perceived risk and the perceived relevance of health information to one's own health (Rosenstock et al., 1988).

Swimmer 15 highlighted the issue with targeting those who are not regular swimmers:

*Um, again for all, you could do it for all ages, uh, the only thing would be how to get information across to someone who just comes sporadically (S15, female, 65+).*

This reinforced the issue of when to provide information to ensure that the message reaches all swimming pool users. This is to ensure that all swimmers can make an informed decision about following hygienic swimming behaviours. Swimmer 15 also stated:

*I don't know. I suppose when people join or come to the pool, um. Should there be leaflets? I don't know, something on the notice board. Again I'm not sure...Because it's m-mainly-it's mainly for children, isn't it?...And families? Because grown-ups know what they're doing anyway (S15, female, 65+).*



Another participant reported that targeting children specifically would also be useful:

*...they can become real ambassadors for that message... Yes, and they can then pass on through the family (HP1).*

As previously discussed, this view is supported by Social Learning Theory in terms of children being able to influence their peers and their parents (Bandura, 1977). Pool Operator 6 also agreed with this:

*I think trying to get that message over, um, for children would help, and then as the generations move through it would be the norm then...instead of just the odd person (PO6).*

The quote suggests that knowledge can be passed down the generations, which in turn may lead to a change in social norms.

Swimmer 5 stated that it would be useful to target care workers:

*Um, and I think it's important for like care workers and stuff who take like disabled people to the pool, um, coz obviously, they'd be responsible for their personal hygiene, so I think it's important for them to know...on their behalf as well (S5, male, 18-24).*

Swimmer 5 reported that it was important to provide care workers with information, as they are responsible for the hygiene of the people they are caring for, highlighting the importance of perceived risks and benefits (Rosenstock et al., 1988) as some individuals who have learning difficulties may not understand the benefits to them of following hygienic swimming behaviours. In this instance, it is for the care worker to decide if the benefits of following hygienic swimming behaviours outweigh the risks to the person for whom they are providing care.

One swimmer also emphasised:

*Yeah. And I have, you know, I've-I've bumped into people-people at the pool whose-whose-whose English is-is probably very limited...Um, you know the-the old-older people who's obviously you know, come swimming regularly and they say, "Hello" but the conversation can't go further than "Hello"...coz their English isn't very good...Um, uh um, so it's- but it- it's-it's still getting the message across...to them (S11, female, 25-64).*

If information is only provided in the English language, then communication to the multicultural populations in the United Kingdom is not going to be successful to those with limited English. Although, it would be beneficial to provide information in different languages for all cultures in the United Kingdom to understand, it is likely that the cost of this would not be feasible (Easton, 2006). It is also important to note that an intervention to target a varied population needs to ensure that any information is culturally sensitive and appropriate: a one-size-fits-all message is inappropriate (Jones & Douglas, 2012). The Ottawa Charter has a predominant focus on trying to reduce health inequalities by reducing the gap in opportunities to access information and resources which can help improve people's health (WHO, 1986).

In addition to the target audience of an intervention, the frequency of the intervention also emerged as a category within this sub-theme of means to raise awareness of hygienic swimming behaviours.

#### 4.4.6.1.5. Intervention frequency

Most participants reported that the efforts to raise awareness should be more frequent than, for example, yearly. They reported that the information would be retained better if they were exposed to it more often:

*Well, it's a it's a good point actually yeah. I think if it was launched initially over a two week period. I suppose the staff themselves would be able to gauge the um immediate launch effect. I'll imagine if they had a intervention for the next couple of months, the whole world would be using the shower...and then slowly there would be deterioration. So it might well be without ever any sort of formal, uh, timetable, it might be like--. We need, we need, we need to sort of wrap it up again. Let's have another sort of, uh, sort of lower key sort of intervention to get the thing going again?..Because, the best human, human nature is actually whereby people will, yeah, be inspired initially...Some will continue. Others will just get back into their normal routine, won't they? (S4, male, 25-64).*

A few participants from the four sample groups also reported that messages should be provided to swimming pool users constantly. This links to what the previous discussion regarding theories about persistence of healthy behaviours so that they become routines (Aunger, 2007), as Pool Operator 1 commented:

*I-- yeah. Definitely, because we want to change people's, um, behaviour, don't we?...And that has to be ongoing (PO1).*

Health promotion theory states the importance of health promotion messages being frequently reinforced to encourage healthy behaviours. (Naidoo & Wills, 2016).

Health Professional 1 suggested:

*...We've also got messages that could be given as part of seasonal interventions...So sort of maybe before some holidays or that-that sort of thing (HP1).*

These are seasons when cryptosporidium is most prevalent in the community (Chalmers et al., 2016). Health Professional 1 suggested it would be beneficial to provide information before these seasons to try to reduce the number of cases of cryptosporidiosis.

As previously mentioned, some swimmers reported that it would be useful to be provided with information regarding the swimming pool itself, in terms of maintenance, cleaning, chemical levels and bacterial measures. Swimmer 16 suggested that yearly statistics could be provided to swimming pool users:

*It would be quite good perhaps to either have on the website, just even if it's like a yearly thing of-- if they do stats or anything of water purity and you know, targets and things like that. Coz I know uh um coz I swim every week, one week the pump had-hadn't worked...and you could see the difference in the pool...So, it'd be quite interesting to know if a-and how open and honest they are is how often does something like that happen? How quickly is it rectified? Coz again you're paying, to me, you're paying good money to come and swim here. It's not cheap, so I would hope that the facilities, you know, they put money back into making sure it's clean and and stuff. So it'd quite interesting to know...Even if it-even if it was yearly-- (S16, female, 25-64).*

If the results of samples taken to measure the amount of residual bacteria were published before and after an intervention to encourage more people to shower, this could show swimmers that showering before swimming does indeed have a perceived benefit. Applying Rosenstock et al.'s (1988) HBM, it could be that providing information to swimming pool users may change their views regarding perceived risks or benefits, and they may modify their behaviour accordingly.

Various types of educational materials were suggested which could help raise awareness, and participants discussed their advantages and disadvantages. It became evident that a variety of methods, such as posters and videos, would need to be used to help raise awareness amongst a diverse community. Various means of delivering that information to swimming pool users were also discussed. Again, using different modes may be beneficial to reach a wide audience. The

consensus was to have readily available information accessible for all swimming pool users at all times.

While discussing how to raise awareness of hygienic swimming behaviours, it became apparent that credibility and trust in public health interventions was also considered important by participants. This sub-theme will be discussed in the next section.

#### 4.4.6.2. *Credibility and trust in public health interventions*

The credibility of the source of information is important if the audience is to take notice of and believe the intended message (Kumkale, Albarracín & Seignourel, 2010). Many participants from all sample groups reported that it would be beneficial to have the support of a well-known organisation to improve the credibility of the information being provided to swimming pool users:

*I think it would be really nice if it did have the support of a national body in some way...Uh, because I think that certainly gives support and credence to messages. Um [pause] but-but at the actual giving the information out, it may depend on what you find. If there are some overarching bodies that can...you know, it could be something that was promoted by [name of organisation] delivered on behalf of [name of organisation] by...whatever, whatever, whatever...Yeah. But I-I just feel that the-- there is a role for the pools...But that's a reinforcement of something hopefully people have already...heard and I think that's the gap at the moment...And maybe not already hearing it (HP1).*

This was supported by another Health Professional who highlighted that involving other authorities besides the swimming pool setting would be beneficial:

*...It puts weight to it, it puts an expert, certainly with Public Health Wales, it puts an expert person behind it...If you wanna talk about consultants and things like that so it's not just-- Doesn't look as though it's just the-the pool operator, uh, being cautious or something like that...I think it is a more genuine reason to then that, um, there are public health reasons behind it and controls in place so- (HP4).*

By contrast, a small number of swimmers/parents of swimmers interviewed suggested the swimming pools themselves as a trustworthy source of information:

*I would definitely trust the pool's, like, um, information... Yeah definitely, you know if it's from your pool specifically then I think that's something that everyone needs to take notice of...I think every pool needs to have like a baseline for hygiene, so I think, you know, the council and maybe even like as far as the government would be good, like you know, if you've got an information sheet, like from the government about your hygiene...in the pools, it's quite formal. And I feel like it would make people want to pay attention to it (S10, female, 18-24).*

Three swimmers/parents of swimmers reported that it would be important for the local government to be involved in providing the information, in terms of their logo being present on any educational materials to enhance trust. A typical response is provided below:

*Um, sometimes being like a friendly leaflet from your local pool might not be enough...It might need like the authority behind it from the government or the council...So maybe the government or council would be like a good like backing...behind it (S10, female, 18-24).*

Swimmer 10 also highlighted that the national government could endorse interventions, and this was supported by a quote from Swimmer 16:

*Umm, yeah-yeah or even if it was um an all Wales thing. I mean I don't how-how if you could do that really umm, you know like Welsh government or something, if they got like a sport-sporting sort of... Yeah, yeah, yeah um I think you would look at it if it were-- I don't know if you would-- I don't think it really matters as such. I mean obviously if the p-the logo's there you're looking at who is...sort of backing what's-what's written. Coz you wanna trust whoever is putting that information up and that they're giving you the correct information isn't it? That's the thing (S16, female, 25-64).*

The National Health Service was also suggested as a credible and trustworthy source of information by another swimmer:

*I think branded would be better coz obviously if they're putting a name to it, it's more likely to be credible. I think also having input of the NHS like talking about the bugs and like putting their name to it as well would also help (S18, female, 25-64).*

This participant highlighted that a branded message would be more credible and specifically mentioned how the input from the NHS would be useful in endorsing the health information.

Swimmer 8 also suggested the NHS:

*I got friends like who work within like the ambulance service, so I get more information from there...Um, but yeah, it's like the internet you can get information off of, as well, and there's always advice about it if you need someone to talk to...t's like the NHS it's part of everything now...If it had -- That it come from like um, like a university is done like [clears throat] sorry. It's done like a study and this is what we believe or it's come from like the NHS...and it's actually on there, then I would think people will take more notice of it...because it's got like a recognised um...a symbol, yeah (S8, male, 25-64).*

This participant also suggested that a university is perceived as a credible source of information. He also referenced the use of the internet as a viable source. The issue of accessing health information online was also reported by Swimmer 13, who highlighted that information online is more credible from certain websites:

*Um, I think if it comes from um, your health authority...um, obviously, um, you gotta be careful with what you find online, anyway because if, you know, you've got access to a plethora of information haven't you?...You know some of it is applicable, some of it isn't. But I think if it's sort of a standard government guidelines from a health authority or a government-backed website then you might be more inclined to, you know, take that as-as being, you know, a good source of information (S13, female, 25-64).*

Another pool user mentioned that people would trust information published by the BBC:

*I think people believe the BBC, perhaps. You know and stuff from the NHS. But, how are you gonna get them to read that? Or listen to it or something? I don't know. If there was an outbreak in [location] people would listen to that, but otherwise it's...Yeah, NHS direct or something like that. Yeah (S2, female, unknown).*

Swimmer 2 believed that the information provided by the BBC would be trusted by some of the community, particularly if information were published regarding an outbreak. She also highlighted the NHS as a credible source of information and specifically mentioned NHS Direct.

As discussed previously, most participants across all sample groups reported that schools should be involved in providing information regarding hygienic swimming behaviours, not only to children but also directly to parents:

*Yes, I do. Um, as a parent generally when your kids are doing things, you know, when they're school age and they're say doing things, they'll get letters sent home to say, you know, your child will be taking part in two weeks of um, swimming lessons, you know. Summertime, that's- I think they tend to do down here um, you know, around about here from, you know, obviously with my own kids that's what I remember. Um, you know, information could be on the-the paper information that's sent home, so it could be k-from council or from school itself (S13, female, 25-64).*

Taylor-Gooby (2004) suggests that trustworthiness is essential in communicating risks. He also suggests that individuals find familiar sources credible, be they family members, friends or health practitioners. This also relates to external influences on hygienic swimming behaviours, as discussed under the first theme.

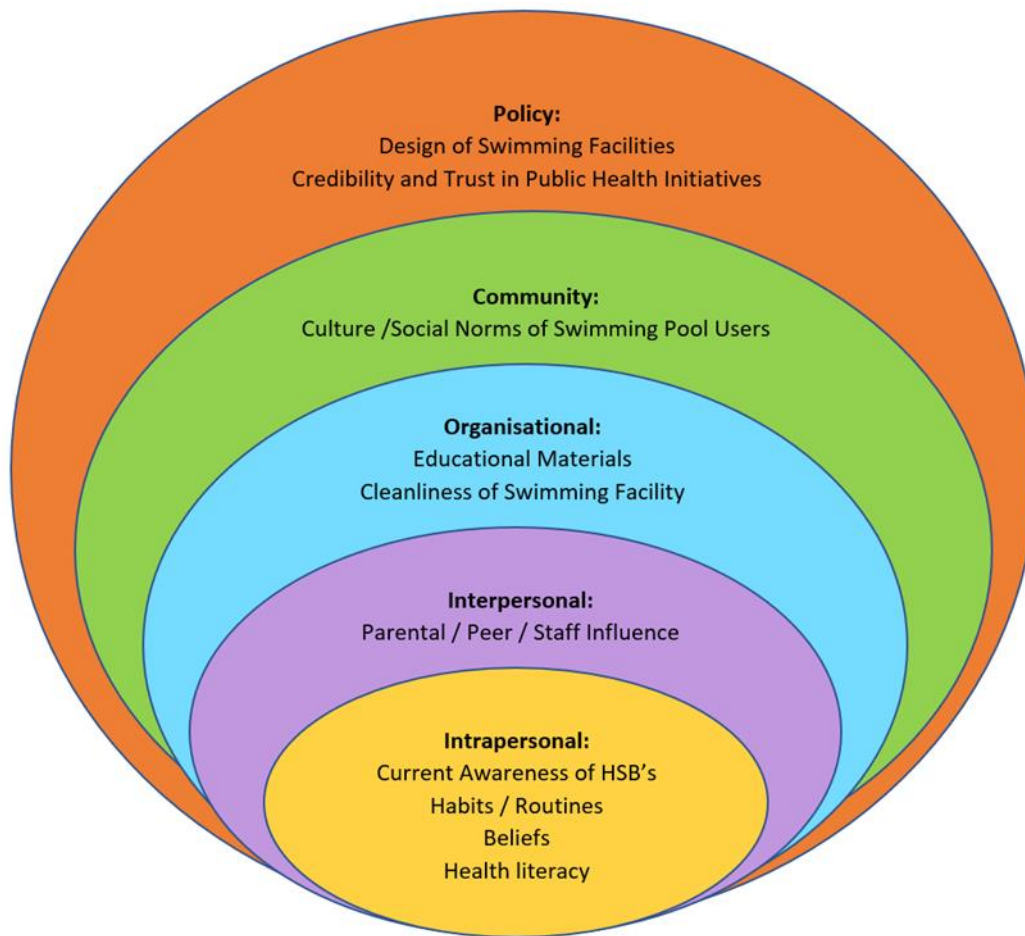
It is also important to note here that the determinants of health are an important aspect within health education, as they have a profound influence on an individual's health (Dahlgren & Whitehead, 1991). It is also important to understand that although the World Health Organisation (1948) defines health as 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity', health can be interpreted very differently. Therefore, some people may perceive health risk and benefits differently irrespective of the information they are given.

In this section, the findings derived from all the sample groups regarding awareness of hygienic swimming behaviours and preferred methods for receiving information have been presented and interpreted. Findings have been discussed in light of health promotion and social learning theories throughout this chapter. In the following section, the findings are applied to the SEM as an overarching model to aid understanding of the findings in their entirety.

#### 4.4.7. Application of the Socio-Ecological Model

It is evident from the data presented in this chapter that the findings can be better understood by applying the SEM (McLeroy et al., 1988). As described in Chapter 3, various levels within the SEM have been shown to influence health behaviours. This model can also be used to support the development of interventions which aim to modify or change behaviour (McLeroy et al., 1988). The findings presented in this chapter will be explained in relation to the SEM to aid understanding of the issues identified. The tables in Appendix 21 show the development of the diagram below, adapted from McLeroy et al.'s (1988) model:

Figure 4c: The Socio-Ecological Model and Hygienic Swimming Behaviours



\*HSB's = Hygienic Swimming Behaviours

As shown in Figure 4c, the findings from the qualitative work can be interpreted using the SEM. The data show how the factors at all the levels have an influence on hygienic swimming behaviours, and how these factors interact with each other (McLeroy et al., 1988). The findings discussed during this chapter indicated that there are a number of factors which influence hygienic swimming behaviours. As identified by the SEM, addressing factors on one level will not in itself bring about a change in behaviour (McLeroy et al., 1988). The SEM is useful to aid understanding of how the different factors at various levels of the SEM which influence hygienic swimming behaviours need to be considered when developing public health interventions to promote these behaviours. The factors identified – from intrapersonal to policy level factors – need to be addressed by public health interventions in order to successfully promote hygienic swimming behaviours. The findings will now be discussed in light of the different levels of the SEM.



#### 4.4.7.1. *Intrapersonal factors identified in phase 1*

As discussed at the beginning of this chapter, a number of intrapersonal factors influence hygienic swimming behaviours. These were found to be current knowledge of hygienic swimming behaviours, personal routines or habits, personal beliefs and health literacy.

It was evident that current awareness of hygienic swimming behaviours varied amongst swimming pool users. Seven hygienic swimming behaviours were identified and discussed previously in this chapter, which included:

- Not swimming whilst suffering from sickness and diarrhoea;
- Exclusion period following illness with sickness and diarrhoea;
- Pre-swim showering;
- Handwashing;
- Using the toilet before swimming to ensure no-one uses the pool as a toilet;
- Swim nappies;
- Informing staff of any faecal accidents.

With one exception, all swimming pool users interviewed stated that they would not go swimming if they were experiencing diarrhoea and vomiting. Reasons for this varied and included the avoidance of a faecal accident in the pool and not feeling up to swimming whilst ill, and seven of the 18 swimmers/parents of swimmer specified that they would not go swimming to avoid transmission of the illness. In addition, one swimmer/parent of swimmer stated that he would not go swimming in the same way as he would not go to work if he were ill. Three participants stated that they would wait for an exclusion period, but this time frame varied from 24 hours to 72 hours, highlighting the variation in swimming pool users' awareness regarding exclusion periods for illnesses. Interestingly, none of the swimmers/parents of swimmers interviewed seemed to be aware of the 14-day exclusion period for cryptosporidium. However, only one participant reported that they knew what cryptosporidium was.

Around half of swimmers/parents of swimmers interviewed stated that they were aware that they or their child needed to shower before swimming; however, this did not always mean that they did so. In addition, most reported that they did not know specifically why it was important to shower before entering the pool. Only one participant specifically said that he showered beforehand to avoid introducing 'bugs' into the water. This demonstrates that although

swimming pool users may be aware that showering is recommended before swimming, they may not be aware of why this behaviour is recommended and the benefits to pre-swim showering.

No swimmers/parents of swimmers highlighted hand washing as a hygienic swimming behaviour; however, when probed, all said that they washed their hands after using the toilet. Three swimmers mentioned taking their child to the toilet before swimming as a hygienic swimming behaviour, in order to avoid the child urinating in the pool. All participants who had taken young children swimming did use swim nappies. Six parents/guardians found them effective in order to avoid embarrassment for the child if an accident were to happen and to also avoid contaminating the swimming pool. However, two parents/guardians of swimmers mentioned that they were concerned about the effectiveness of swim nappies. In addition, one participant mentioned that swim nappies were costly. This highlighting how intrapersonal factors such as affordability of swim nappies for parents could influence their use. Most swimmers/parents of swimmers highlighted that they would inform a member of staff of a faecal accident in the swimming pool, demonstrating that they were aware that remedial action needed to be taken if there were faeces in the swimming pool water.

Seven swimming pool users, from 18 interviewed, reported that they were aware that there could be 'bugs' in swimming pools but only one knew what cryptosporidium was. This participant said that she was aware of cryptosporidium because she had previously worked in a laboratory in a hospital setting. This demonstrates how intrapersonal factors such as occupation can affect peoples' awareness of hygienic swimming behaviours and cryptosporidium.

The findings also identified that an individual's beliefs can influence their hygienic swimming behaviours. Most swimmers perceived swimming whilst symptomatic to be unhygienic, whereas one swimmer stated that they did not believe there were any risks associated with this. He believed that there would be no risks to themselves from swimming whilst symptomatic, as he believed that he would not have a faecal accident within the pool. This relates to awareness, as he was not aware of how faecal matter can be introduced into the swimming pool without a faecal accident. Faecal matter can enter the pool from other means, such as contaminated hands or swimming costumes.

In terms of waiting 48 hours before returning to the pool, one swimmer believed that this was important in order to protect themselves. She believed that their illnesses could become worse

if they returned to swimming before fully recovering. This shows how some swimmers/parents of swimmers may consider it important to avoid swimming for 48 hours to protect themselves rather than avoiding the transmission of pathogens in the pool water. The findings suggest that some parents may not exclude their children from a swimming lesson due to vomiting and diarrhoea because they have paid up front for the lesson. The health professionals and pool operators reported that parents would be more likely to exclude their child if the lesson was refunded, although none of the parents interviewed raised this as an issue.

One swimmer/parent of swimmer interviewed highlighted the importance of swim nappies and taking toddlers on regular toilet breaks to avoid faecal accidents in the pool water. The participant believed that their child was not at risk of a faecal accident, as they did not wear nappies; however, the child on this occasion had an accident in the pool. This highlights the importance of raising awareness of ensuring that children take regular toilet breaks during their swim session.

In relation to showering before swimming, a person's belief was found to influence this behaviour. It was identified that some swimmers believed that the showers are provided to use after their swimming session to rinse the chlorine off their body and did not believe that there was any reason to take a shower before getting into the pool. The findings also suggested that some users believe that chlorine can kill all pathogens in the pool, which relates to an individual's intrapersonal factors, such as current awareness of cryptosporidium and its resistance to the chlorination levels used in swimming pools. One swimmer/parent of swimmer highlighted that some swimming pool users may not understand terms such as 'cryptosporidium' or 'cryptosporidiosis', which demonstrates how intrapersonal factors such as health literacy may influence their awareness of hygienic swimming behaviours and cryptosporidium.

The findings also indicated that one swimming pool users believed that she was benefiting from swimming in a 'bacterial soup' in order to gain a low-level immunity to illnesses, and therefore might not perceive there to be benefits to some hygienic swimming behaviours such as showering before swimming. Conversely, this study found that swimmers tried to avoid swallowing pool water, as they thought this could pose a risk to their health in terms of the 'bugs' in the water or believed that chlorine could be a risk to their health if ingested.

One pool user suggested that following hygienic swimming behaviours was part of her routine. The findings demonstrated that swimming pool users may follow hygienic swimming behaviours because they are part of their routine and something they have always done.

It was identified that swimming organisations are providing different educational materials to their users, with some facilities making no effort to raise awareness. Various formats to raise awareness of hygienic swimming behaviours were identified by all participants and included signage, leaflets, video, verbal and online information. The strengths and weaknesses of these formats were also identified; however, the majority of participants suggested signage as the best way to provide information to swimming pool users. Various types of signage were suggested, including posters, logos and signs in various places in the pool setting. In addition, one swimmer highlighted the benefit of signage on the backs of toilet doors to address a captive audience. Many participants stated that leaflets could be used to raise awareness of hygienic swimming behaviours, but only two swimmers stated that they would prefer a leaflet. A video to play using various avenues was also suggested by eight of the 28 participants, while one pool operator suggested a DVD. This demonstrates that different swimming pool users may require intervention in different formats to draw their attention to the message and interest them in the information.

All participants from sample groups suggested that information regarding hygienic swimming behaviours should be clear and understandable for all swimming pool users. Given the diverse types of people that visit swimming pool settings, it is likely that swimming pool users will have different educational levels. Hence, a retainable message which is understood by all is important. This demonstrates that policy developments for interventions to raise awareness of hygienic swimming behaviours need to consider the intrapersonal factors among swimming pool users. Ensuring a consistent message across all facilities was also perceived to be beneficial. Two swimmers reported that it would be useful to inform swimming pool users of the consequences of not following hygienic swimming behaviours, while three swimmers/parents of swimmers specifically highlighted that the messages provided should not scare people or put them off swimming, with all pool operators agreeing with this.

There were varied responses amongst swimmers/parents of swimmers as to whether they wanted to receive information specifically about cryptosporidium or whether they would prefer a more general message regarding hygienic swimming behaviours. Three swimmers/parents of swimmers stated that it would be beneficial to know information specifically on

cryptosporidium, whereas the other 15 believed that this was not necessary. These 15 swimmers/parents of swimmers reported that it was more beneficial to know what behaviours they could follow to help keep the pool water clean and healthy. In addition, one health professional highlighted the benefit of providing a general message, as it would also target other pathogenic organisms found in swimming pool water. Providing the explanation behind the benefits and reasons to shower before swimming may result in more people having a pre-swim shower. Therefore, it is evident that participants believed that being provided with information regarding the benefits and reasons for hygienic swimming behaviours might change their attitudes and beliefs about them, which in turn could result in a behaviour change. One swimmer also emphasised the importance of messages being understood by all swimming pool users, including those who may not understand English. In addition, the benefit of providing information from credible and trustworthy sources such as government bodies was also highlighted from the findings of this study.

#### *4.4.7.2. Interpersonal factors identified in phase 1*

Parents, peers and staff members appear to have an influence on hygienic swimming behaviours. One swimmer suggested that he has an influence on his child in terms of teaching her hygienic behaviours. He believed that if children are taught these behaviours at a young age, they are more likely to follow hygienic behaviours routinely. However, one swimmer/parent of swimmer reported that he was not aware of some hygienic swimming behaviours or cryptosporidium and would thus not be able to influence his child. On the other hand, one health professional highlighted how children can influence their parents. She explained how her children had become the ‘hand washing police’ following a hand hygiene intervention in their school. This shows how children can be advocates for hygienic swimming behaviours. In addition, one swimmer/parent of swimmer stated that as a child, she was not influenced by her parent to shower before swimming, but that she did follow this behaviour now as an adult after being influenced by signage at the swimming pool settings. This demonstrates that parental beliefs, as discussed in the previous section, can influence children’s beliefs, but also that children may grow up to form their own beliefs regarding hygienic swimming behaviours.

Peers can also play a role, for example, the findings highlighted how one swimmer/parent of swimmer did not shower before entering the swimming pool because his peers did not do so

either. However, another swimmer/parent of swimmer highlighted that her swimming peers had not influenced her behaviours, as she reported seeing people take a shower before getting into the pool, but she did not do so herself. Thus, peer influence may not always change one's behaviour. Nevertheless, one participant did state that if he were given information regarding hygienic swimming behaviours, he would try to influence his friends by passing it on.

Participants highlighted how staff can be influential in that ensuring swimming pool users inform them of a faecal accident within the swimming pool by being friendly and approachable. It was also evident that staff need to react to the faecal accident in a timely and efficient manner.

#### *4.4.7.3. Organisational factors identified in phase 1*

The cleanliness of the swimming pool setting appeared to influence hygienic behaviours. For example, one swimmer stated that the hand washing facilities and toilets were of a poor standard. This demonstrates how cleanliness of the swimming facilities may present a barrier to following the recommended hygienic behaviours. In addition, all swimmers/parents of swimmers reported that the hand washing facilities were accessible, although one participant did believe that these facilities were not up to standard. Again, this demonstrates the influence of the facilities at the swimming pool setting on hand washing behaviour. Furthermore, one swimmer/parent of swimmer stated that the toilet facilities at Swimming Pool A were not hygienic. He believed that the facilities were in poor working order, with the toilet system leaking onto the floor, providing the potential for cross-contamination of pathogens from the toilet facilities into the pool. This highlights that poor maintenance of the swimming facility does not encourage hygienic swimming behaviours or environments.

In addition, two swimmers/parents of swimmers reported that sometimes the showers at the swimming facility they attend did not work correctly. Again, this demonstrates how organisational factors such as the maintenance of the facilities can provide a barrier to swimming pool users' hygienic swimming behaviours such as showering before swimming.

The current educational materials available to swimming pool users were also identified as a factor which influenced hygienic swimming behaviours. From interviews with pool operators, it was evident that the current educational efforts varied considerably, from no information provided at all to TV screens in reception, posters and leaflets. In some instances, there were

signs in the swimming pool addressing hygienic swimming behaviours, but swimming pool users had not seen them.

Two swimming pool facilities had information regarding hygienic swimming and cryptosporidium on display. However, it was noted that not all participants who attended these two pools had noticed this information. This highlights that educational materials need to be noticeable to influence awareness. Seven of the 18 participants stated that they had seen information of some kind regarding hygienic swimming behaviours in the swimming pool setting. Participants highlighted that facilities should provide information about hygienic swimming behaviours frequently in order to influence users' behaviour. In addition, one health professional highlighted that it might be beneficial to provide the information regarding hygienic swimming behaviours, particularly exclusion periods, before swimmers enter the facilities.

Pool Operators interviewed as part of this study reported that it was important to raise awareness of hygienic swimming behaviours and for swimming pool users to adhere to the recommended actions. All pool operators also highlighted the importance of people following exclusion rules to avoid transmission of cryptosporidium and other pathogens along with avoiding any disruption to pool operations.

As previously discussed, a pool operator interviewed stated that their staff members were required to ask users to shower before entering the pool at the band station. This highlights how the organisation can influence hygienic swimming behaviours, but only if written policies and procedures are implemented by their staff members. The swimming pool facilities themselves were found to influence hygienic swimming in terms of their operation and design.

#### *4.4.7.4. Community factors identified in phase 1*

The findings suggest that the culture within swimming pool settings encourages some hygienic swimming behaviours but not others. For example, it appears that the social norms are to enter the pool without showering beforehand. However, it is also the social norm to avoid swimming whilst suffering diarrhoea and vomiting. Interventions to raise awareness of hygienic swimming behaviours ought to address social norms and create a culture where hygienic swimming behaviours are the norm within each swimming community, as has been achieved in other countries, such as Norway, as highlighted by one health professional. Thus, all

communities, such as athletes, recreational swimmers, school swimming classes and so on, will create a culture where hygienic swimming behaviours are perceived to be normal practice. However, it is important to note that one swimmer/parent of swimmer did highlight that seeing others shower did not mean that they conformed to this behaviour, highlighting the need to raise awareness of why it is beneficial to adopt such behaviours.

#### *4.4.7.5. Policy factors identified in phase 1*

It is evident from the findings of this study that there is a need to raise awareness of all hygienic swimming behaviours amongst swimming pool users. It was also identified that swimming organisations are providing different educational materials to their users, with some facilities making no effort to raise awareness. Therefore, there is a need for public policy to encourage and support all swimming facilities to provide consistent and correct information to their users on how they can help to keep pools clean and healthy. As discussed in Chapter 1, there is currently no requirement for swimming facilities to provide information to swimming pool users, however it is recommended by guidance. Public policy relating to communicable diseases may need to incorporate hygienic swimming behaviours and interventions to raise awareness of such behaviours.

This chapter also highlighted that interventions developed to raise awareness of hygienic swimming behaviours need to take various factors into consideration. Therefore, it would be beneficial to create a public health intervention which could be adopted by swimming pool operators across Wales that addresses the various factors identified. For example, various formats to raise awareness of hygienic swimming behaviours were identified by all participants and included signage, leaflets, video, verbal and online information. This demonstrates that different swimming pool users may require interventions in different formats to draw their attention to the message and interest them in the information. Policy factors to develop interventions should consider these intrapersonal factors. In addition, the findings from this study suggest that information regarding hygienic swimming behaviours should be clear and understandable for all swimming pool users.

If public policies and guidance documents were to be more encouraging of swimming pool operators, and an intervention was adopted, a consistent message could be provided across all facilities in Wales.



In addition, providing information from credible and trustworthy sources such as government bodies was also highlighted from the findings of this study. This could be factored into health and safety policy, under which the regulations of swimming pool facilities lie. Sources such as the NHS or the local authority were highlighted as an important factor that would encourage users to take note of these communications and trust the messages being provided. In addition, most participants highlighted how schools could play a role in raising awareness of hygienic swimming behaviours. It is evident that health education is an integral part of the school curriculum and connections between the school and the wider community can influence children's health (Segrott & Roberts, 2019). Thus, demonstrating how policy could be changed to support schools in incorporating education of hygienic swimming behaviours into an existing curriculum where school children are taught to swim.

Another important policy factor identified from the findings was the design of swimming facilities. The design of the swimming pool setting needs to be addressed in public policy in terms of constructing new facilities and renovating old swimming pools. The location of pre-swim showers and the throughput from the changing rooms to the pool itself seemed to influence how people behaved. For example, if the pre-swim showers were not located near the entrance from the changing room to the pool water, it seemed that swimmers would be less likely to shower before entering the pool water. However, one swimmer/parent of swimmer reported that she had noticed showers at the pool side but did not use them, demonstrating the need for consideration of many factors.

The privacy of pre-swim showers was also highlighted as a barrier to showering before swimming. Pre-swim showers located at the side of the swimming pool seemed to be off-putting to some individuals due to the lack of privacy. The design of swimming facilities needs to ensure that no pool user faces a barrier to following hygienic swimming behaviour. As identified by one parent, it was not easy for them to shower their child before swimming or to change their swim nappy. This was because they believed that the facility they attended did not seem to be fully accessible for their disabled child. This should be taken into consideration by public policy, specifically the British Standards which require swimming pool to be designed to be safe, to include cryptosporidium and hygienic swimming practices. As discussed in this chapter, the design of swimming facilities can be a barrier to following hygienic swimming behaviours, therefore policy relating to construction and design of swimming facilities need to address this.

#### 4.5. Summary

To conclude, this chapter has provided the methods used to conduct this first phase of the study. This phase aimed to explore stakeholders' views on hygienic swimming behaviours and how to raise awareness of these behaviours. The findings demonstrate that there are many different factors which influence hygienic swimming behaviours, which have been discussed in light of the Socio-Ecological Model in the previous section. These include intrapersonal factors such as current awareness and individual beliefs regarding hygienic swimming. Interpersonal factors, peer and parental influences, were also shown to be important. Organisational factors such as current educational materials provided by swimming pool facilities and the cleanliness of facilities were highlighted as further influences upon hygienic swimming behaviours. In addition, community factors such as social norms within swimming populations were shown to affect hygienic swimming. Lastly, policy factors such as the design of swimming facilities and the need for interventions to raise awareness of hygienic swimming behaviours were identified.

These findings demonstrate the need to consider many of these factors when developing a public health intervention to raise awareness of hygienic swimming behaviours. The findings regarding the preferred methods of communication, the content of the messages and the credibility of the information are useful to develop an awareness-raising intervention.

The next chapter provides detail of how the findings presented in this section were further explored using a quantitative approach. The methods, results and discussion of phase 2 of this study are presented in Chapter 5.

## 5. Chapter Five: Quantitative survey to explore hygienic swimming behaviours and how to raise awareness of them amongst swimming pool users (Phase 2)

### 5.1. Introduction

This chapter will detail the methods used to conduct this second phase of work, with a discussion on how the findings from phase 1 of this study informed the development of this second phase. The results of this quantitative survey are presented in section 5.3. and discussed in section 5.4.

### 5.2. Methods

This section presents a discussion and justification of the methods used to carry out the second phase of the study. The first phase of research informed the development of the tools used in this phase. A theoretical framework, outlined below, was used to guide this phase of work. Descriptions of the sample, the tools used, the procedures employed, data analysis and ethical considerations are presented in this section.

#### 5.2.1. Aim of phase 2

The aim of phase 2 of the research was to quantify and verify the findings of phase 1 by gathering data from swimmers and parents of swimmers from a larger sample. This connects to the overall aim of this research: to explore awareness of hygienic swimming behaviours and to develop and evaluate a public health intervention to reduce the transmission of cryptosporidium.

Objectives for phase 2 were to:

- Explore swimmers' and parents of swimmers' awareness of hygienic swimming behaviours and cryptosporidium.
- Explore how swimmers and parents of swimmers would like to receive health information.

#### 5.2.2. Development of this phase from the findings of phase 1

Phase 1 of this research identified many different factors that can influence hygienic swimming behaviours, as described in Chapter 4, section 4.4. To be able to develop a public health intervention to raise awareness of hygienic swimming behaviours and reduce transmission of cryptosporidium, it was evident that further exploration of these factors was needed. The findings in phase 1 identified intrapersonal, interpersonal, organisational, community and policy factors that influenced the hygienic behaviours of swimmers. Thus, a number of factors were further explored in this second phase of work.

As identified in Chapter 4, the SEM (McLeroy et al., 1988) was used to aid interpretation and understanding of the findings. Therefore, the SEM was the overarching framework used when developing this second phase of work. To achieve the aim and objectives of this phase, as presented earlier in this section, a questionnaire was developed to address some of the different factors identified through interpretation of the findings from phase 1. A reminder of the first phase findings in relation to the SEM can be found in Chapter 4, section 4.4.7., figure 4c.

Many of the questions can be related to more than one level within the SEM. The questions are all interlinked in order to investigate the phenomenon of hygienic swimming behaviour further. For example, the question relating to respondents' usual swimming facility is interlinked with the question regarding noticing information at the swimming facility usually attended by the respondent.

The questionnaire was designed to gather information from respondents about six different themes relating to swimming and hygienic swimming behaviours. The first set of questions (Q 1-3) focused on the participants' swimming habits. This was in order to explore the intrapersonal factors of the SEM (McLeroy et al., 1988), such as whether they went swimming and how often they swam, to examine whether swimmers' frequency of swimming could influence their awareness of hygienic swimming behaviours. The third questions asked the

participant to state their usual swimming facility. The purpose of this question was to explore organisational and community factors (McLeroy et al., 1988). Interviews conducted with pool operators in phase 1 highlighted how organisations differ in terms of their efforts to promote hygienic swimming behaviours: therefore, it was considered important to explore this further. Also, the swimming facilities which took part in this study are set within different rural and urban communities within South Wales, so it would be interesting to attribute some results to the swimming facilities to explore further the culture and social norms within different communities.

As demonstrated by the findings in phase 1, parents/guardians can have an influence on children's hygienic swimming behaviours. Therefore, the second set of questions (Q 4-7) focused on whether the participant took children swimming. If they did take children swimming, participants were asked whether any of them were under the age of five. This question was included because children under five are more likely to have a toileting accident in a swimming pool (PWTAG, 2017). Thus, this section further explored some interpersonal factors (McLeroy et al., 1988). Organisational factors were also considered for question 7 regarding where parents took their children swimming, to help to understand whether different swimming facilities are providing information to influence parents/guardians of swimmers. This also links to community factors in relation to whether swimming facilities are helping to create cultures which are encouraging and supportive of hygienic swimming behaviours.

The third section of the questionnaire (Q 8-10) focused on the respondents' knowledge and attitude towards hygienic swimming behaviours, including a Likert scale asking them to what extent they agreed or disagreed with swimming pool settings giving information about hygiene behaviours to swimming pool users. This section of the questionnaire focused upon many different levels of the SEM (McLeroy et al., 1988). The intrapersonal factors focused on the individual level, such as knowledge and attitudes of hygienic swimming behaviours. Phase 1 provided evidence that there was varied awareness amongst swimming pool users: therefore, it was considered important to explore this further in the second phase, as demonstrated by these three questions.

Question 8 can also be considered to be on the interpersonal level in that the questions includes 'or parent of a swimmer' in order to understand whether respondents knew what they could do as a parents to help keep the swimming pool water clean and healthy: that is, whether they can influence their children's hygienic swimming behaviours. Organisational factors such as

whether respondents had seen information in their usual swimming facility and whether they felt that swimming facilities should be responsible for providing information to swimming pool users were also explored in this section of the questionnaire. Questions 8-10 also explore community and policy factors, that awareness of hygienic swimming behaviours needs to be raised amongst the swimming pool user population. Does policy need to be adapted to incorporate hygienic swimming behaviours in order to encourage and support a national culture where these behaviours are seen to be the social norm within swimming facilities?

Showering before swimming was a particular behaviour that was found to be influenced by a number of factors. Phase 1 highlighted how swimmers may be aware of the recommended behaviour to shower before swimming, but this did not mean that they always followed this behaviour. To provide a further insight into this, the fourth section (Q 11-12) of the questionnaire developed gathered information about when swimmers shower at the swimming pool: that is, whether they shower before swimming, after swimming or both. Showering before entering the pool helps to remove make-up, bodily grease and perfumes. These larger particles tend to sit at the top of the pool water, leading to an unpleasant swimming experience, but also affecting the ability of chlorine to denature pathogens (PWTAG, 2017). This section also focused on factors that may influence behaviour at the interpersonal and intrapersonal level of the SEM, but also included the organisational level. Focusing on the behaviour of showering before swimming allowed for the further exploration of when swimmers shower to identify their knowledge and stated routines. A question (Q 12) was included to identify whether swimmers or parents had seen any information about hygienic swimming behaviours at the swimming pool setting. This relates to the organisational level of the SEM in relation to whether the swimming pools are creating a culture that supports and educates swimmers regarding hygienic swimming behaviours.

The next section of the questionnaire (Q 13-15) was designed to gather information about how participants would like to receive information from the swimming pools about hygienic swimming behaviours. This section related to the policy, organisational and intrapersonal factors identified from phase 1. For example, how respondents want to receive information regarding hygienic swimming behaviours can be linked to other intrapersonal factors such as age, gender and educational levels. Organisations' ability to provide the type of intervention most preferred by respondents is relevant here, in addition to policy factors which encourage the adoption of such interventions by swimming facilities.

This section included two open-ended questions to allow respondents to note any other means of delivering information that would be acceptable for them. The options for receiving information regarding hygienic swimming behaviours presented to respondents of this questionnaire were developed based on the findings from phase 1. During the predominantly semi-structured interviews conducted in phase 1 with many different stakeholders, many ways to provide information to swimming pool users were identified. The most commonly identified way to raise awareness of hygienic swimming behaviours was posters in the changing rooms. Other common answers included leaflets, social media posts and information on the swimming facilities' websites. One participant (a swimmer) in phase 1 highlighted how posters or signs on the backs of toilet doors would be a good way to reach a captive audience, while a small number of participants identified the benefit of a video in reception which demonstrated what the recommended hygienic swimming behaviours were. Other means to raise awareness were identified during the first phase, such as audio that was played in the changing rooms to instruct swimmers of the recommended hygienic behaviours. However, following analysis of the findings from phase 1, previous literature and a consideration of the practical implementation of a public health campaign, the following options were presented to respondents to choose from in phase 2:

- Leaflets in reception
- Posters/Signs on changing room walls
- Posters/Signs on the backs of toilet doors
- Video/Posts on the swimming pools' social media pages
- Video/Posts on the swimming pools' website
- Video on TV screens in reception

The final section (Q 16-17) collected demographic data, age and gender, in order to compare whether more than one method of raising awareness would be needed to ensure that all swimmers were targeted by the intervention, which was highlighted as important in phase 1 of this study.

Phase 1 highlighted the influence of many factors upon hygienic swimming behaviours. Therefore, all levels of the SEM were considered in order to develop an appropriate questionnaire to further explore these factors. It is important to consider the intrapersonal and interpersonal levels to understand how to influence people on an individual level, while the

organisational and community levels focus on influencing people at a population level. These questions link to the fifth level of the model, namely public policy, as the answers provided from these questions help to support the need for a public health intervention.

The next sub-sections provide detail of how phase 2 of this study was conducted, in order to quantify and verify the findings from phase 1 of this study.

### 5.2.3. Sample

Respondents were required to be swimmers or parents/guardians of a swimmer and to be over the age of eighteen. Respondents were also required to be able to express themselves in English or Welsh. Individuals who did not meet the inclusion criteria were excluded from the study. This was because the study was focused on gathering information from people who had experience of being in a swimming pool setting. Although they did not need to be frequent swimmers (less than once a month, for example), they were required to be in the swimming environment to be able to provide the data required in this phase of the study. The questions were focused on swimmers' or parents of swimmers' experience of being in a swimming pool. The focus was upon how swimmers/parents of swimmers wanted to receive information from the swimming pool settings. The swimming population was considered to be the most appropriate sample to answer this specific question, as they are the ones for whom the health educational materials developed following phase one and phase two would be targeted. Reinforcing the importance of the need to involve the target audience in health educational is imperative in creating a successful public health intervention (Craig et al., 2008).

Due to the tight timeframe for this research, in relation to collecting data in two phases and allowing time to develop an evidenced-based intervention, use of a convenience sample was deemed most appropriate for this phase (Lavrakas, 2008). Although using a convenience sampling technique can introduce bias, it was considered the most appropriate for this research, as it is time saving, affordable and relies on participants being readily available (Jensen & Laurie, 2017). As this research was carried out as part of a funded PhD, there was a time constraint to complete all phases of work in order to allow for completion by the deadline.

Due to the nature of swimming pools, it is hard to access participants outside of the pool setting, as it is not easy to identify whether someone participates in swimming or takes their child swimming unless they are at a pool. Even then, it was found that some people at the swimming



pool setting were not in fact swimmers or parents of a swimmer. Generally, these were individuals who used the cafés at the swimming pool settings. Gaining access to swimmers or parents of swimmers outside the swimming pool setting was considered. It was planned for swimming pools to send out an email to their members asking them to take part in the research, using a convenience sampling technique. Unfortunately, with the new General Data Protection Regulations (2018), the swimming pools were not able to carry this out, as their policies were in the process of being updated.

It is important to note that the sampling technique used in this study can and did lead to some bias being introduced. For example, some members of the sample were underrepresented, such as those who do not come into the swimming pool but were parents of swimmers. In order to ensure that the convenience sample did not introduce too much bias into the research, I attended the swimming pools to conduct face-to-face data collection at various dates and times of the day, during various activities, to try to capture data from a broad range of the swimming population. For example, I did not solely focus on attending the pools during children's swimming lessons, where parents were more likely to be watching, providing a large number of potential participants. This would have introduced bias in the sample, with parents of swimmers being over-represented and other swimming pool users such as older people being under-represented. Unfortunately, it was apparent that some swimmers did not have time to complete the questionnaire following swimming due to time restraints and other commitments. For example, those who were swimming early in the morning did not have time because they needed to commute to work. In this instance, they were offered the opportunity to take a questionnaire home and bring it back to the swimming pool reception area. The response rate is provided later in this chapter in section 5.3. They were also offered a QR code to access the online version of the questionnaire, which also did not always prove to be productive. The QR code was placed on a small card the size of a business card and could be scanned using the camera of a mobile device such as a phone or a tablet (assuming that the device supported this technology). Scanning the code would bring up the online questionnaire for respondents to complete on their mobile device.

With all issues considered in terms of sampling the swimming population in six different swimming pools, the convenience sampling technique worked well and provided a broadly representative sample of the swimming population.

A minimum target of 100 participants was set before data collection began. This was based on the difficulties faced in the recruitment process of phase one and the fact that a convenience sampling technique does not require to sample to saturation. Ideally, if this study were to be replicated, a sample size and power calculation would be conducted to confirm the number of participants required, to help avoid a type I or type II errors (Forstmeier, Wagenmakers & Parker, 2017). A type I error is when it is reported that there is a difference between two groups when in fact there is not, whereas a type II error is when it is reported that there is no difference between two groups, when in fact there is a difference (Forstmeier, Wagenmakers & Parker, 2017). Therefore, there is a need to recruit sufficient participants to ensure the power of a study (Faber & Fonseca, 2014). However, as this study was the first of its kind in the United Kingdom, there is a lack of literature on this type of research and therefore data are not available on which to base the calculations (Rudestam & Newton, 2014).

#### 5.2.4. Location

Participants were recruited at six different swimming pools in the South Wales area. These were the same six pools that were used to recruit participants in phase one of this study. Three swimming pools were located within one local authority and the other three were in another local authority. These pools were chosen due to their potential to have high bather loads (number of swimmers at one time). The pools were located in various socio-economic communities and were used by a range of people. This was to capture data from various demographics to try and obtain a representative sample of the swimming population in the South Wales area.

Although recruitment took part in the six swimming pools, participants could be swimmers or parents of swimmers from outside these six swimming pools. For example, some participants were using the swimming facilities while they were on holiday: therefore, when they were asked what swimming pool they usually went to, they did not note the pool from where they were recruited. This provided invaluable access to participants from outside the South Wales area.

#### 5.2.5. Method of data collection and recruitment

A quantitative questionnaire (Appendix 3a) was developed based on the findings from the interviews carried out in phase one. Literature on hygienic swimming behaviours, cryptosporidium and previous surveys used in communicable diseases and health behaviours were also consulted during the development stage. The questionnaire was piloted amongst a small group of ten people of various ages and educational levels. Questionnaires were piloted amongst some of my friends, family members and colleagues prior to ethical approval being sought for this phase of work. I asked 10 people to fill in a paper copy of the questionnaire at a time and location convenient to them (at the University or at friends / family home address). The questionnaire was not changed after being piloted, as no issues were raised at this stage. Each pilot participant was timed to calculate an average completion time for the questionnaire in order to include this information for participants at the start of the questionnaire and in the participant information sheet. It was calculated that on average, the questionnaire did not take longer than ten minutes to complete. Questionnaires were available in English and Welsh. The majority of swimming pools required the materials to be bilingual due to the requirements of Welsh Language legislation. I am a first language Welsh speaker, and therefore felt comfortable to translate any Welsh questionnaires for analysis. Translations were checked for accuracy by a Welsh-speaking friend.

There were 17 questions in total, with 13 being closed questions and four being open-ended. It was decided to use a quantitative questionnaire with predominately closed questions, as this allows for questions to be easily answered by participants and easily compared and analysed by the researcher (Kelley, Clark, Brown & Sitzia, 2003).

No technical jargon was used in the questions, as the aim of the study was to recruit participants of various ages, from different socio-economic backgrounds and with a variety of literacy levels. The data collection tool was created to look professional, incorporating the Swansea University logo. The questionnaire was considered by the pilot group to be clear and concise. The pilot group of 10 individuals, as previously discussed, felt that the instructions included on the questionnaire were easily understood.

Although no issues were raised when the questionnaire was piloted, it was evident from some responses that the one ranking question (question number thirteen) did cause some confusion for some participants. They were asked 'Please rank the following options from your most (top) to least (bottom) preferred method of receiving information from the swimming pool about

how you can help keep the pool water clean and healthy. 1 being your most (top) preferred choice and 6 being your least (bottom) preferred choice.’ Unfortunately, some participants put the number one against three of the options presented to them and then the number 6 against the other three options, as an example. This occurred only on the paper version, as the online version controlled for this by only allowing the participants to rank an option as their most preferred once.

Participants were provided with a Participant Information Sheet (Appendix 3b) to read before taking part in the study. The paper copy was provided separate to the paper questionnaire to allow participants to keep the information if they wished to do so. The online version was presented to participants when the web-link was opened, and they were advised to screenshot the information to access it at a later date. The information sheet provided information about the study and on data protection measures. This was also available in Welsh both on paper and online.

To aid in recruitment when I was not present at the swimming pools, bilingual posters (Appendix 3c) and cards (Appendix 3d) were developed. Both included a QR code to scan to access the online version of the questionnaire. My name and email address were provided in case participants wished to contact me to ask any questions or if they had any difficulty accessing the questionnaire through the QR code. An email was created which included the web-link to the online questionnaire to help recruit participants through the swimming pools’ mailing lists, but as previously mentioned, this was not possible due to the new GDPR.

To debrief participants, my contact information was provided at the end of the questionnaire and they were advised that they could contact me if they required any further information or to ask any questions. A web-link directing respondents to information on hygienic swimming behaviours on the Centres for Disease Control and Prevention (CDC) website was also provided. Although this organisation is American, this website was deemed to provide the best information about hygienic swimming with good resources including videos. Unfortunately, there is no such website from an UK organisation. The focus of the video is predominantly on providing information about cryptosporidium and ways to prevent it spreading in the swimming pool.

Data collection was carried out from the 1<sup>st</sup> of August 2018 until the 30<sup>th</sup> of September 2018. These dates were selected to capture data from the summer holiday swimming pool users and the regular, term-time swimmers. From speaking with the swimming pool managers, August

would provide potential participants from less frequent swimmers during the summer holidays, while September would provide potential participants from the regular users in terms of swimming lessons and those who swam before or after work.

Each pool had its 'data collection pack' provided to them on the 1<sup>st</sup> of August. The data collection pack included Welsh and English copies of the following documents as detailed in previous sections: questionnaires (which included consent forms), participant information sheets, recruitment posters and recruitment cards. They were given the posters and cards to display at their reception and paper copies of the questionnaires to be available behind the reception desk. One swimming pool informed me that they would not be able to display the posters or have the questionnaires behind reception, but they were happy to hand out cards to their customers from the reception area.

It was evident that face-to-face recruitment was needed, as after two weeks of the pools receiving their data collection packs, no paper copies and very few online questionnaires had been completed. Therefore, I developed a face-to-face recruitment timetable whereby different times were selected based on the different swimming activities timetabled to gather data from a variety of people. For example, one week I would attend swimming pool A at a time where swimming lessons were the main activity; and swimming pool B early in the morning where regular swimmers attended before work, including those who were retired. The following week, I would attend the swimming lessons at swimming pool B and a late evening public swimming session in swimming pool A, and so on. Prior to attending any sessions, all swimming pool representatives were contacted in advance to inform them that I would be present on a certain date during a certain time.

In some instances, staff members (usually reception staff) would also help with recruitment while I was present. It was hoped that staff members would be more active in recruiting participants by handing out the cards to their customers, but it became evident that the cards were placed on the reception area and it was left to customers to pick one up if they wished to. As previously stated, only one pool actively handed out the cards. A record of the number of cards handed out was recorded in order to calculate a response rate, which is included in the results section.

Face-to-face recruitment was conducted either in the reception area of the swimming pool, the café area or the viewing area, where people can sit and watch the swimmers. These areas were approved by all pool representatives. It was not deemed appropriate to approach people in the

changing areas of the swimming pool for ethical reasons; moreover, this would have biased the results considerably, as I would have only been able to recruit female participants.

Potential participants were approached to ask if they were swimmers or parents of a swimmer and were willing to take part in a short survey about swimming. They were told that they did not have to take part if they did not want to. Participants were told they could complete a paper copy of the questionnaire there and then, with pens and a seating area provided, or they could take a paper copy home to complete and then return to reception. They also had the option to take a card instead to access the online version either there and then or at a later date. The number of paper copies handed out to take home and the number of cards handed out were also noted to allow calculation of the response rate.

Once the participant had completed the questionnaire, they were informed that they could hand it back to me or give it to a staff member at reception who would keep it safe until the next time I was present to conduct data collection. They were encouraged to keep the participant information sheet and if they had any questions at the end of the questionnaire to ask myself there and then or email me at a later date.

Online questionnaires were collected using Qualtrics (Qualtrics, 2005) which is the software used by Swansea University. The questions were the same, with the same layout as the paper versions. The cards provided had the QR code to access the questionnaire online.

#### 5.2.6. Data analysis

The completed questionnaires were all provided with a unique identifier code before data was added to a spreadsheet using SPSS version 25. The variables had already been created during the data collection timeframe where variables were coded: for example, for the variable 'gender', male was coded as 1 and female was coded as 2. This made for easy inputting and analysis of the data in SPSS.

Thematic analysis was conducted on the open-ended questions. Descriptive statistics were carried out to describe the sample, such as the percentage of males and females who took part in the study. Cross-tabulations were also carried out to compare groups, such as the preferred way of receiving information from the swimming pools for males compared with females. The focus of the descriptive analysis was to answer the aim and objectives set for this second phase

of work, which were stated at the beginning of this chapter. A Shapiro-Wilks test was undertaken to identify whether the data was normally distributed prior to conducting the inferential statistics. The p values and confidence intervals have been scrutinised to identify accuracy and the probability that the results found were not due to chance. Further detail of the analysis conducted is detailed later in this chapter, in the results section (5.3).

#### 5.2.7. Ethical considerations

It was decided to use the same pools as in phase one, as obtaining gatekeeper permission for these pools took some time. Therefore, the same contacts made from phase one were contacted to ask permission to conduct a second phase of data collection at their pools. Letters were provided by all swimming pool representatives to confirm their permission to conduct the study.

Consent was provided at the beginning of the paper questionnaire by asking participants to initial next to the statements provided in relation to taking part in the survey. Generally, consent is assumed when a survey is completed online (Sue & Ritter, 2012).

Ethical approval was provided by the Ethics Committee for the College of Human and Health Sciences, Swansea University on 19<sup>th</sup> of June 2018 (Appendix 3e).

Participants were not coerced into taking part in the survey. However, if they declined to take part initially but were interested in the study, I advised them that information was available at reception until the 30<sup>th</sup> of September 2018 if they did change their mind.

It was not envisaged that the questionnaire would cause any harm or distress to the participants. The questions asked were designed to be understood by people of various educational backgrounds by using easy-to-understand language. Respondents were provided with sources of additional information regarding cryptosporidium and hygienic swimming behaviours at the end of the questionnaire, in addition to my contact details (University email address).

There were no physical risks to me, as data collection took place in a public area, in the swimming pools, during normal opening hours. There was a risk that there would not be sufficient questionnaires completed to analyse, which is why the QR code cards and posters were created and face-to-face recruitment was planned prior to applying for ethical approval.

A section was included on both the online and paper questionnaires in relation to the right to withdraw from the study without giving a reason, up until data had been analysed. Participants were instructed to provide a unique six-digit code that they would need to remember in order to withdraw from the study at any point by contacting myself and quoting the number. No participants did contact me to withdraw from the study at any point.

Data were stored on a password-secured laptop and in a locked filing cabinet to ensure that only I and my supervisors had access to the data. Data will be destroyed after five years when publications and all outputs from the study have been completed. Paper copies will be shredded and any electronic copies such as memory sticks will be destroyed accordingly. Responsibility for the destruction will lie with the main researcher (myself), and data will be destroyed in a confidential and secure manner. The questionnaire did not require the participants to disclose their name or any other identifiable information.

#### 5.2.8. Validity and reliability

The validity and reliability of the questionnaire was considered. To ensure validity, the questionnaire developed needed to measure what it intended to measure (Bolarinwa, 2015). To address validity, the questionnaire was scrutinised by me and by my PhD supervisors to try to ensure as far as practicable that it provided answers to the aim and objectives of this second phase of work. It was believed that the questionnaire did further explore awareness of hygienic swimming behaviours amongst a larger sample of swimming pool users. An explanation of how and why the questions were developed is provided in section 5.2.2., which provides justification of the questionnaire being developed to be valid. As mentioned previously in this section, the questionnaire was piloted amongst a group of 10 volunteers of different ages, genders and educational levels. The questionnaire was considered reliable, as it was developed to be able to create reproducible results and to be valid (Bolarinwa, 2015).

The next section presents the results of this second phase of work.



### 5.3. Phase Two Results

This section presents the results from the quantitative survey, as described in section 5.2. The characteristics of the sample population and descriptive statistics are presented in this section, and a discussion of the findings is presented in section 5.4. The purpose of this phase of the study was to verify how swimmers/parents of swimmers would prefer to receive information about hygienic swimming behaviours from the swimming pool they attended. The options for receiving this information were developed based on the findings from the predominantly semi-structured interviews conducted in phase 1 and presented to survey respondents.

#### *Hypotheses*

- Hypothesis: there would be a difference between the six different options for receiving information from the swimming pools, with one option being more preferred than the others.
- Null hypothesis: There would be no difference in preference for the options for receiving information from the swimming pools.

#### *Response rate*

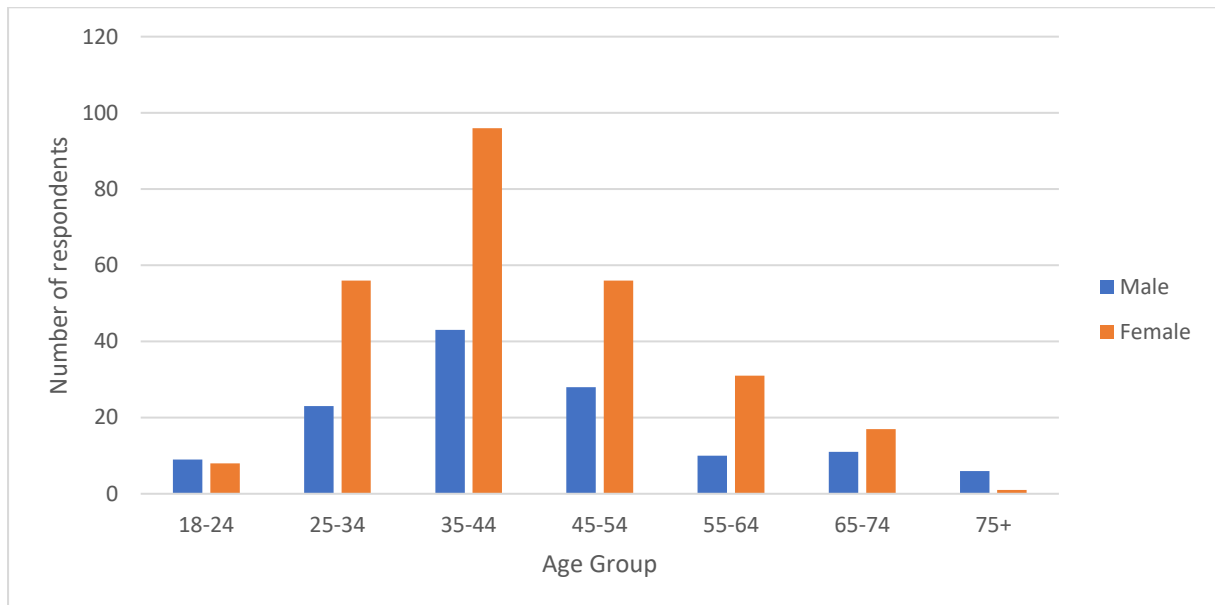
A total of 1162 questionnaires were distributed to potential participants, of which 400 were paper copies and 762 were QR code cards which provided access to the online questionnaire. The total number of questionnaires returned was 407, providing a response rate of 35%.

Table 5a: Response rate for phase 2 questionnaire

Type of Survey	No. distributed	No. of responses	Response Rate %
Paper	400	366	92%
Online	762	41	5%
<b>Total</b>	1162	407	35%

### 5.3.1. Characteristics of respondents

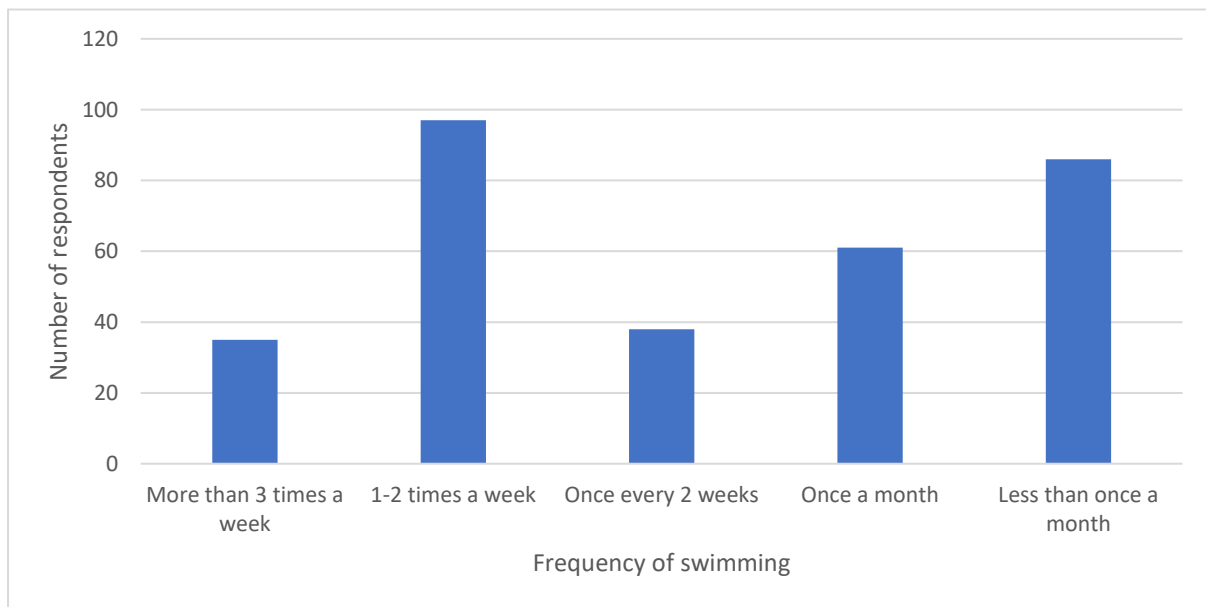
Figure 5a: The number of respondents in phase 2 by age group and gender



There were nine (2%) missing entries for gender, while 65% (n=265) of respondents were female, 32% (n=130) of respondents were male, and 1% (n=3) preferred not to disclose their gender.

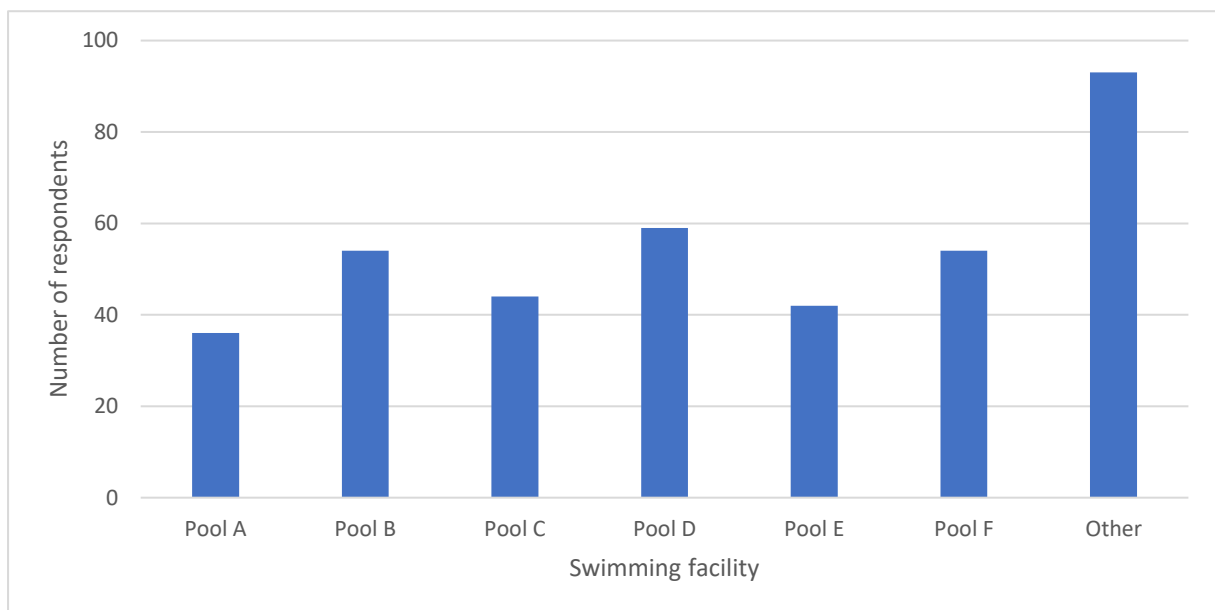
The majority of respondents were aged between 35 and 44 years (n=142, 35%). The age groups with the lowest numbers of respondents were 18-24 years (n=17, 4%) and over 75 (n=7, 2%). Six (1%) respondents did not complete this question. Of the three respondents who preferred not to disclose their gender, two were aged between 35 and 44 years and one was aged between 45 and 54 years.

Figure 5b: The number of respondents in phase 2 who swam by how frequently they swam



Of the 407 respondents surveyed, 78% (n=317) were swimmers, whereas 22% (n=90) did not go swimming themselves. Respondents were required to be a swimmer or a parent of a swimmer for their responses to be included in the data set. Of the 317 respondents who did go swimming, 31% (n=97) went swimming 1-2 times a week while 27% (n=86) went swimming less than once a month. Thirty-five (11%) swimmers went swimming more than three times a week.

Figure 5c: The number of respondents in phase 2 by their usual swimming facility

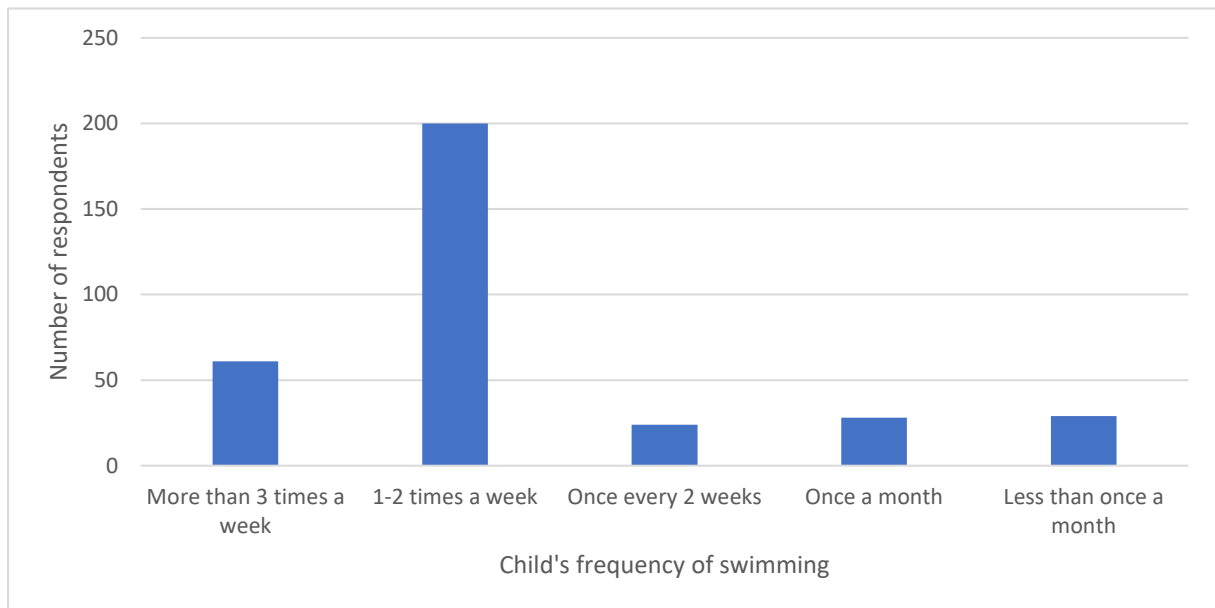


Of the 317 swimmers, the highest number of respondents (n=93, 29%) usually swam at a pool other than that where data collection took place. Some respondents listed more than one pool where they usually swam: therefore, more than one answer was recorded for this question.

### *Taking children swimming*

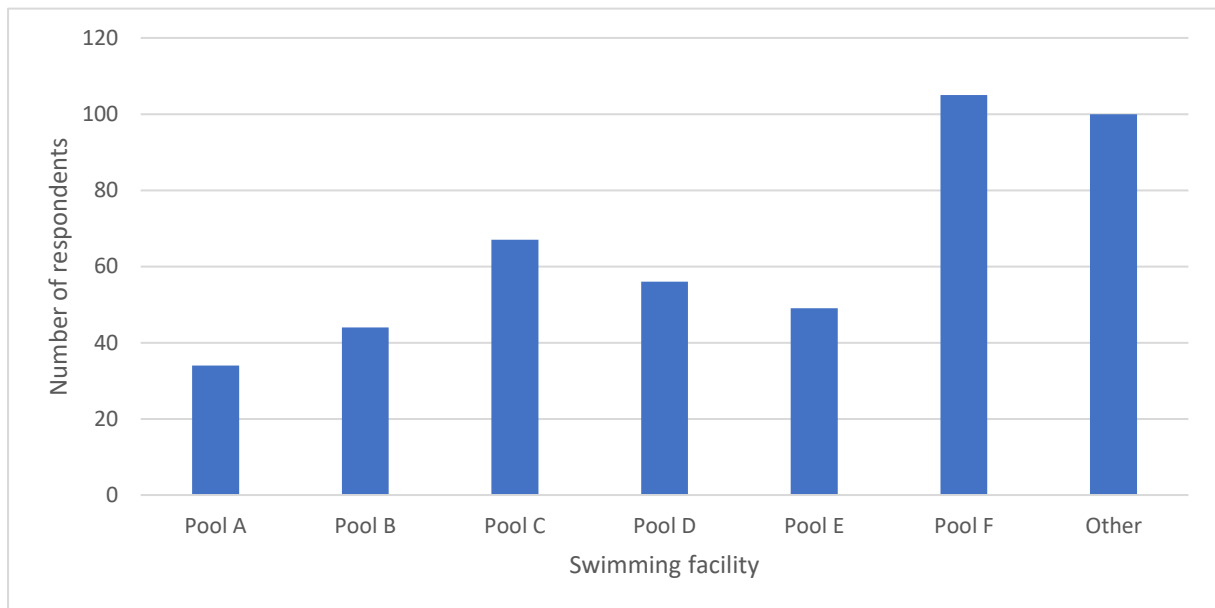
In total, 342 (84%) respondents took children swimming, and 33% (n=114) of those took a child under 5 years of age swimming. Of the 317 respondents who said that they went swimming, 252 (79%) said that they also took children swimming, whilst 63 (20%) did not. There were two missing entries for this question.

Figure 5d: The number of respondents in phase 2 who took their child(ren) swimming by how often their child(ren) went swimming



Of the 342 respondents who took their child(ren) swimming, 58% (n=200) said that the child(ren) went swimming 1-2 times a week.

Figure 5e: The number of respondents in phase 2 who took their child(ren) swimming by their child(ren)'s usual swimming facility

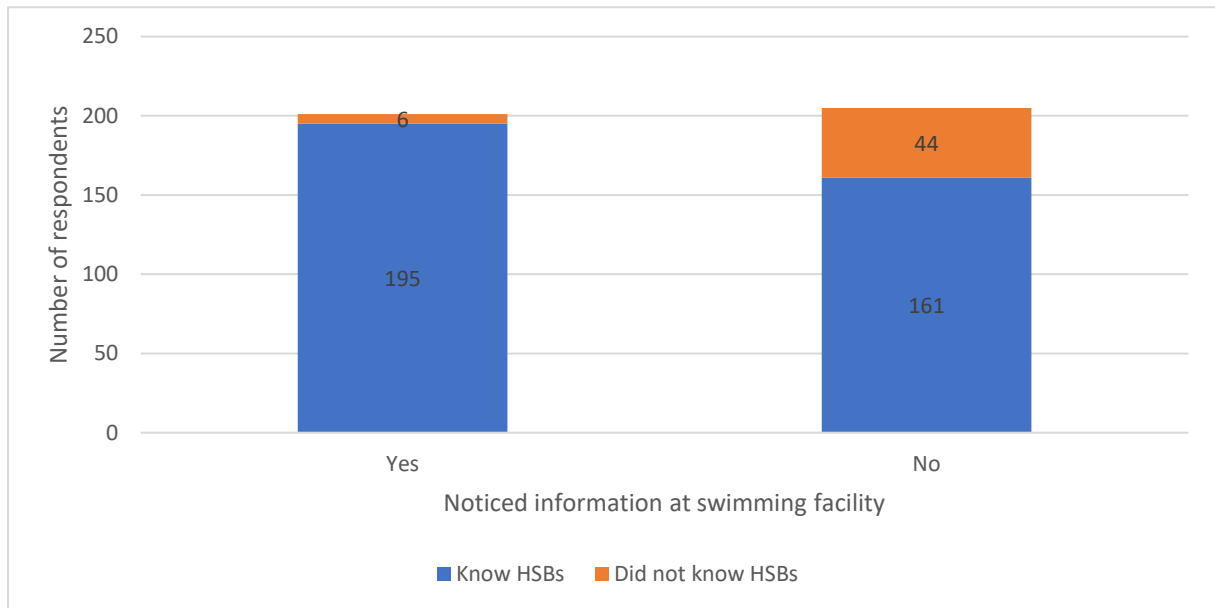


The majority of respondents who took their child(ren) swimming noted that their child(ren) usually swam at Pool F (n=105, 31%). Some respondents listed more than one pool where the child(ren) usually swam: therefore, more than one answer was recorded.

### 5.3.2. Awareness of hygienic swimming behaviours

Most respondents said that they did know what they could do as a swimmer or a parent of a swimmer to help the pool water to remain clean and healthy (n=356, 87%). Whilst 49.4% (n=201) of respondents had noticed information at their usual swimming pool about how they could help to keep the pool water clean, 50.4% (n=205) of respondents had not. One respondent (0.2%) did not answer this question.

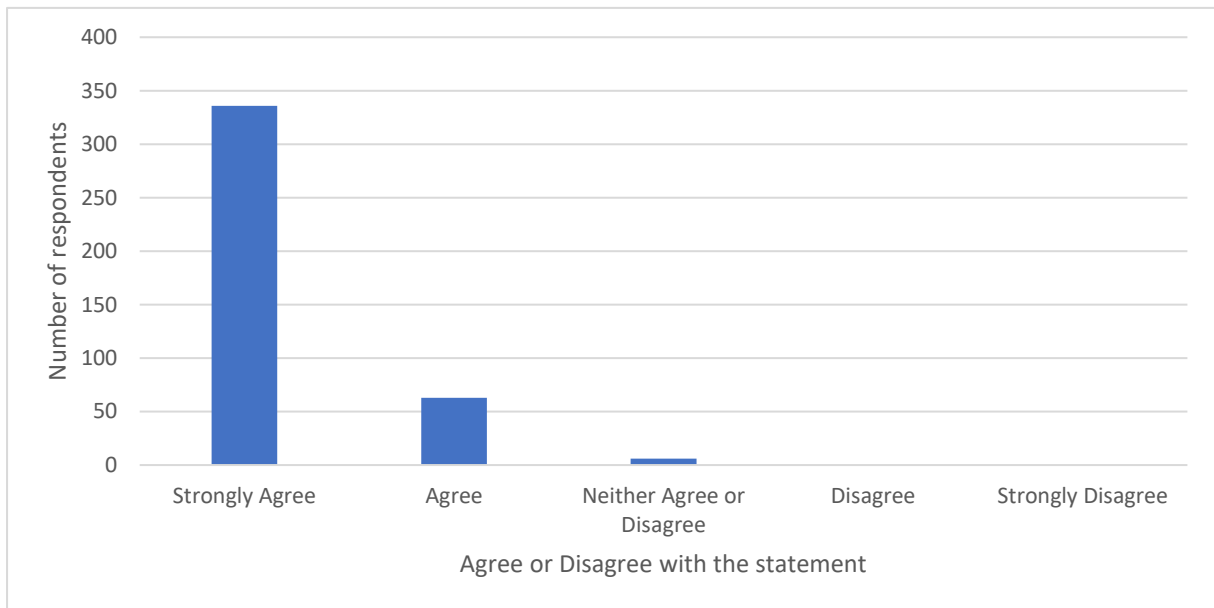
Figure 5f: The number of respondents in phase 2 by whether they had noticed information at their usual swimming facility and if they were aware of hygienic swimming behaviours



Of the 356 respondents who said that they did know what they could do as a swimmer or a parent of a swimmer to help keep the pool water clean and healthy, 55% (n=195) had noticed information at the swimming pool they usually attend about how they could help to keep the pool water clean and healthy. However, 161 (45%) respondents had not noticed any information at the swimming pool they usually attend.

Of the 50 respondents who said that they did not know what they could do as a swimmer or a parent of a swimmer to help keep the pool water clean and healthy, 88% (n=44) had not noticed information at the swimming pool they usually attend about how they could do so. Although they had noticed information at their usual swimming pool about how they could help keep the pool water clean and healthy, 12% (n=6) of respondents did not know what they could do as a swimmer or a parent of a swimmer to help to do so.

Figure 5g: The number of respondents in phase 2 by their response to how much they agreed or disagreed with the following statement: "It is important for swimming pools to let everyone know what they can do to help keep the pool water clean and healthy."



None of the respondents disagreed with the above statement, and 98% (n=399) of respondents either strongly agreed or agreed that swimming pools should let everyone know what they can do to help keep the pool water clean and healthy. Six respondents (1.5%) provided a neutral response to this question, while two (0.5%) did not answer it.

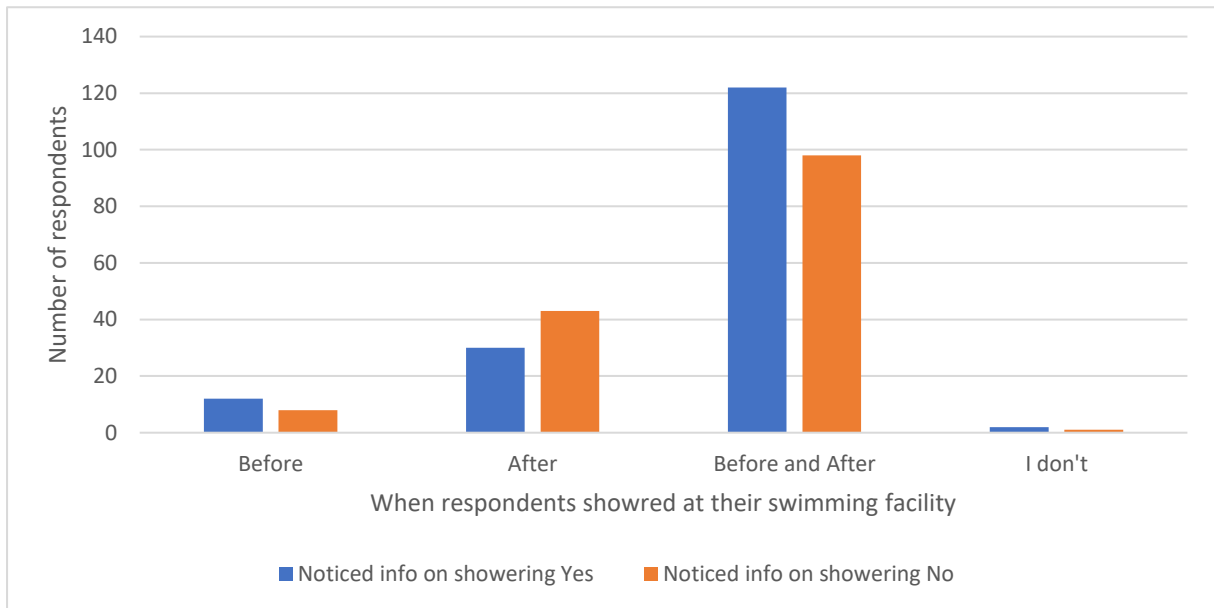
### *Awareness of showering*

Ninety respondents were excluded from the analysis under this section, as they did not go swimming themselves. Question 1 of the survey asked respondents ‘Do you go swimming?’ and if their answer to this question was ‘No’, they were excluded from the analysis focusing on showering at the swimming pool facility.

The majority (n=220, 69%) of respondents said that they showered before and after swimming, 6% (n=20) said they showered before swimming while 23% (n=73) of respondents said they only showered after swimming. Three (1%) swimmers reported that they did not shower at the swimming facility. One respondent did not provide an answer to this question.



Figure 5h: The number of respondents in phase 2 by when they shower at the swimming facility and whether they had noticed information about showering before swimming



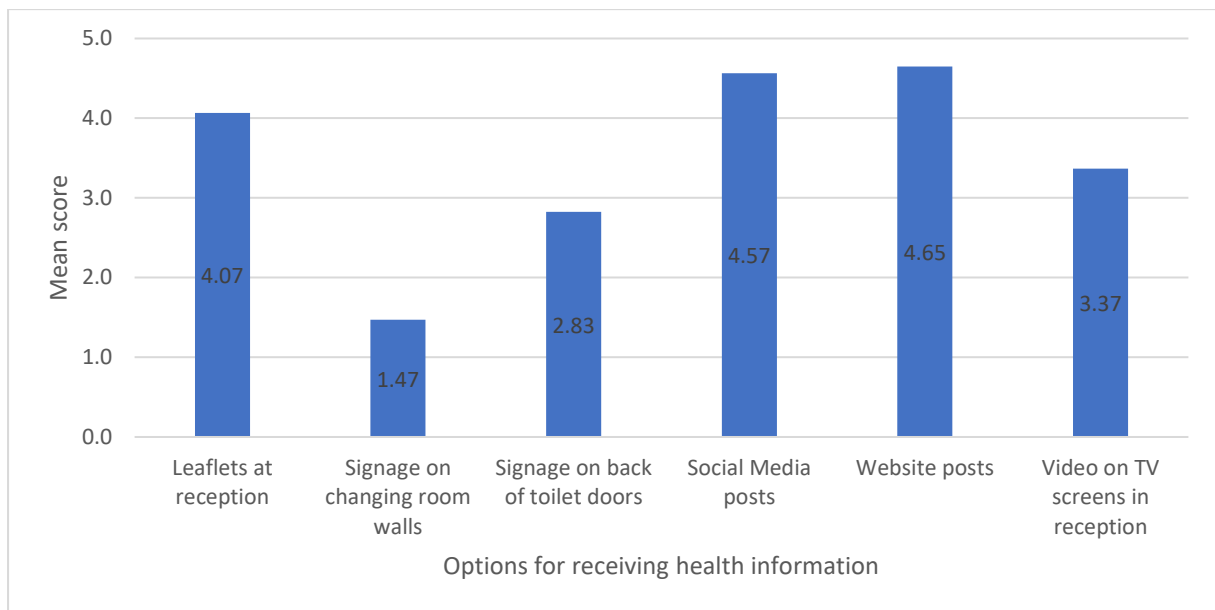
N.B. A respondent who noted that they showered after swimming had not answered the question to whether they had noticed information about showering at the swimming pool.

Of the 73 respondents who said they only showered after swimming, 41% (n=30) had seen information about showering before swimming, while 59% (n=43) had not. There were 220 respondents who said they showered before and after swimming, of whom 55% (n=122) had seen information about showering, while 45% (n=98) had not. Of the 20 respondents who said they showered before swimming, 60% (n=12) had seen information about showering, while 40% (n=8) had not.

### 5.3.3. Preferred means of receiving information

To make inferences about the preferred means of receiving health information, the mean scores for each option were calculated. The option with the lowest mean score was the most preferred option, while the option with the highest mean score was the least preferred option.

Figure 5i: The mean score of each option for receiving health information (phase 2)



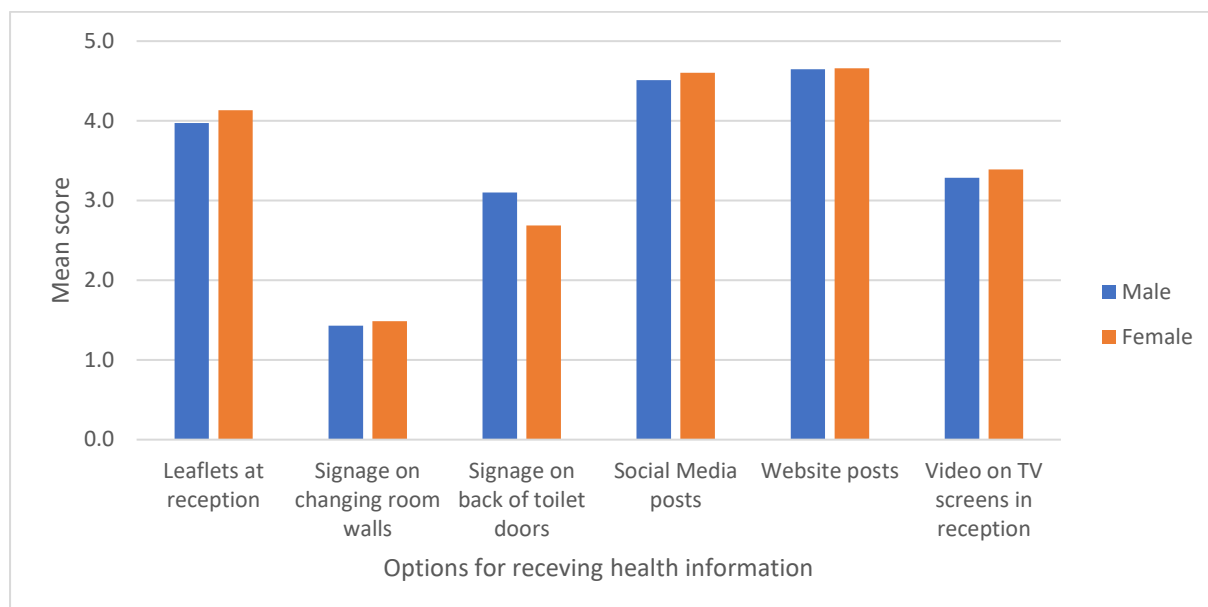
*Note: lower mean score = most preferred option*

N.B. 18% of respondents had not completed this question correctly or had left it blank, and therefore were excluded.

The data were coded so that each of the options are separate variables and are assigned a number from one to six, based on the rank the respondent had given the option. Therefore, a respondent who ranked leaflets as their most preferred option received a 1 under the variable 'leaflets at reception'. The option that received the most scores of 1 had the lowest mean score, and therefore was the most preferred option.

Signage on changing room walls had a mean score of 1.47 (SD = 1.05), which was the lowest score. This means that it was the most preferred way of receiving information from the swimming pools. Signage on the backs of toilet doors had the second lowest mean score of 2.83 (SD = 1.27). Video on TV screens in reception had the third lowest mean score, 3.37 (SD = 1.43).

Figure 5j: The mean score of each option for receiving health information by gender (phase 2)



Note: lower mean score = most preferred option

There is no difference in these results when looking at the independent variable of gender. The order of the top three preferred choices remained the same for males and females. There was, however, a difference when looking at the preferences by age group.

Table 5b: The mean score of each option for receiving health information by phase 2 respondents' age groups

Age Group	Leaflets at reception	Signage on changing room walls	Signage on back of toilet doors	Social media posts	Website posts	Video on TV screens in reception
18-24	4.41	2.47	3.53	3.76	4.41	2.41
25-34	4.30	1.51	2.81	4.29	4.61	3.43
35-44	4.17	1.33	2.73	4.62	4.69	3.50
45-54	4.00	1.46	3.12	4.53	4.55	3.24
55-64	3.36	1.52	2.76	4.97	4.84	3.50
65-74	4.00	1.38	2.25	5.21	4.74	3.10
75+	3.00	1.33	2.33	5.17	4.83	4.33

For respondents aged 18-24 years, the most preferred option was TV screens in reception, with signage on changing room walls being the second option and signage on the backs of toilet doors as the third option.

The most preferred option for the 55-64 year age group and the 75+ age group was signage on the changing room walls, followed by signage on the backs of toilet doors, while their third option was leaflets at reception.

All other age groups preferred signage on changing room walls, with signage on the backs of toilet doors as their second option and the TV screens as the third preferred option.

No difference was found in the mean scores for each option when comparing respondents who did go swimming to those who did not. There was no difference in mean scores of the top four options when comparing the frequency of those who did go swimming. This was also true when looking at the swimming pools where people swam.

Respondents who took children swimming and those who did not had the same preference and order for the six different options for receiving information. There was no difference in mean scores for the top four options when comparing how often the children swam. However, while comparing mean scores of each option by the swimming pool where the child(ren) usually swam, the top three options remained the same. However, the bottom three preferred options varied between pools.

No difference was found in respondents' preferences for the top two options of signage on the changing room walls and signage on the backs of toilet doors when looking at those who strongly agreed, agreed, or neither agreed or disagreed with the following statement: "It is important for swimming pools to let everyone know what they can do to help keep the pool water clean and healthy." Those who agreed or strongly agreed indicated a video as their third option, while those who neither agreed nor disagreed indicated leaflets. None of the respondents disagreed or strongly disagreed with the statement.

While comparing when respondents showered at the swimming pool, no difference in the mean score of the top two most preferred options were identified. Those who did not shower at the pool had the video as their least preferred option, while those who did shower at the pool at some point had video as their third option. Those who did not shower at the pool selected leaflets as their third option.

### *Inferential statistics*

Hypothesis: Signage on changing room walls is the most preferred option for receiving information by swimmers/parents of swimmers.

Before performing any statistical analysis, a test of normality using the Shapiro-Wilk test was undertaken to identify whether the data were normally distributed or not. Normally distributed data would require parametric tests to be performed, while skewed or non-normal distribution would require non-parametric tests (Field, 2018).

Table 5c: Shapiro-Wilk test to test for normality of phase 2 data

Options for receiving health information	Shapiro-Wilk, Test of Normality		
	Statistic	df	Sig.
Leaflets at reception	0.885	344	0.000
Signage on changing room walls	0.514	349	0.000
Signage on back of toilet doors	0.799	340	0.000
Social media posts	0.877	334	0.000
Website posts	0.871	334	0.000
Video on TV screens in reception	0.927	336	0.000

As the significance of the Shapiro-Wilk test was below 0.05 for each variable, the data were not normally distributed: therefore, non-parametric tests were performed.

The Friedman Test was performed in order to see whether there was a significant difference between each of the six different options for receiving information. The results show that there was a statistically significant difference between the preferences for the six different options,  $X^2(5) = 702.2$ ,  $p < 0.001$ . However, this test did not show where the differences lie between the options.

Five separate Wilcoxon Signed Rank Tests were performed in order to see whether there was a difference between the means of the option of poster on changing room walls and each other option. This allows us to see whether the preferred option of posters on changing room walls was significantly different from the other options (separately).

The results showed that there was a statistically significant difference between the option of signage on changing room walls and all other options:

- Leaflets at reception,  $Z = -14.514$ ,  $p < 0.001$ .
- Signage on the back of toilet doors,  $Z = -14.463$ ,  $p < 0.001$
- Social media posts,  $Z = -14.747$ ,  $p < 0.001$
- Website posts,  $Z = -14.713$ ,  $p < 0.001$
- TV screens in reception,  $Z = -12.343$ ,  $p < 0.001$

All five Wilcoxon Signed Rank Tests showed that there was a significant difference ( $p < 0.001$ ) between mean scores of signage on changing room walls and each other option.

To identify whether the results observed were due to chance, a binomial test was also carried out.

Table 5d: Results of the Binomial Test on Signage on the Changing Room Walls (phase 2)

Signage on Changing Room Walls	Binomial Test			
	N	Observed Prop.	Test Prop.	Exact Sig. (1-tailed)
Most Preferred	266	0.654	0.166	0.000
Other Preferred & Missing	141	0.346		
Total	407	1.000		

In order to perform the Binomial Test, the categories for the option variables had to be recoded to a new variable, as the Binomial Test can only work with two groups. Group 1 in this case is the option most preferred, with group 2 including all other options and any missing values.

The test proportion was set to  $1 / 6 = 0.166$ , as there were six options to choose from. This is what would be expected from chance if respondents were randomly choosing the options (or didn't have much of a preference): that is, 16.66% would select a given option for receiving information. The selection needed to be significantly different from 16.66%. Signage on walls was chosen by 65% of the sample, which is significantly higher than the test proportion.

The significance of this finding was 0.000, showing that the results were not due to chance: therefore, the null hypothesis could be rejected and it could be concluded that signage on changing room walls was the most preferred option of receiving information.

### *Additional information*

Thematic analysis of the two open questions included in the questionnaire resulted in the emergence of three themes. These were:

- Suggestions from respondents of ways to raise awareness of hygienic swimming behaviours;
- Suggested considerations from respondents for interventions to raise awareness of hygienic swimming behaviours;
- Suggested hygienic swimming behaviours that should be promoted.

Respondents offered alternative ways in which information regarding hygienic swimming behaviours could be provided to swimming pool users, which included email, lessons for children and on locker doors, for example. One respondent did state that no further information was required with regard to keeping the swimming pool water clean and healthy. The table below shows the suggested ways of raising awareness of hygienic swimming behaviours, including a supporting quote relating to each interpretation.

Table 5e: Suggestions from respondents in phase 2 of ways to raise awareness of hygienic swimming behaviours

Feedback interpretation	Example quote
Locker doors	"Within the locker doors"
Floor of changing areas	"On the floor in splats to the changing area as kids would notice it"
Signs on pool side	""Have you showered?" posts on entering pool area (pool side)"
Verbally by staff/audio	"Staff in changing area speaking to people"
Receipts	"On receipt for swimming"
During registration	"When booking onto swimming lessons"
Email	"Email to members"
Information by post	"Post a leaflet"
Text	"Via text message i.e. send link to site with info"
App	"App"
Website	"Regular updates on the website"
Swim lessons/club	"As my children are members of a swimming club - presentations to the kids would be good"
At school	"Information days in school"
Media (TV, Newspaper)	"TV advert"
None required	"We have all the information we need"

The next table provides an example quote for each interpretation in relation to suggested considerations for raising awareness of hygienic swimming behaviours.



Table 5f: Suggested considerations for interventions to raise awareness of hygienic swimming behaviours, from respondents in phase 2

Feedback interpretation	Example quote
Expectation of intervention	"Being realistic. Germs aren't always bad. We can be too clean"
User friendly	"User friendly - disabled - pictures; videos in the changing rooms similar to plane safety demo"
Reach of intervention	"Daughter is 14 so I do not go into the changing room"
Maintenance information	"I would like to see the Ph. and chlorine level too"
Improve facilities (maintenance)	"Better showering facilities"
Improve facilities (cleanliness)	"In my view our changing rooms are dirty. Cleaning seems sporadic. I have once seen poo in the shower, the panels are not cleaned for months, used plasters were left on the poolside for two weeks and only cleaned up when I told the manager"
Risks of unhygienic behaviours	"More information with regards to what would happen if it's not clean"

Respondents highlighted the need for any information relating to hygienic swimming behaviours to be user-friendly and to actually reach the varied audience that attend swimming facilities. They also raised issues regarding the facilities' cleanliness and maintenance. One respondent highlighted that it may be beneficial for interventions to raise awareness of hygienic swimming behaviours to demonstrate the risks of unhygienic swimming behaviours. Some respondents also highlighted some hygienic swimming behaviours for which awareness-raising is important.

Table 5g: Suggested hygienic swimming behaviours that should be promoted, from respondents in phase 2

Feedback interpretation	Example quote
No urine or faecal contamination	"No peeing or pooing"
Exclusion rules	"More info on times needed after illness before swimming. it is sometimes lacking"
Swim caps	"All to wear swimming caps"
No shoes pool side	"No shoes on poolside, staff included"
Footbaths	"Footbath on entering changing room"
Verruca / wound information	"Socks covering verruca"
Swim nappies	"Swimming nappies for all children under a certain age"
Informing staff	"Inform the lifeguard if there is anything in the pool that should not be there"

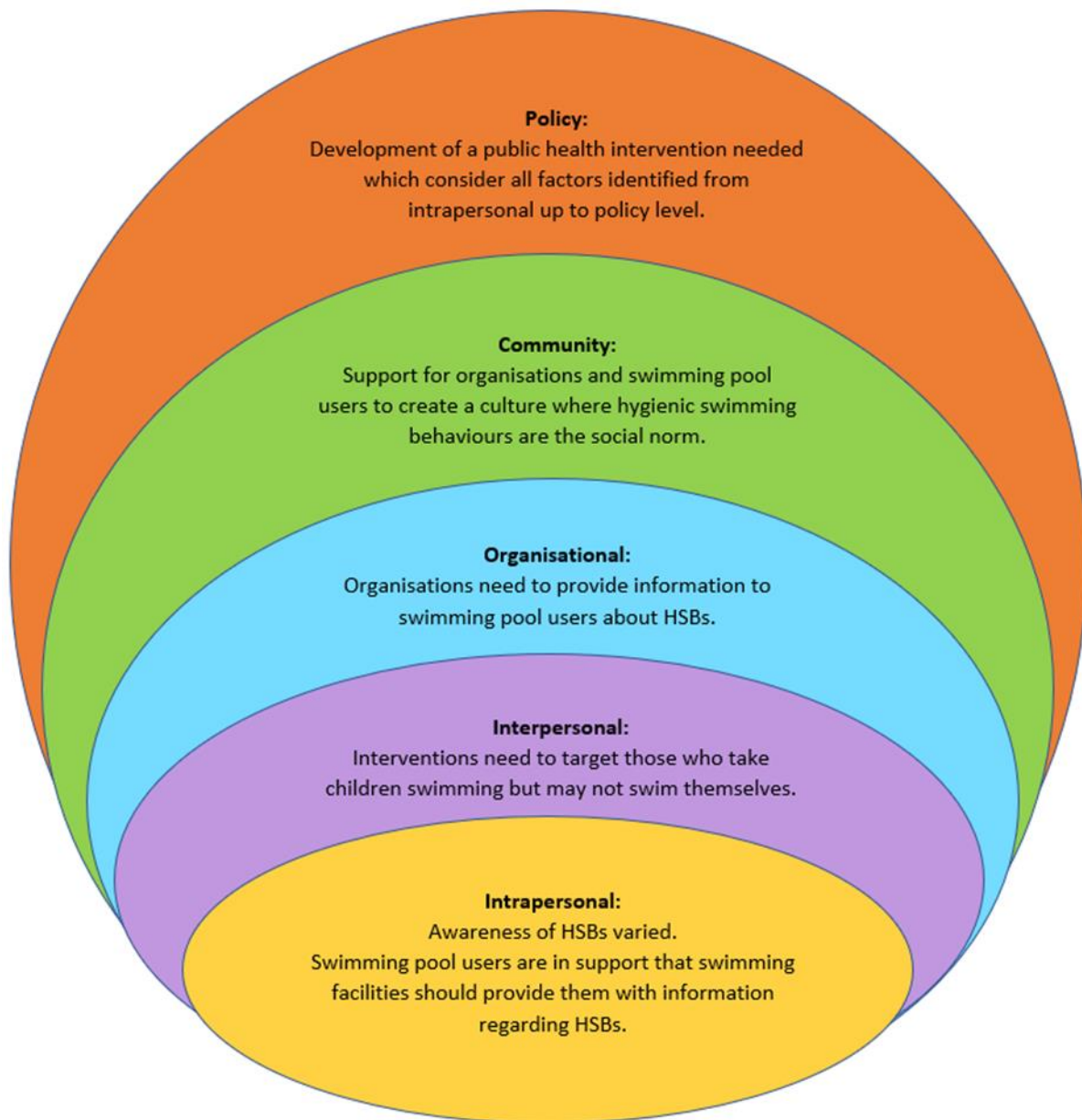
As can be seen in Table 5g, various hygienic swimming behaviours were noted here, some of which are considered in the introduction to this thesis (Chapter 1). On the other hand, behaviours such as wearing swimming caps, the use of footbaths, verruca/wound information and not wearing shoes on the pool side were highlighted by some respondents as being important behaviours to raise awareness of.

To summarise these results, the most preferred way of receiving information about hygienic swimming behaviours from swimming pools was signage on changing room walls, which was found to be statistically significant. The second preferred option was signage on the backs of changing room doors, while a video on the TV screen in reception was the third preferred option and a leaflet at reception was the fourth. A discussion of these results is provided in the next section.

#### 5.4. Discussion of findings from phase 2

The aim of phase 2 was to further explore the findings of phase 1 by gathering data from a larger sample of swimmers/parents of swimmers. The data collection tool used in phase 2 was developed based on the findings from the qualitative study conducted in phase 1, as detailed in Chapter 4. The quantitative survey further explored swimming pool users' awareness of hygienic swimming behaviours and explored their most preferred means of receiving information about hygienic swimming. Figure 5k provides a summary of the findings in relation to the different levels of the SEM.

Figure 5k: Findings of phase 2 in relation to the Socio-Ecological Model



\*HSBs = Hygienic Swimming Behaviours

#### 5.4.1. Intrapersonal factors identified in phase 2

The findings from this second phase of work supported the evidence from the first phase, along with previous literature, in that there is a varied level of reported awareness of hygienic swimming behaviours amongst swimming pool users. Most respondents in this study (n=356, 87%) reported that they did know what they could do as a swimmer or a parent of a swimmer to help the pool water remain clean and healthy. This highlights how current awareness and current educational materials provided can influence knowledge regarding hygienic swimming behaviours. However, 13% (n=51) of respondents reported that they did not know how to help keep the swimming pool clean and healthy. Meanwhile, 49.4% (n=201) of respondents reported that they had noticed information regarding hygienic swimming behaviours at the swimming facility they usually attend, while 50.4% (n=205) had not. One respondent (0.2%) did not answer this question.

This finding demonstrates how intrapersonal factors such as an individual's knowledge and awareness can affect their hygienic swimming behaviours. Understanding that some swimming pool users are not aware of how they can help keep the swimming pool clean and healthy is important when developing a public health intervention to encourage these behaviours. This finding shows that the public health intervention needs to help educate swimming pool users on what the recommended hygienic swimming behaviours are in the first instance, before a behaviour change can take place.

However, it is important to note here that although the questionnaire collected data on a swimmers usual swimming facility, it is evident that swimmers may visit pools outside of their local areas, in particular for training if part of a swimming club. There were 54% (170/317) of respondents who swam once every two weeks, 1-3 times a week or more than 3 times a week. The demographic details collected in the questionnaire did not include indicators of socio-economic status. Therefore, it is important to acknowledge that the extent to which the sample is representative of all swimmers of these ages/genders is unknown.

In terms of the recommended behaviour of showering before swimming, this survey found that the majority (n=220, 69%) of respondents reported that they would shower both before and after swimming. It is important to consider respondent bias here, as respondents may have provided a socially desirable answer. Around half (52%) of respondents had noticed information regarding pre-swim showering at the pool they usually attend.

This finding shows that the majority of the respondents were aware of pre-swim showering; however the cross-sectional design prevents conclusions as to whether those respondents did actually shower before swimming. An observational study may be beneficial to observe swimming pool users' pre-swim shower habits, as conducted by Nett et al. (2010), Zwilling (2014) and Ribbers (2016), who demonstrated that observation study be beneficial to explore swimming pool users' actual behaviours rather than reported behaviour. However, some may argue that an improvement in hygienic behaviours may be seen as individuals are aware that they are being observed (Gould et al., 2007).

Nevertheless, the findings from the first phase of this study, as previously discussed in Chapter 4, section 4.4, highlight the various barriers that explain why swimming pool users may not shower before swimming. Understanding these barriers, rather than merely observing that people do not shower before swimming, may be more beneficial in order to implement interventions to encourage pre-swim showering.

While most respondents reported that they showered before and after swimming, 104 respondents reported that they only showered after swimming. This may highlight a lack of awareness of the importance of showering before swimming. This was also explored in phase 1, whereby it was evident that some swimming pool users were not aware of pre-swim showering and its importance. This again highlights the importance of considering intrapersonal factors, as proposed by the SEM, in relation to how individuals' knowledge and awareness can affect behaviour.

The findings of this study support the body of knowledge that there is a lack of awareness amongst swimming pool users with regard to showering before swimming. For example, Pasquarella et al. (2013) identified that from their sample of 4,356 adults in Italy, only a low percentage (5%) of respondents to their self-administered questionnaire knew the benefits of pre-swim showering. Galle et al. (2016) also identified that there was low compliance with pre-swim showers amongst their 368 respondents of their cross-sectional survey conducted in Italy. The preliminary study using a self-administered questionnaire conducted by Zwilling (2014) found that of those who said they generally showered before swimming, fewer than half (34.8% of 69 respondents from two swimming pools and two soccer clubs) stated that this was mainly for hygiene reasons.

As discussed previously in Chapter 4, section 4.4, the findings of this study highlight how interventions to raise awareness of hygienic swimming behaviours need to take into account

how improved perceptions among swimming pool users of the benefits of pre-swim showering, and also the risks associated with not showering before swimming, may help to encourage more individuals to change their pre-swim behaviours (Rosenstock et al., 1988).

Previous studies have also demonstrated the importance of taking into consideration individuals' perceived risks and benefits of hygienic swimming behaviours. McLain, Bernhardt and Beach (2005) found that parents needed to be aware of recreational water illnesses and to understand the risks before they can adopt hygienic swimming behaviours. Their study also found that there may be low levels of awareness of how to prevent recreational water illnesses, such as cryptosporidiosis, amongst the parents surveyed. Another quantitative survey also found that 16.3% (n=30/184) of adult respondents reported that they had urinated at least once in the swimming pool water (Galle et al., 2016). This shows the importance of adults being aware of the effects that non-hygienic behaviours, such as urinating in the pool, can have: that is, there is less free chlorine available to target and de-nature pathogens in the swimming pool water.

In addition, in the present study, all respondents, apart from six (1.5%) who provided a neutral response and two (0.5%) who did not provide a response to the question, agreed that swimming facilities should provide information to users about how they can help to keep the swimming pool clean and healthy.

Generally, the most preferred means of receiving information about hygienic swimming behaviours was through a poster displayed in the changing rooms of the swimming pool settings. It was hypothesised that one of the options presented to the respondents would be preferred over the other options. No difference was found in the preferred option between genders, although there was a difference when looking at age groups. The most preferred option for 18- to 24-year-olds was a TV screen in reception, with signage on changing room walls being the second preferred option and signage on the backs of toilet doors as the third preferred option. The 55 to 64 age group and the 75+ age group preferred signage on the changing room walls, followed by signage on the backs of toilet doors, and their third most preferred was leaflets at reception. All other age groups preferred signage on changing room walls, with signage on the backs of toilet doors as their second option and TV screens as the third. However, it is important to note here that most (n=142, 35%) of the respondents were aged between 35 and 44 years old. In addition, 65% (n=265) of respondents were female. Therefore, it is important to take these points into consideration when interpreting the findings.

This finding does, however, demonstrate how considering intrapersonal factors such as age within the SEM is important when developing a public health intervention. It is evident that age may have an impact on the type of intervention that would capture the attention of an audience which includes a range of ages. People of all ages use swimming facilities: therefore, interventions to raise awareness of hygienic swimming behaviours need to address this. This study highlighted how those aged 18 to 24 would prefer information about hygienic swimming behaviours to be provided on the TV screens in receptions, rather than in the form of a leaflet available in reception. This could be because the TV screen may draw their attention more than a leaflet. Secondly, this relates to the intrapersonal factor of health literacy levels. For example, a leaflet may provide some individuals with more motivation and understanding to follow hygienic swimming behaviours, while others may find information from a cartoon video more digestible. In addition, respondents provided other suggestions such as information on changing room lockers and lessons in schools, as presented in Table 5e in section 5.3.3. The findings also demonstrate that the frequency with which individuals attend swimming pools varies, with 31% (n=97) of respondents reporting that they swim 1-2 times week while 27% (n=86) reported swimming less than once a month. These findings show the importance of being able to capture all types of swimming pool user, from frequent to occasional swimmers.

#### 5.4.2. Interpersonal factors identified in phase 2

As identified in the findings from phase 1, the results from this second phase of work highlighted the importance of considering interpersonal factors with regard to hygienic swimming behaviours. This section provides a discussion of the results in phase 2 which relate to the interpersonal level of the SEM.

The findings demonstrate that a high number (n=342, 84%) of respondents took children swimming. This highlighting how parents or guardians can influence the hygienic swimming behaviours of children. For example, this study found that 13% (n=51) of respondents reported that they did not know what they could do as a swimmer or a parent of a swimmer to help keep the pool water clean and healthy. This supports the finding from phase 1 whereby one swimmer/parent of swimmer identified that he was not able to influence his child with regard to some hygienic swimming behaviours and cryptosporidium, as he was not aware himself. The findings from phase 1 and phase 2 show the need to consider interpersonal influences, such as awareness and beliefs of parents, when developing a public health intervention.



Ensuring that parents of swimmers are targeted is also important. For example, one respondent provided a comment on the questionnaire highlighting how the respondent's daughter is 14 and therefore goes into the changing room by herself. This demonstrates that the development of public health interventions to raise awareness of hygienic swimming behaviours should consider how to target parents who may not enter the swimming facility, but can be of influence to their children's behaviours at that facility.

#### 5.4.3. Organisational factors identified in phase 2

The results from phase 2 of this study support the findings presented in Chapter 4 (phase 1) with regard to how organisational factors can influence hygienic swimming behaviours. In order for swimming pool users to follow the recommended hygienic swimming behaviours, pools need make them aware of behaviours that are recommended and those that are discouraged. Just over half (n=205) of the respondents surveyed in this study stated that they had not seen information regarding hygienic swimming at their usual swimming facility. Whilst visiting the swimming pools at the start of this research, I found that only two clearly displayed information regarding hygienic swimming behaviours. Four swimming pools did not provide information to their users about the recommended hygienic behaviours. However, it is important to consider the effect of this finding in relation to the high number (n=93, 29%) of respondents who reported that they usually swam at a pool other than those where data collection took place. In addition, of the respondents who took children swimming, the highest proportion (n=105, 31%) of children usually swam at Swimming Pool F. During fieldwork, I identified that Swimming Pool F provided information to its users by displaying a poster on the TV screen in reception.

Interestingly, all respondents agreed that swimming facilities should provide information to their users on how they can help to keep the pool water clean and healthy. Therefore, it is evident that hygienic swimming behaviours are influenced by organisational factors, such as swimming facilities providing their users with information about what the recommended hygienic swimming behaviours are and why they are important.

Hence, it is important to take into consideration organisational factors when developing an intervention to raise awareness of hygienic swimming behaviours. The swimming pool facilities need to have 'buy-in' of the intervention in order to improve its effectiveness

(Chittleborough et al. 2013). For example, they need to invest and support the intervention initially, and also in the long term, in order to continue to raise awareness of hygienic swimming behaviours amongst new and frequent swimming pool users. This also highlights community factors, whereby pool users and swimming facilities create a community which is actively encouraging and supportive of hygienic swimming behaviours, and where these behaviours are perceived as the norm.

#### 5.4.4. Community factors identified in phase 2

The results from phase 2 will be discussed in this section in light of the community level of the SEM. The findings from phase 2 demonstrated that respondents agree that swimming facilities should provide information to their users to raise awareness of hygienic swimming behaviours, thus demonstrating how organisational factors could help to create a community where hygienic swimming behaviours are seen as the norm within their facility.

In addition, the findings can also help to understand the current culture being promoted within the swimming facilities that took part in this second phase of the study. This is demonstrated by 50.4% (n=205) of respondents reporting that they had not noticed information at their usual swimming facility about hygienic swimming behaviours. This could highlight how interventions currently in place to raise awareness of these behaviours are not being noticed by swimming pool users, yet it also highlights that swimming facilities may not be providing information to their customers. Fieldwork undertaken as part of this study to identify current educational materials provided to swimming pool users by the six different swimming facilities highlighted that some were not giving any information to their swimming pool users. Therefore, these findings together can show how some swimming facilities may not be creating a culture where hygienic swimming behaviours are encouraged and supported.

As highlighted previously, the highest proportion (n=93, 29%) of respondents swam at a facility other than that where data collection took place. This demonstrates the need to create a culture within the swimming population as a whole, rather than different cultures within different swimming facilities in terms of the norm for hygienic swimming behaviour. In order to achieve this, public health interventions to raise awareness of hygienic swimming behaviours need to be considered on the policy level.

#### 5.4.5. Policy factors identified in phase 2

As identified from the first phase of the study, policy factors can influence hygienic swimming behaviours. These findings were also supported by the results in the second phase of this study.

In considering all the factors already discussed in this chapter, it is important to highlight how many different policy factors need to be addressed when developing a public health intervention to raise awareness of hygienic swimming behaviours. For example, as discussed in the introduction chapter (Chapter 1), there is no mandatory requirement for swimming facilities to provide information to their swimming pool users on how to help keep the pool clean and healthy. If a policy change were to be introduced, which required swimming facilities to provide hygiene information to their users, this might lead to more swimming pool users being aware of the recommended behaviours. However, as highlighted previously from findings in phase 1 (Chapter 4, section 4.4), other factors also influence hygienic swimming behaviours. It is evident that knowledge and awareness alone is not always enough to encourage hygienic swimming behaviours. Therefore, while public policy considers awareness-raising as important, public policy also needs to address other factors. Factors identified in phase 1 of this research include the design of swimming facilities and ensuring that these facilities are maintained to a high standard.

This study also found that many respondents (n=93, 29%) usually swam at a different swimming pool to where data collection was being carried out. This corresponds with the findings in phase 1 whereby some participants identified the importance of having a consistent message across all swimming pools. This has proved to be an important finding, as it is evident that swimmers can use more than one swimming facility. This finding demonstrates the importance of having a consistent message across all organisations, ensuring that all swimming facilities are providing these messages to swimmers and parents of swimmers. This is also influenced by public policy, in that having policies or regulations which require swimming facilities to provide information to swimming pool users would support this.

In addition, all respondents, apart from eight (2%) who provided a neutral response or no response, agreed that swimming facilities should let swimming pool users know how they can help to keep the pool water clean and healthy. Respondents demonstrated a need for a public health intervention to raise awareness of hygienic swimming behaviours to be developed, to enable all swimming facilities to provide a consistent and informative message about these

behaviours. This study identified that the most preferred option for receiving health information was signage on changing room walls. However, when stratified by age, the 18-24 year age group's most preferred option was information on TV screens in reception. This highlights the importance of considering intrapersonal factors, along with external factors at the policy level, when developing public health interventions.

## 5.5. Summary

To summarise, this chapter has provided the methods used to conduct this second phase of the study. In addition, the results have been presented and discussed in light of the SEM (McLeroy et al., 1988). The results presented demonstrate that the most preferred way of receiving information about hygienic swimming behaviours from swimming pools was signage on changing room walls, which was found to be statistically significant ( $p < 0.001$ ). The second most preferred option was signage on the backs of changing room doors, while a video on TV screen in reception was the third preferred option and a leaflet at reception was the fourth. In order to meet the needs of swimmers of various ages, more than one option needs to be provided. Therefore, a poster was designed that could be displayed in the changing rooms, but also displayed on TV screens and social media.

The next chapter provides detail on the methods adopted to conduct phase 3 of this study, along with the results and discussion of that phase.

## 6. Chapter Six: Public Health Intervention (Phase 3)

### 6.1. Introduction

This chapter begins with a report of the methods employed in the third and final phase of this study. The development of a public health intervention to raise awareness of hygienic swimming behaviours is provided in section 6.2.2, while the methods employed to evaluate the intervention are described in section 6.2.3. The results from the evaluation are presented in this chapter (section 6.3.) with a discussion of these results provided at the end of the chapter (section 6.4.).

### 6.2. Methods

This section describes the methods used to conduct the third and final phase of work in this research study. The section also details how a poster was developed, informed by the findings from the first and second phases of the study, as well as from the published literature. A description and justification of the sample, the tools used, the procedures employed, data analysis and ethical considerations are presented in this section.

#### 6.2.1. Aim of phase 3

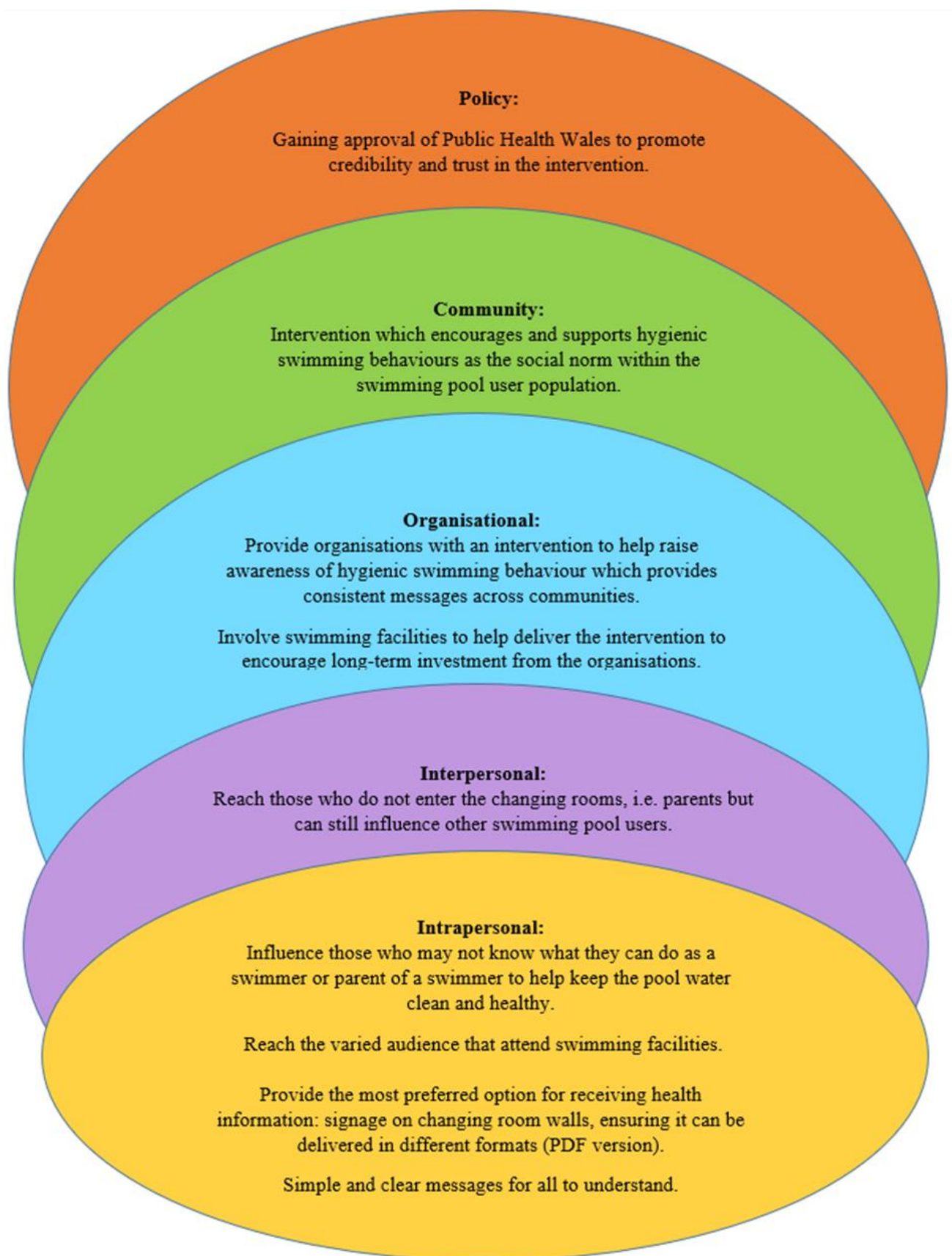
The aim of this phase was to develop a public health intervention to raise awareness of hygienic swimming behaviours, to reduce the transmission of cryptosporidium. It also aimed to obtain feedback on the poster 'A Healthy Swimmer is a Happy Swimmer' (Appendix 4a).

### 6.2.2. Development of the intervention

To be able to develop a public health intervention to raise awareness of hygienic swimming behaviours and reduce the transmission of cryptosporidium, it was evident that the intervention needed to address some of the factors identified in phases 1 and 2.

Although one option (signage on changing room walls) was clearly preferred (as described in chapter 5, section 5.3.3), a Public Health intervention needs to consider how best to reach the target population (Bailey et al., 2015). As swimmers cover a variety of age groups (The Amateur Swimming Association Limited, 2020), more than one option should be considered. Phase 1 and 2 of this study also highlighted the various age groups that attend swimming facilities. Therefore, a poster needed to be designed which could be displayed in the changing rooms, but also could be displayed on TV screens, social media and various other channels. Figure 6a demonstrates how the findings of phase 1 and 2 informed the development of the intervention.

Figure 6a: Development of the intervention based on phase 1 and 2 findings



The poster aimed to address the factors which influenced hygienic swimming behaviours derived from phases 1 and 2 and which were applied to all levels of the SEM. Displaying the posters in the swimming pool settings aimed to address the interpersonal and interpersonal levels. It was hoped that providing information to swimming pool users would enhance their knowledge and in turn seek to modify their attitudes and behaviours. The posters aimed to provide swimming pool users with the knowledge of the behaviours advised to help keep themselves and the swimming pool clean and healthy. The findings from the literature review and phases 1 and 2 of this research identified that there is a varying level of awareness of hygienic swimming behaviours amongst swimming pool users. For example, as highlighted in phase 1, a participant identified that they did not shower before swimming, and they were not aware of the benefits to showering beforehand. In addition, 23% (n=73) of respondents in the second phase of this study noted that they showered after swimming only. The findings from the literature review also identified a mixed awareness of showering before swimming. Thus, the information gathered in Chapter 2, Chapter 4 and Chapter 5 provided evidence that an intervention to raise awareness of all the hygienic swimming behaviours would be beneficial.

Involving different swimming pool settings addressed the organisational and community levels of the Socio-Ecological Model, as the poster aimed to create a culture of awareness of hygienic swimming behaviours. It was also hoped that the organisations would get behind these posters and maintain the efforts even after this research had ended. It was evident from the findings in phase 1 that swimming facilities varied in terms of providing information to their swimming pool users regarding hygienic swimming behaviours. In addition, phase 2 identified that some swimming pool users had not seen any information at their usual swimming facility relating to information about how they can help to keep the swimming pool clean and healthy. Therefore, these findings supported the need for an intervention to be developed, that could be adopted by swimming organisations, to provide clear and consistent messages to swimming pool users.

As discussed in Chapter 4, the credibility and trustworthiness of sources of information was highlighted to be important by participants for a public health intervention to raise awareness of hygienic swimming behaviours. The final level of the SEM, relating to Public Policy, was addressed by involving Public Health Wales in the development process and in the approval process in terms of displaying their logo on the posters. It was hoped that gaining permission to include the Public Health Wales logo in addition to the Swansea University logo would help to increase the public's trust and the credibility of the information included within the intervention.



Chapter 5 presented the findings of phase 2 which demonstrated that the most preferred means of receiving health information amongst a sample of the swimming population was a poster on the changing room walls. In addition, phase 1 of this study (Chapter 4) identified that many participants suggested signage as a way of raising awareness of hygienic swimming behaviours. These findings are the reason as to why a poster was developed specifically as a public health intervention to raise awareness of hygienic swimming behaviours.

The purpose of the poster produced (Appendix 4a) was to try to raise awareness of hygienic swimming behaviours. Additional signage was created in order to direct swimmers to the showers to encourage pre-swim showering (Appendix 4b). Public Health Wales approved these posters, and permission was granted to display the Public Health Wales logo on them to aid credibility and trust in the information (Appendix 4c). A contact within Public Health Wales, with a connection to cryptosporidium work streams, aided this process by contacting the relevant people within Public Health Wales to gain this permission. The poster was sent to various stakeholders within Public Health Wales for comments before approval was granted to add the logo to the posters. No changes were required to the poster.

The poster was developed based on the main hygienic swimming behaviours as follows:

- Not swimming whilst experiencing symptoms of diarrhoea and vomiting;
- Waiting 48 hours after symptoms of diarrhoea and vomiting have stopped before returning to swimming;
- Showering before swimming;
- Washing hands after using the toilet;
- Ensuring that those required to wear proper swim nappies do so;
- Taking children on regular toilet breaks and ensuring no one uses the pool as a toilet;
- Informing a member of staff of any faecal incidents as soon as possible (PWTAG, 2009).

These main messages were developed into rhymes in order to catch people's attention and to be memorable. It was also decided to use cartoon images to represent each hygienic behaviour in order to visualise the required behaviour. This was to address the intrapersonal and interpersonal factors identified from phases 1 and 2 of this study. Health literacy was identified as important from the findings in phase 1, therefore consideration was taken as to the best way

to provide clear and concise information to swimming pool users, to help provide information to them on how they can help keep the swimming pool clean and healthy.

An expert in cryptosporidium control in swimming pools was consulted in order to ensure that the correct messages were being included. As previously discussed, a panel of Health Professionals at Public Health Wales were consulted on a draft of the bilingual posters prior to approval being granted for the logo to be included on the posters and to ensure that correct messages were being provided to the swimming population.

All four swimming pools were given A1 posters (Appendix 4a) in Welsh and English to display in their changing rooms. They were also given four A4 shower sign posters (Appendix 4b). The A1 posters were sourced from a manufacturing company that produced waterproof signs, whereas I printed and laminated the A4 posters myself. The managers of the swimming pool settings were happy to put the posters up on my behalf in a location in the changing room that they felt most appropriate. Posters were provided to the swimming pools on the 31<sup>st</sup> of May 2019, ready to be displayed on the 1<sup>st</sup> of June 2019.

PDF versions of the posters were given to all swimming pool settings to display electronically, such as on their websites and social media pages. This was done in order to address findings from phase 1 and 2 of this study, in relation to the need for different formats of the intervention in order for it to reach the varied audience that use swimming pools. For example, in the second phase of this study it was identified that the most preferred means of receiving information for those aged 18-24 years old was a TV screen in reception, with signage on changing room walls being the second preferred option. Therefore, to address this, the poster was developed so that it could be displayed on TV screens in the reception area as a PDF version. In addition, the pool operators are able to display the PDF on their websites or social medias, and could provide paper copies to those who would prefer a leaflet as a means of receiving health information. Unfortunately, no swimming pool setting took up this opportunity and they only displayed posters in their changing rooms. In addition, the poster contained a QR code, which, when scanned by a smart device, opened a YouTube video. The video contained an animated version of the poster that was available from this link <https://youtu.be/iiM3-kkFjXk> embedded in the QR code. Again, this providing the intervention in different formats to address findings from phase 1, where many formats and means of delivery were suggested, in addition to the second phase where respondents provided information on their preferred means to receiving information regarding hygienic swimming behaviours.

As discussed in this section, the intervention draws on the key theoretical framework presented within the thesis, the Socio-Ecological Model (McLeroy et al., 1988). The section has highlighted how the SEM (McLeroy et al., 1988) was used to ensure consideration of intrapersonal, interpersonal, organisational, community and public policy factors that have been identified as part of this study. In addition, the poster intervention has drawn upon key consideration from the Health Belief Model (Rosenstock et al., 1988), which was presented in Chapter 4. The intervention aims to reduce barriers identified such as lack of awareness of the recommended hygienic swimming behaviours, and brief explanations as to why these behaviours are beneficial. In addition, the intervention aims to address the cues to action element of the HBM (Rosenstock et al., 1988), whereby the poster can act as a prompt to engage in hygienic swimming behaviours. In addition, theories relating to health literacy were also consulted, to ensure the intervention developed aimed to be understood by all swimming pool users.

Figure 6b: The intervention developed in phase 3

# A HEALTHY SWIMMER IS A HAPPY SWIMMER...



If you've had a poorly tummy, and your poos are rather runny, please don't use our pool, wait 48 hours, that's the rule.



A proper swim nappy keeps everyone happy!



Before swimming have a shower, to give chlorine more germ-killing power!



Before swimming use the loo, and make sure to wash your hands too!



If there's any 'poo in the pool', let the staff know and stay cool!



If you need a number 1 or 2, get out and use the loo!

**FOLLOW THESE SIMPLE STEPS SO THAT EVERYONE HAS A CLEAN AND HEALTHY SWIM!**

For more information, visit this link: <https://youtu.be/iIM3-kkFjXk> or scan the QR code



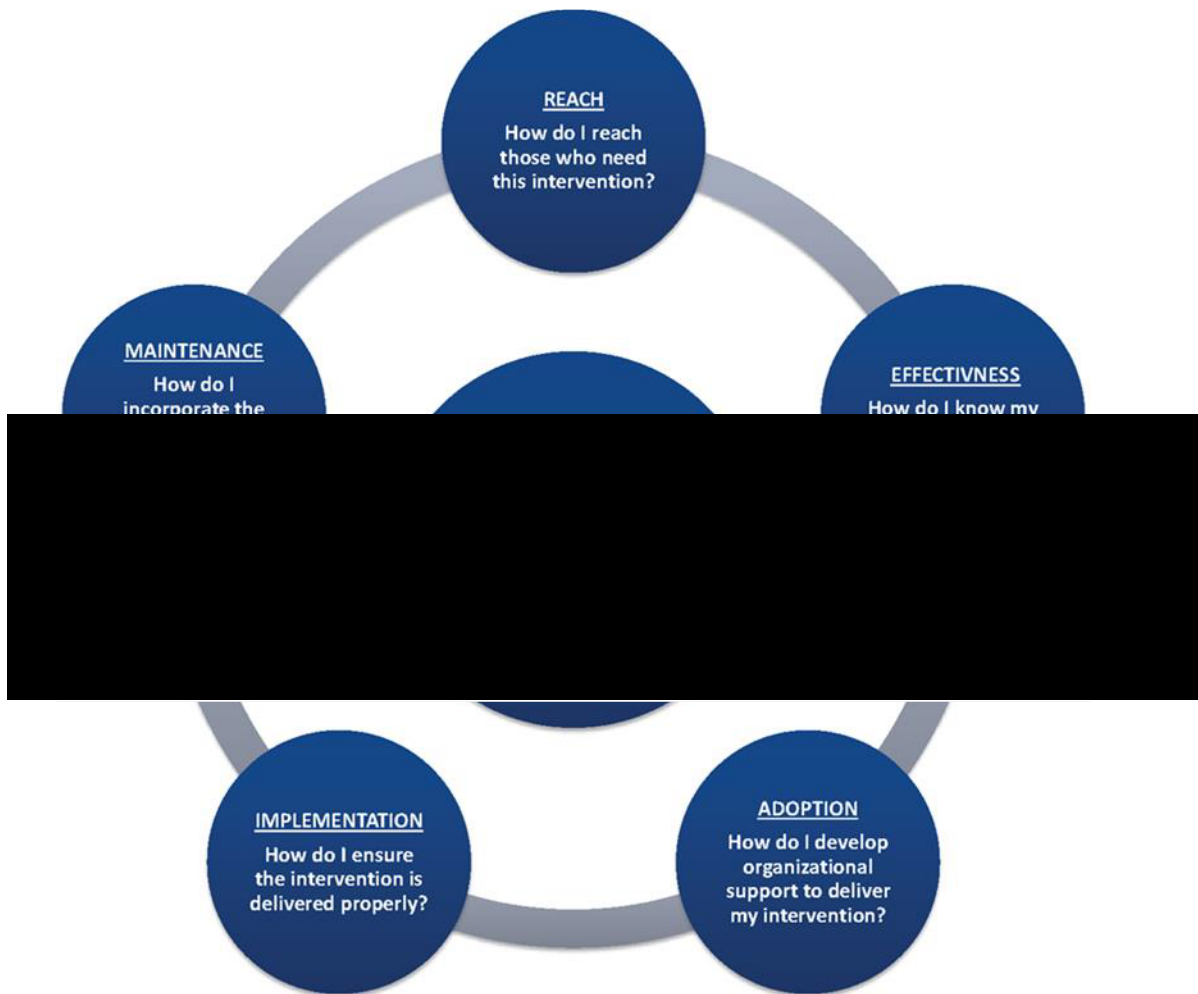
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### 6.2.3. Evaluating the intervention

A questionnaire (Appendix 4d) was developed based on the findings from phases one and two. Literature on evaluating public health interventions (Craig et al., 2008, Spiegelman, 2016), including public health posters, was also consulted when developing the questionnaire to evaluate the poster.

The questionnaire was designed to gather feedback from participants on the poster ‘A Healthy Swimmer is a Happy Swimmer’ (Appendix 4a). The first set of questions (Q 1-8) focused on gathering feedback about the poster, while the second section (Q 9-12) collected demographic data. As in phase 2, the SEM (McLeroy et al., 1988) along with previous literature, was consulted while developing the questionnaire. The RE-AIM evaluation framework (Glasgow et al., 1999) was also used to develop the evaluation. This framework takes into consideration the broader dimensions of evaluating a public health intervention in terms of its reach, adoption, implementation and maintenance (Glasgow et al., 1999). Figure 6c and Table 6a provide further detail on how the RE-AIM framework was adopted in this third phase.

Figure 6c: Elements of the RE-AIM evaluation framework



(Glasgow et al., 1999).

Table 6a: The RE-AIM Framework and Evaluating the Public Health Intervention

<b>RE-AIM Element</b>	<b>Interpretation</b>	<b>How was this addressed?</b>
Reach	How do I reach those who use the swimming pool facilities?	By collecting data on the demographics of respondents and by being able to calculate the proportion of respondents who had seen the poster. The poster was designed to be able to be displayed on changing room walls and in PDF format for other means such as websites and TV screens.
Effectiveness	How do I know the intervention is raising awareness of hygienic swimming behaviours?	A Likert scale question to address respondents' intended hygienic swimming behaviours after seeing the poster.
Adoption	How to I develop support from the swimming facilities to deliver my intervention?	Asking participants to note their usual swimming facility was used to understand how well the intervention was adopted by the swimming facilities. The poster was developed based on involvement from swimming facilities, and these facilities had control over where to display posters in the changing rooms.
Implementation	How do I ensure that the posters are displayed by the swimming facilities?	I visited swimming pools to conduct data collection and checked that posters were being displayed.
Maintenance	How do I ensure that this intervention is delivered long term in the swimming facilities?	As above in the adoption section.

As previously mentioned, the questionnaire was developed in light of the Socio-Ecological Model and findings from the two previous phases of work.

Participants were asked whether they had seen the poster (Q1). If they had, they were asked to provide feedback on the poster (Q 2-8). If they had not seen the poster, they were asked to skip to the 'About You' section (Q 9-12). This first question was considered to be important in order to identify whether the intervention was reaching the intended audience. This relates to the intrapersonal and organisational levels of the Socio-Ecological Model in terms of whether individuals have been provided with the information to enhance their knowledge and modify their attitudes. In addition, the interpersonal factor is relevant here, as it was intended that posters could encourage parents to influence their children's hygienic swimming behaviours. This also relates to reach and effectiveness in the RE-AIM evaluation framework (Glasgow et al., 1999).

A Likert-Scale question (Q6) was included to identify the effectiveness (impact on behavioural outcomes) of the poster in changing intended behaviour (Glasgow et al., 1999). For example, participants were asked how likely they were to shower before swimming after seeing the poster. The intended behaviours outcomes of interest were how likely they were to follow the recommended behaviours after seeing the poster:

- Shower before swimming;
- Avoid swimming if ill with sickness and diarrhoea;
- Avoid coming back to swimming for 48 hours after symptoms have stopped;
- Tell a member of staff if there is any 'Poo in the Pool'.

This question relates to many levels of the SEM, as the responses could help to understand how the poster intervention could be incorporated into public policy to create communities where hygienic swimming behaviours are the social norm. If organisations adopt the intervention, they may be able to influence awareness of hygienic swimming behaviours among swimming pool users, who in turn can influence their peers. However, the intervention needs to be proven to be effective before this can be considered.

The final section (Q 9-12) collected demographic data – age, gender, swimming pool user type, and usual swimming facility – in order to compare whether this influenced the feedback



received. This section addressed various levels of the Socio-Ecological Model (McLeroy et al., 1988), with age, gender and swimming pool user type being factors at the intrapersonal level of the model. The usual swimming facility relates to the organisational and community levels of the SEM (McLeroy et al., 1988) in terms of whether the different swimming pool settings had an effect on whether the poster had been seen or not. In addition, the feedback from the various settings could have been different due to other cultural and organisational reasons, such as where pool staff had decided to display the posters in their changing rooms.

The sub-sections that follow provide detail on how the evaluation of the poster was conducted.

#### *6.2.3.1. Sample*

To take part in the study, participants needed to be over the age of 18, be able to express themselves in English or Welsh and be a swimmer or parent of a swimmer. This phase focused on gathering information only from swimming pool users. The questions were focused on establishing whether respondents had seen the poster, and if so, on obtaining their feedback on it. A sample of swimming pool users, including parents of swimmers, was considered the most appropriate to participate in this third phase of the study. Yet again, ensuring the involvement of the target audience in health education is imperative in creating an effective public health intervention (Craig et al., 2008).

Due to the short timeframe for this phase of work, the use of a convenience sample was deemed most appropriate (Lavrakas, 2008). As discussed previously (chapter 5, section 5.2.3), using a convenience sampling technique can introduce bias, but this approach was considered to be the most appropriate for this research, as it is time saving, affordable and relies on participants being readily available (Jensen & Laurie, 2017).

Due to the nature of swimming pools, it is hard to access participants outside of the swimming pool setting, as it is not easy to identify whether someone participates in swimming or takes their child swimming unless they are at a pool. The same process was followed in this phase of the study as the second phase, and has been described previously in Chapter 5, section 5.2.

As with the second phase of the study, there were issues with accessing swimmers who were there to swim and then needed to leave, and thus could not take part in the study. For example, those who were swimming early in the morning did not have time to complete the questionnaire before going to work. In this instance, they were offered the opportunity to take a questionnaire

home and bring it back to the swimming pool reception area. They were also offered a QR code to access the online version of the questionnaire. The response rate is provided in section 6.3.

The aim was again to recruit a minimum of 100 participants for this third phase. Please refer to Chapter 5, section 5.2.3, where the issue of sample size has been discussed in detail.

#### *6.2.3.2. Location*

Respondents were recruited at four different swimming pools in the South Wales area, all of which had been used to recruit participants in phases one and two of this study. Three pools were located within one local authority and the other was in another local authority. Unfortunately, the other two pools used in phases one and two of the research did not take part in the final phase due to a lack of communication from relevant contacts in these swimming pool settings. Therefore, permission was not granted to conduct the research in these two swimming pools.

The pools that did take part were chosen due to their potential to have high bather loads (number of swimmers in a pool at one time). The pools were located in varied socio-economic communities and were used by a range of people. This was to capture data from various demographics to try to obtain a sample representative of the swimming population in the South Wales area. Although recruitment took part in the four specific swimming pools, participants could be swimmers or parents of swimmers from outside these four pools.

#### *6.2.3.3. Method of data collection and recruitment*

The questionnaire was piloted amongst a small group of ten people of various ages and educational levels. It was not changed after being piloted, as no issues were raised at this stage. These participants were timed to calculate an average completion time for the questionnaire. This information was included for participants at the start of the questionnaire and in the participant information sheet. It was calculated that on average, the questionnaire did not take longer than five minutes to complete. Questionnaires were available in English and Welsh.

There were 12 questions in total, of which nine were closed questions and three were open-ended. A quantitative questionnaire with predominately closed questions was used, as this

allows for questions to be easily answered by participants and easily compared and analysed by the researcher (Kelley, Clark, Brown & Sitzia, 2003).

It was aimed to recruit participants of various ages, from different socio-economic backgrounds with various literacy levels: therefore, no technical jargon was used in the questions. The data collection tool was created to look professional, incorporating the Swansea University logo. The pilot group considered the questionnaire to be clear and concise, and they felt that the instructions included were easy to understand and follow.

Before taking part in the study, participants were provided with a Participant Information Sheet (Appendix 4e) that informed them of the purpose of the questionnaire and their requirements as a participant. The participants were able to keep the Participant Information Sheet. An online version was provided to participants when the web-link was opened, and they were advised to screenshot this information so that they could access it at a later date.

Recruitment posters (Appendix 4f) and cards (Appendix 4g) were developed to aid in recruitment when I was not present at the swimming facilities. Both posters and cards included a QR code to scan to access the online version of the questionnaire, as discussed previously in Chapter 5, section 5.2.5. Contact details and sources of further information was provided to respondents, as described in Chapter 5, section 5.2.5.

Posters were provided to the swimming facilities on the 31st of May 2019 to be displayed from the 1st of June 2019 onwards. After data collection for the questionnaires was completed, the swimming pool managers were encouraged to keep these posters on display in order to maintain the efforts to raise awareness of hygienic swimming behaviours. Data collection for the questionnaires was conducted from the 1st of June 2019 until the 31st of July 2019. These dates were selected to capture data from the regular, term-time swimmers and from the summer holiday period.

All swimming pool settings received their recruitment posters and recruitment cards on the 31st of May 2019. They were given these posters and cards to display at their receptions to inform swimming pool users that the study was being conducted at those premises. It was hoped that staff members would be more active in recruiting participants by handing out the cards to their customers, but it became evident that the cards were being placed on the reception area and it was left to customers to pick one up if they wished to.

It was evident that face-to-face recruitment was required to aid in data collection, as there were limited responses from the recruitment cards and posters. I developed a face-to-face recruitment timetable whereby different times were selected based on the different swimming activities scheduled to gather data from a variety of people. Prior to attending any sessions, all swimming pool representatives were contacted in advance to inform them that I would be present on a certain date during a certain time.

The same procedure was carried out in this third phase as in the second phase of this study. Please see Chapter 5, section 5.2.5, for details.

#### *6.2.3.4. Data analysis*

Analysis of the data collected was as described for phase two in relation to data handling and descriptive statistics (please refer to Chapter 5, section 5.2.6).

#### *6.2.3.5. Ethical considerations*

Four of the six swimming facilities from phases one and two were used in this phase. Therefore, the same contacts as those used in phases one and two were contacted to ask permission to conduct a third phase of data collection in their swimming pools. They were also asked permission to display posters in their changing rooms. Letters were provided by all swimming pool representatives to confirm their permission to conduct the study.

Participants were asked to provide consent at the beginning of the paper questionnaire by initialling next to the statements provided in relation to taking part in the survey. In terms of the online questionnaire, consent is generally assumed when someone completes an online survey (Sue & Ritter, 2012).

Ethical approval was provided by the Ethics Committee for the College of Human and Health Sciences, Swansea University, on the 30th of May 2019 (Appendix 4h).

The ethical considerations for this third phase were the same as those for the second phase in this study (Chapter 5, section 5.2.7.). Validity and reliability are also discussed in section 5.2.8.

The next section presents the results after conducting this third phase of the study.

### 6.3. Evaluation Results

This section presents the results from the second quantitative survey, as described in section 6.2. The aim of this phase was to obtain feedback on the poster ‘A Healthy Swimmer is a Happy Swimmer’. The poster was developed based on data collected from the interviews conducted in the first phase of work and the survey conducted as part of the second phase, as detailed in section 6.2.3 of this chapter. The characteristics of the respondents and descriptive statistics are presented in this section, with a discussion of the findings presented in the next section.

#### *Hypotheses*

- Hypothesis: the poster had encouraged swimmers or parents of swimmers to become more aware of hygienic swimming behaviours by:
  1. Having seen the poster,
  2. The poster being easy to read and
  3. The poster having encouraged them to increase their intended likelihood of following hygienic swimming behaviours.
- Null hypothesis: The posters had not raised awareness of hygienic swimming behaviours amongst swimming pool users (swimmers and parents of swimmers).

#### *Response rate*

In total, 233 questionnaires were distributed in phase 3 of this study. Paper (n=166) and online (n=67) questionnaires were distributed, with 153 questionnaires returned, giving a response rate of 66%.

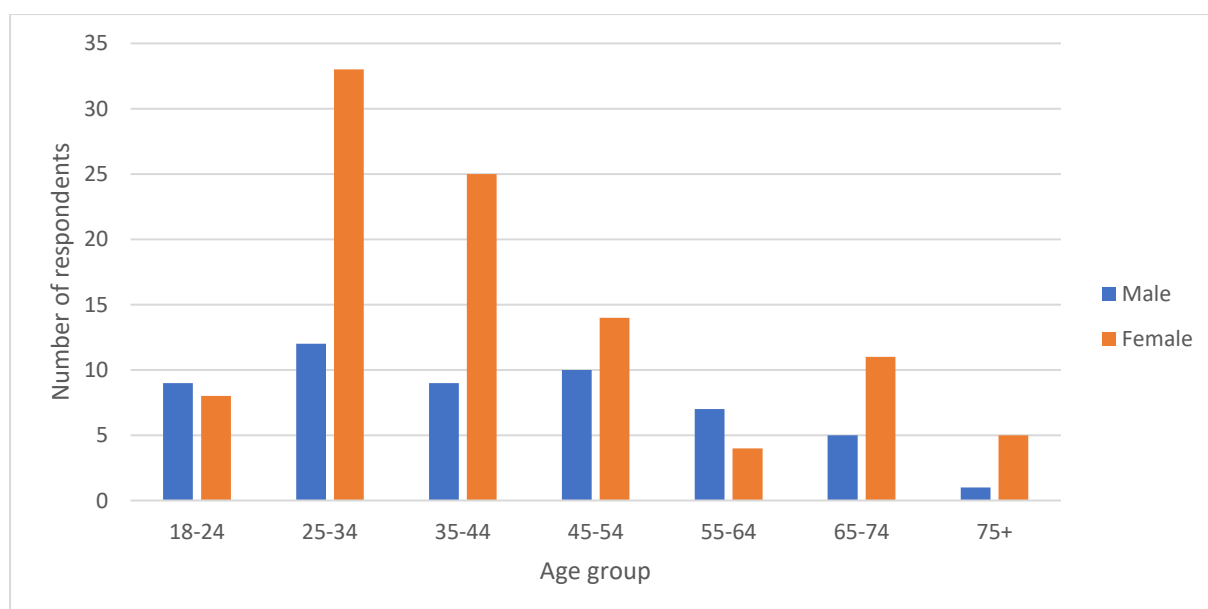
Table 6b: Response rate of questionnaires distributed in phase 3

Type of Survey	No. distributed	No. of responses	Response Rate %
Paper	166	142	86%
Online	67	11	16%
<b>Total</b>	<b>233</b>	<b>153</b>	<b>66%</b>

### 6.3.1. Characteristics of respondents

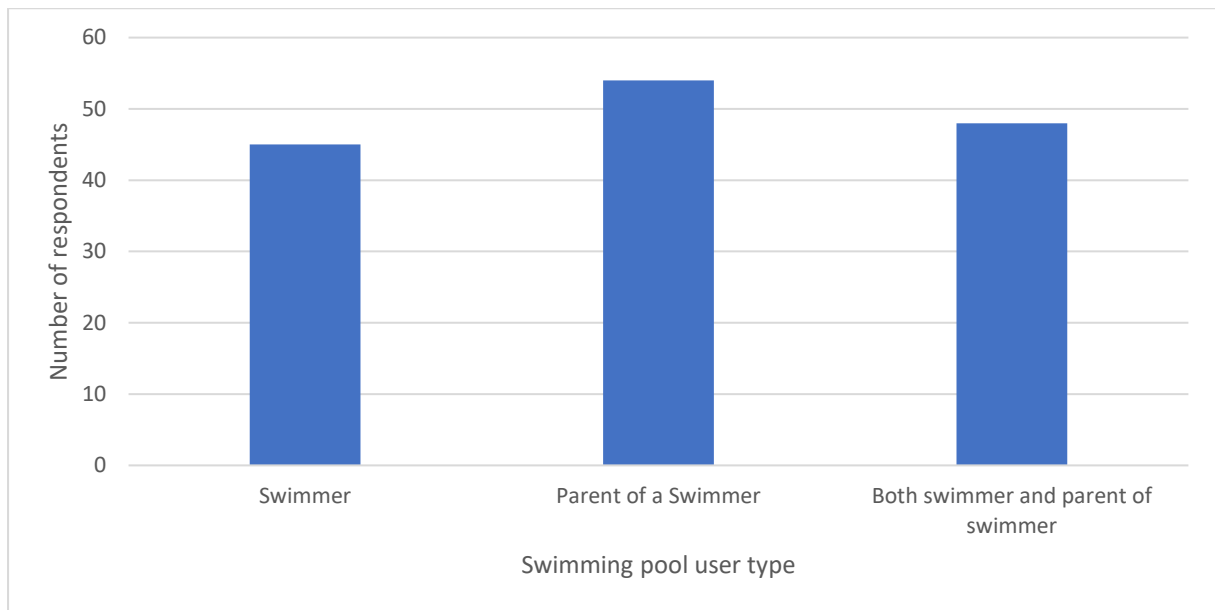
Two of the pools from earlier phases did not take part in phase 3: Pool E and Pool F. Pool F had recently changed management and permission could not be secured from the new management to complete this research study. Although Pool E had granted permission to display the poster, there was a loss of communication due to the personal circumstances of the contact at that particular centre, and so the posters were not displayed in the changing rooms after being delivered to reception.

Figure 6d: Number of respondents in phase 3 by their age group and gender



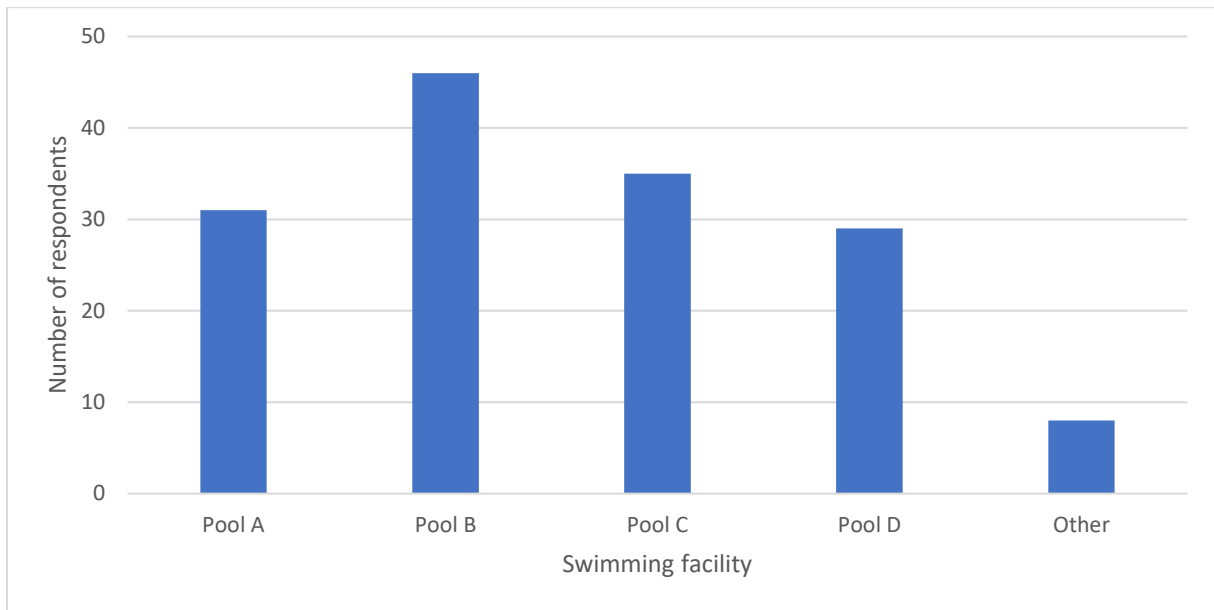
Most of the respondents were female, 65% (n=100), while 35% (n=53) were male. The majority of respondents were aged between 25 and 34 (n=45, 29%). The age groups with the lowest numbers of respondents were 55-64 years old (n=11, 7%) and the over 75's (n=6, 4%).

Figure 6e: The number of respondents in phase 3 by swimming pool user type



Of those who responded to the survey, 35.3% (n=54) were parents of swimmers, 31.4% (n=48) were both swimmers and parents of swimmers and 29.4% (n=45) were swimmers. Six respondents (3.9%) did not answer this question.

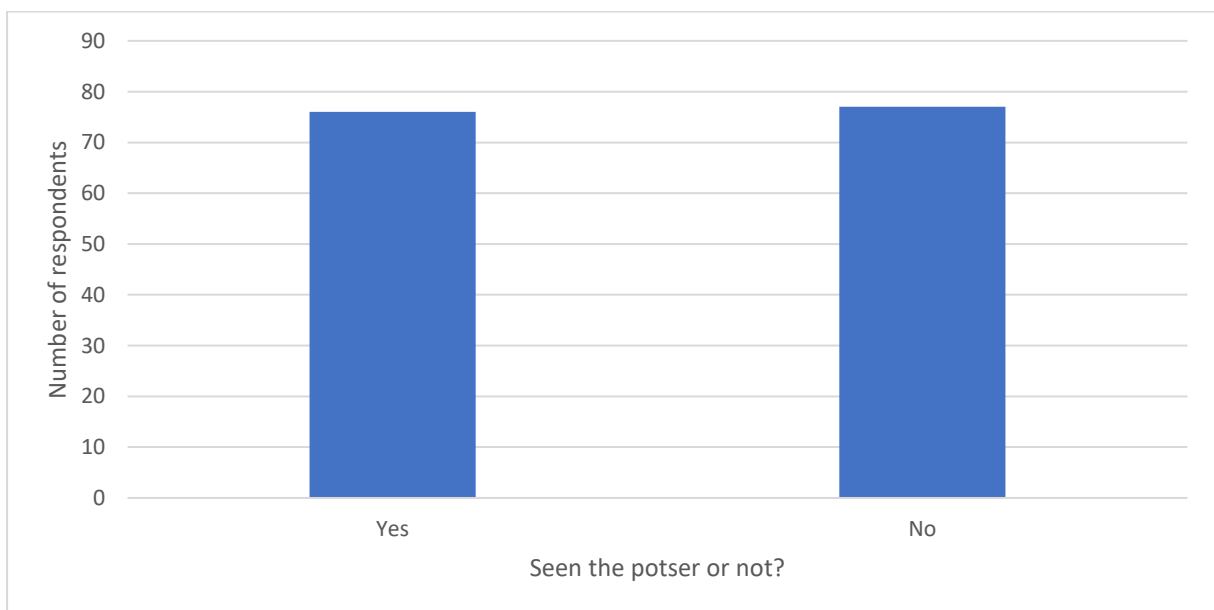
Figure 6f: The number of respondents in phase 3 by their usual swimming facility



The majority of respondents (or their children) swam at Pool B (30% n=46). Five percent (n=8) of respondents usually used a different facility to those that took part in the study. They have been included in this data because they were recruited at one of the swimming pools that took part.

### 6.3.2. Respondent feedback

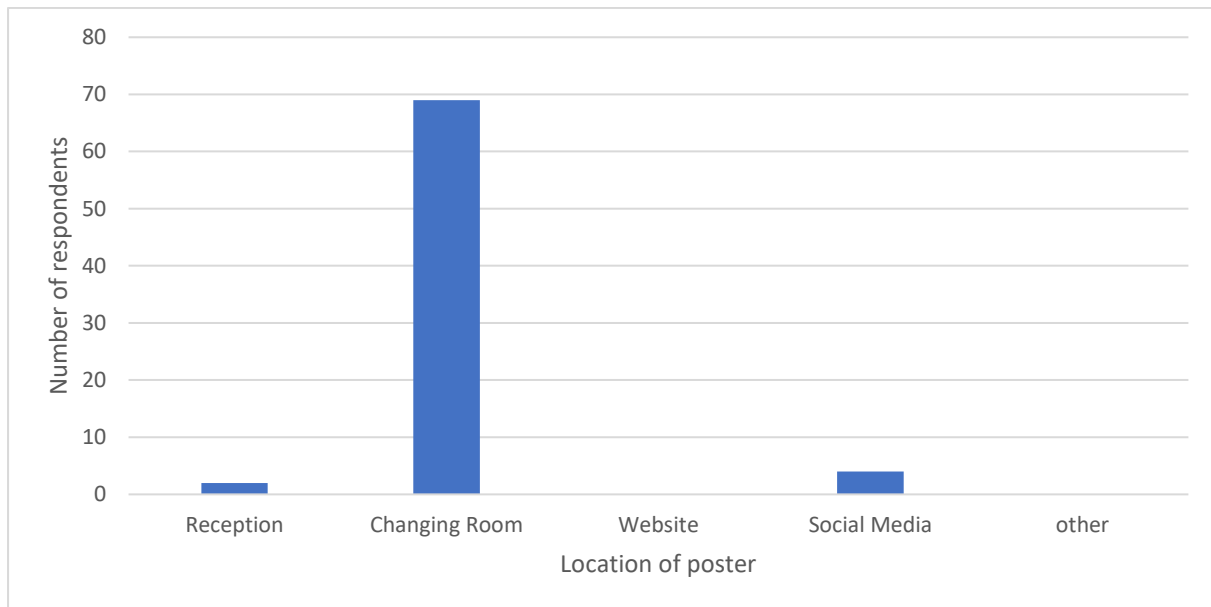
Figure 6g: The number of respondents in phase 3 by whether or not they had seen the poster





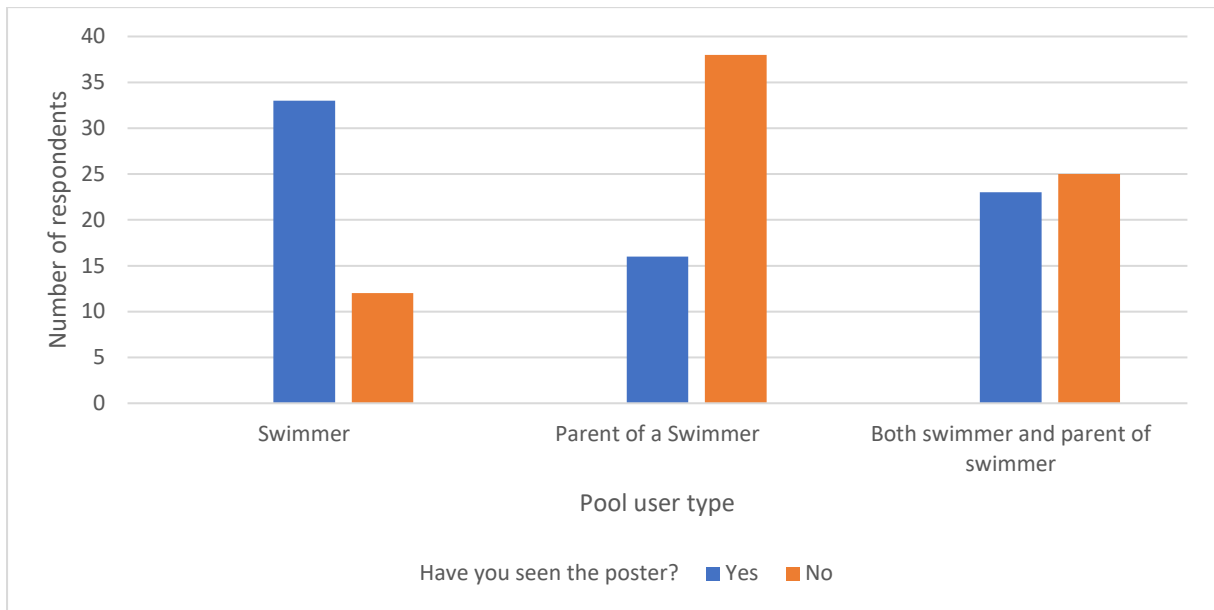
Slightly under half of the respondents (49.7%: n=76) had seen the poster ‘A Healthy Swimmer is a Happy Swimmer’, while 77 (50.3%) had not seen the poster.

Figure 6h: The number of respondents in phase 3 by where they had seen the poster



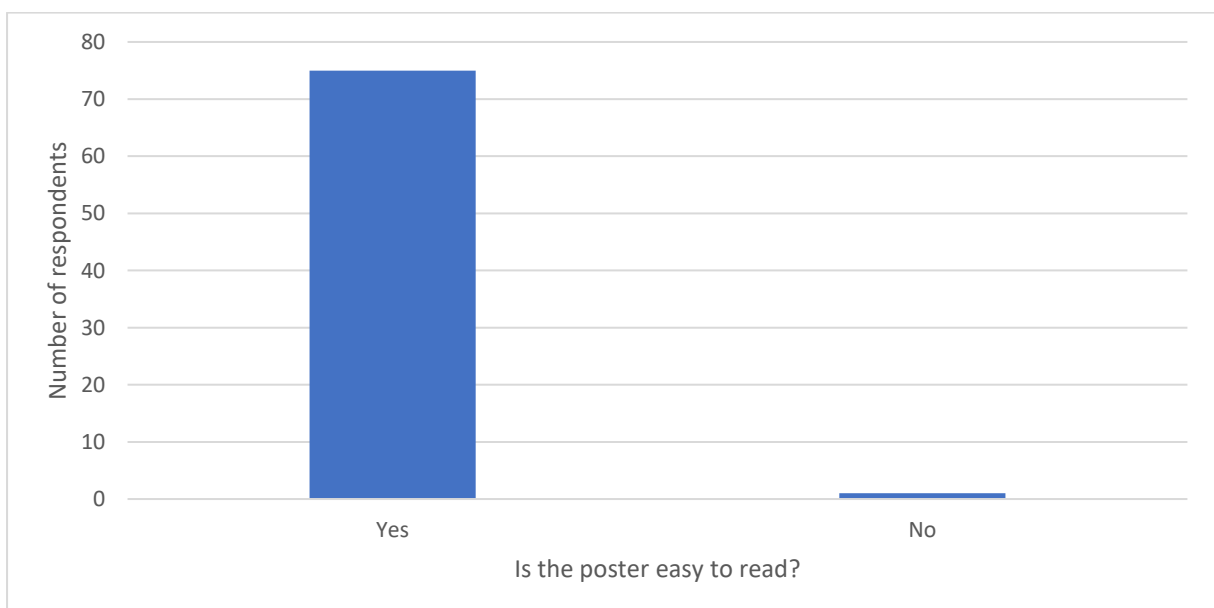
Of those who had seen the poster, 91% (n=69) reported that they had seen the poster displayed in the changing room of the participating swimming pools. Some stated that they had seen the poster through different avenues, but no pools used these other avenues. Pools were provided with PDF versions of the poster to use on their social media, websites and TV screens but these were not used: posters were only displayed in changing rooms. Respondents might have confused the ‘A Healthy Swimmer is a Happy Swimmer’ with another poster, or it is possible that some swimming pool users may have shared an image of the new poster to social media.

Figure 6i: The number of respondents in phase 3 who had seen the poster by pool user type



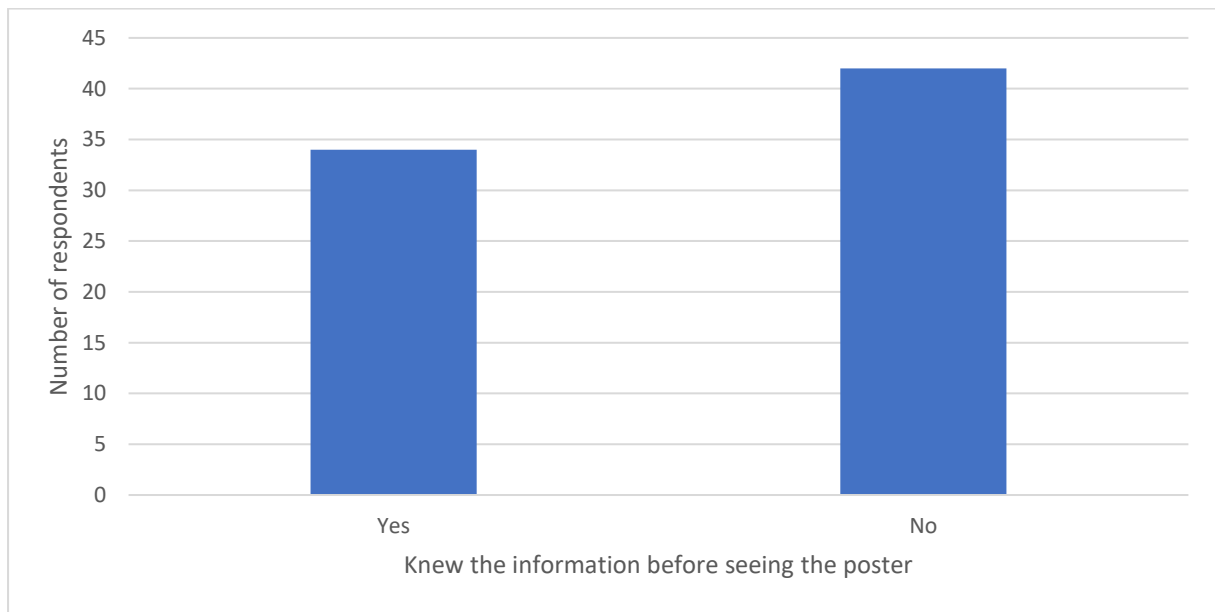
Of those who had noted that they were swimmers, 73% (n=33) had seen the poster, while 27% (n=12) had not. Of the parents of swimmers who responded, 30% (n=16) had seen the poster, while 70% (n=38) had not. Those who were both swimmers and parents did not show any marked difference as to whether they had seen the poster or not, with 48% (n=23) having seen the poster, while 52% (n=25) had not.

Figure 6j: The number of respondents in phase 3 by whether they thought the poster was easy to read



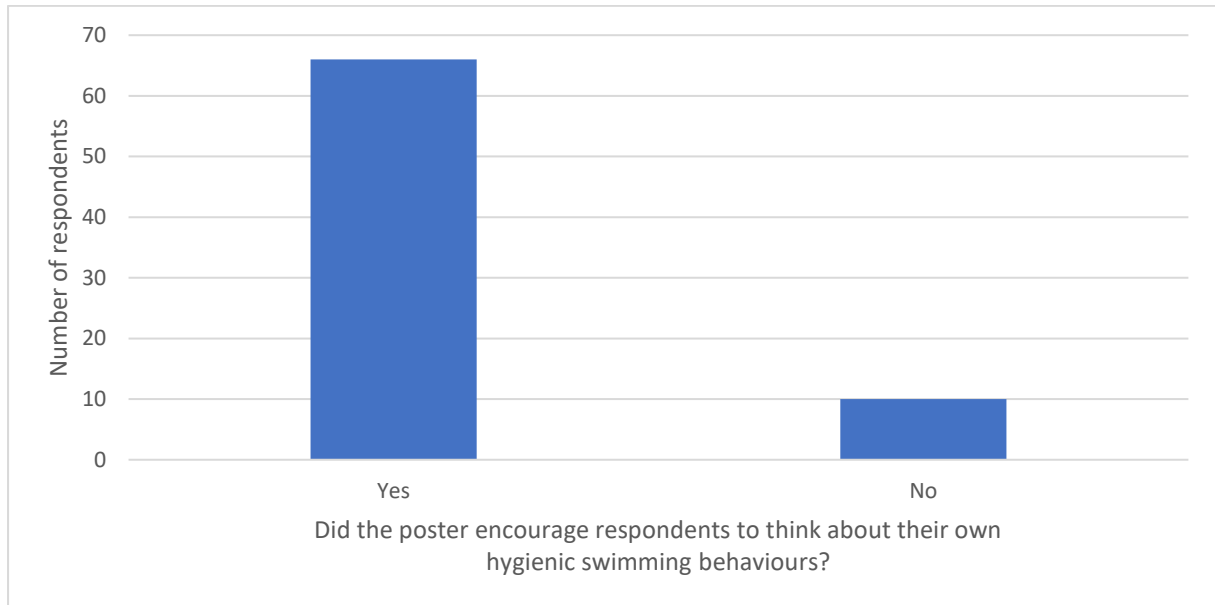
Of the 76 respondents who had seen the poster, 99% (n=75) noted that it was easy to read. One responded did not agree.

Figure 6k: The number of respondents in phase 3 who had seen the poster by whether they knew the information on the poster beforehand



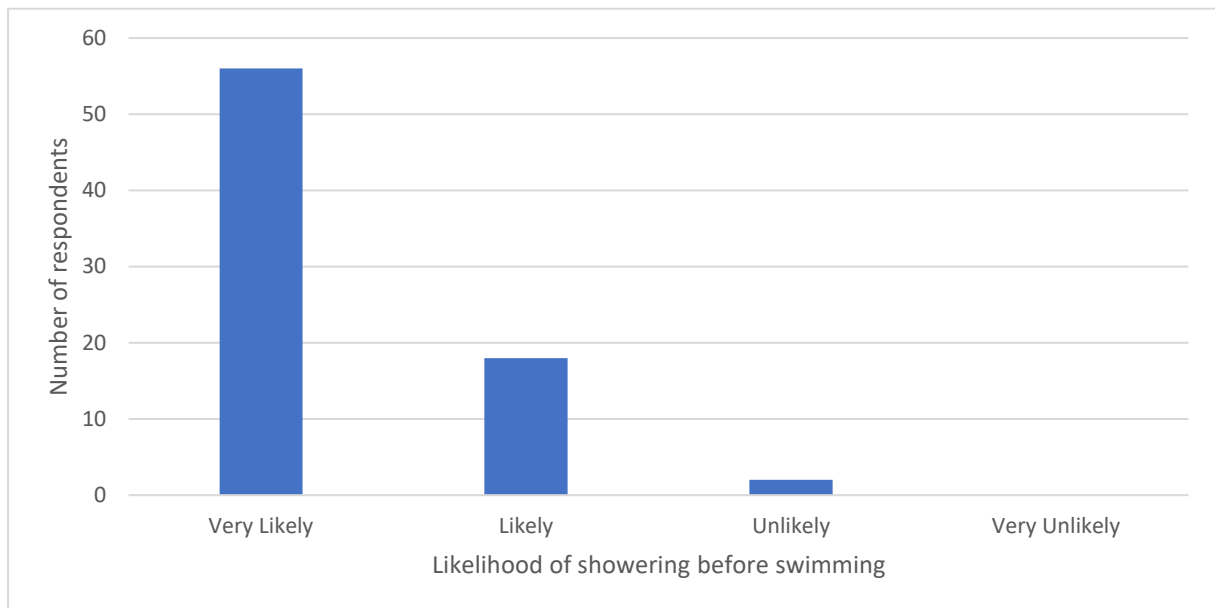
With regard to whether the respondents who had seen the poster knew the information about hygienic swimming behaviours beforehand, 45% (n=34) said that they did know the information, whereas 55% (n=42) stated that they did not.

Figure 61: The number of respondents in phase 3 who had seen the poster by whether the poster had encouraged them to think about their own Hygienic Swimming Behaviours



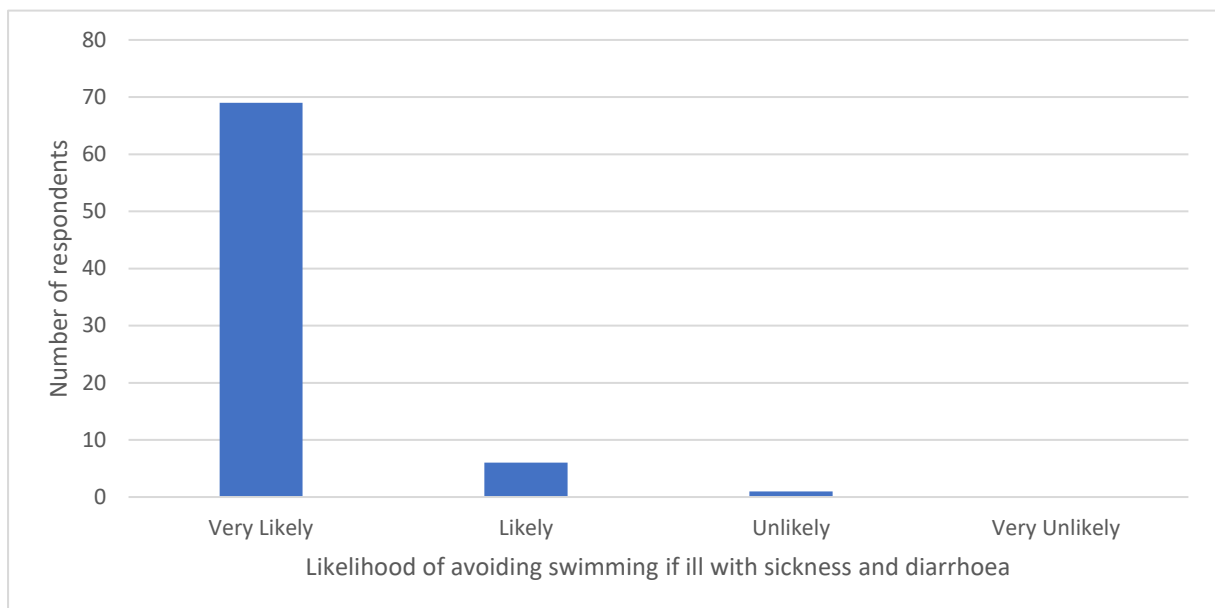
The poster had encouraged 87% (n=66) of the respondents who had seen the poster to think about their own hygienic swimming behaviours. However, 13% (n=10) of respondents reported that it had not encouraged them to think about their own hygienic swimming behaviours.

Figure 6m: The number of respondents in phase 3 who had seen the poster by how likely they were to shower before swimming



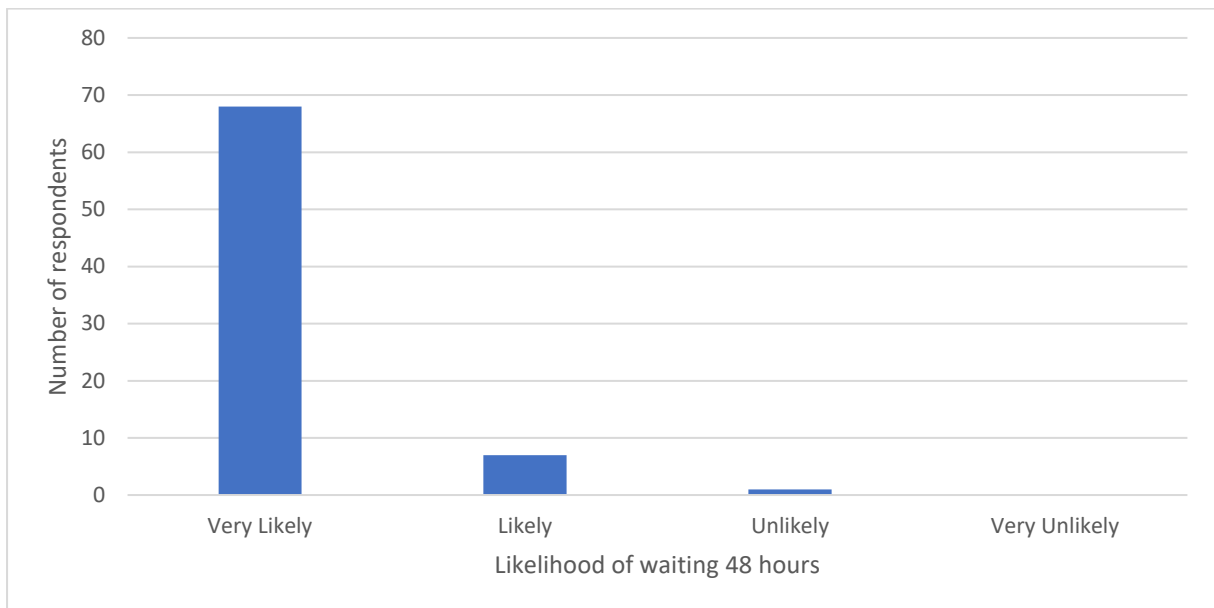
Of the respondents who had seen the poster, 97% (n=74) stated that they were very likely or likely to shower before swimming after seeing the information on the poster. Two (3%) respondents stated that it was unlikely that they would shower before swimming.

Figure 6n: The number of respondents in phase 3 who had seen the poster by how likely they would be to avoid swimming if they were ill with sickness and diarrhoea



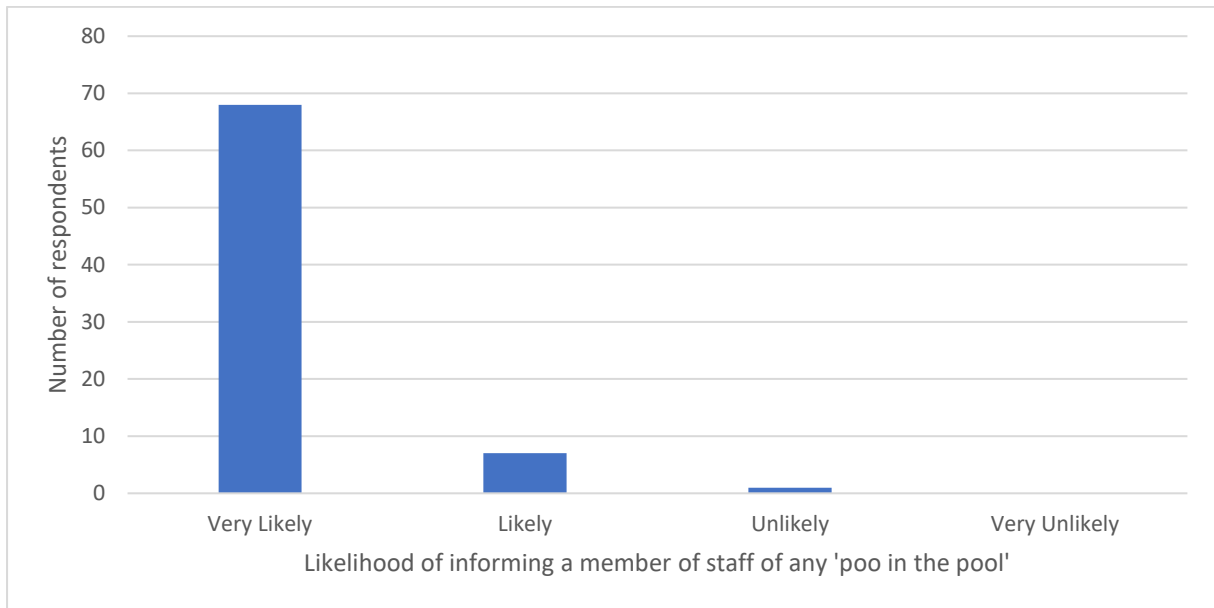
The majority of those who had seen the poster reported that it was likely or very likely that they would avoid swimming if they were symptomatic (99%, n=75). One (1%) person stated that it was unlikely that they would avoid swimming if ill. There was no elaboration on this answer: therefore, it is not possible to make any inference as to why this was.

Figure 60: The number of respondents in phase 3 who had seen the poster by how likely they would be to wait 48 hours before returning to swimming after symptoms of sickness and diarrhoea had stopped



Most respondents who had seen the poster (99%, n=75) stated that they would be very likely or likely to wait 48 hours before returning to swimming after their symptoms of sickness and diarrhoea had stopped. One (1%) respondent said that it was unlikely that they would wait 48 hours. This is the same respondent who reported it would be unlikely that they would avoid swimming if ill.

Figure 6p: The number of respondents in phase 3 who had seen the poster by whether they would inform a member of staff of any ‘poo in the pool’



One respondent who had seen the poster stated that they would be unlikely to inform a member of staff of any ‘poo in the pool’, whereas 75 (99%) said they would be very likely or likely to inform a member of staff. This is a different participant whom stated they would be unlikely to avoid swimming if ill and to avoid waiting 48 hours before returning to swimming after suffering from sickness and diarrhoea.

The questionnaire provided two open-ended questions for respondents to provide any feedback on the poster or voice any other concerns. Twenty-one comments were received. They were grouped based on their topic/theme and examples are provided in the table below.



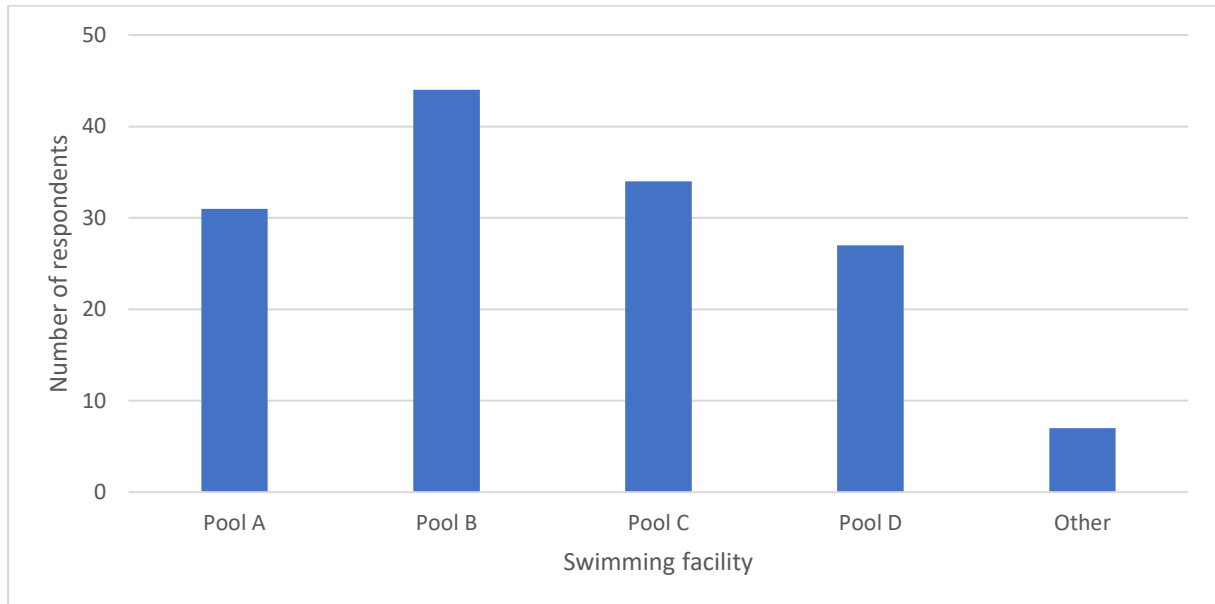
Table 6c: Comments provided by respondents in phase 3

Feedback interpretation	Example quote	Number of comments
Clear and easy to read	Brilliant poster, very easy to read and understand. Animations are very good.	9
Child friendly	The children like the cartoons on the poster, they find them funny and they understand their meaning.	4
Bilingual	It was good to see that the poster was also displayed in welsh	2
Promotion and location of poster	Better if there was a big event saying look at our new posters.	3
Not needed	Know it anyway!	1
Not memorable	Not very memorable. I'm not 100% that I've even seen one.	1

From the comments provided from respondents, it was evident that there were many positive aspects to the poster in terms of it being clear and easy to read. However, one respondent stated that poster was not memorable and another stated that they already knew the information provided. All pools received two posters, one in English and one in Welsh, but perhaps it would have been beneficial to provide more copies, as some respondents stated that having more posters on display would have been useful.

*Location of the posters within the swimming facility*

Figure 6q: The number of respondents in phase 3 who had seen the poster by swimming facility



Although more respondents had seen the poster in Pool B, those who stated that they swam at Pool A or Pool C were more likely to have seen the posters in comparison to those at Pool B or Pool D. This is also corroborated by the data in Table 8, below. Please note, the graph represents number of respondents while the table below represents the percentage of respondents from each swimming pool that had seen the poster.

Table 6d: The percentage of respondents in phase 3 who had seen the poster by the respondents' usual swimming facility

Swimming Pool	Total number of respondents	Number of respondents who had seen the poster	Percentage of respondents who had seen the poster
Pool A	31	20	65%
Pool B	46	16	35%
Pool C	35	25	71%
Pool D	29	10	34%
Other	8	2	25%

This may not be representative, as the sampling method used was convenience sampling, meaning that whoever was at the pool at the time was asked to take part. This could present data collection bias and the results should thus be interpreted with caution. The pools had control over where to display the posters in the changing rooms.

Further evaluation would need to be undertaken with a larger sample size to determine whether the location within the swimming pool itself (i.e. where exactly the posters are located in the changing room) had an effect on whether respondents had seen the poster or not.

To summarise the results section, it is evident that only half of those surveyed reported that they had seen the poster 'A Healthy Swimmer is a Happy Swimmer' after these posters had been displayed from the 1<sup>st</sup> of June 2019 until the 31<sup>st</sup> of July 2019 (some posters may have been displayed for slightly less time due to a delay in them being put up). From those who had seen the poster, there was positive feedback in terms of it being easy to read and informative. The posters were also reported to be child and adult friendly and the children particularly liked the cartoons, which were memorable. This is a key aspect of any awareness interventions. The majority of respondents also stated that the poster had encouraged them to think about their own hygienic swimming behaviours, which was the aim of the poster.

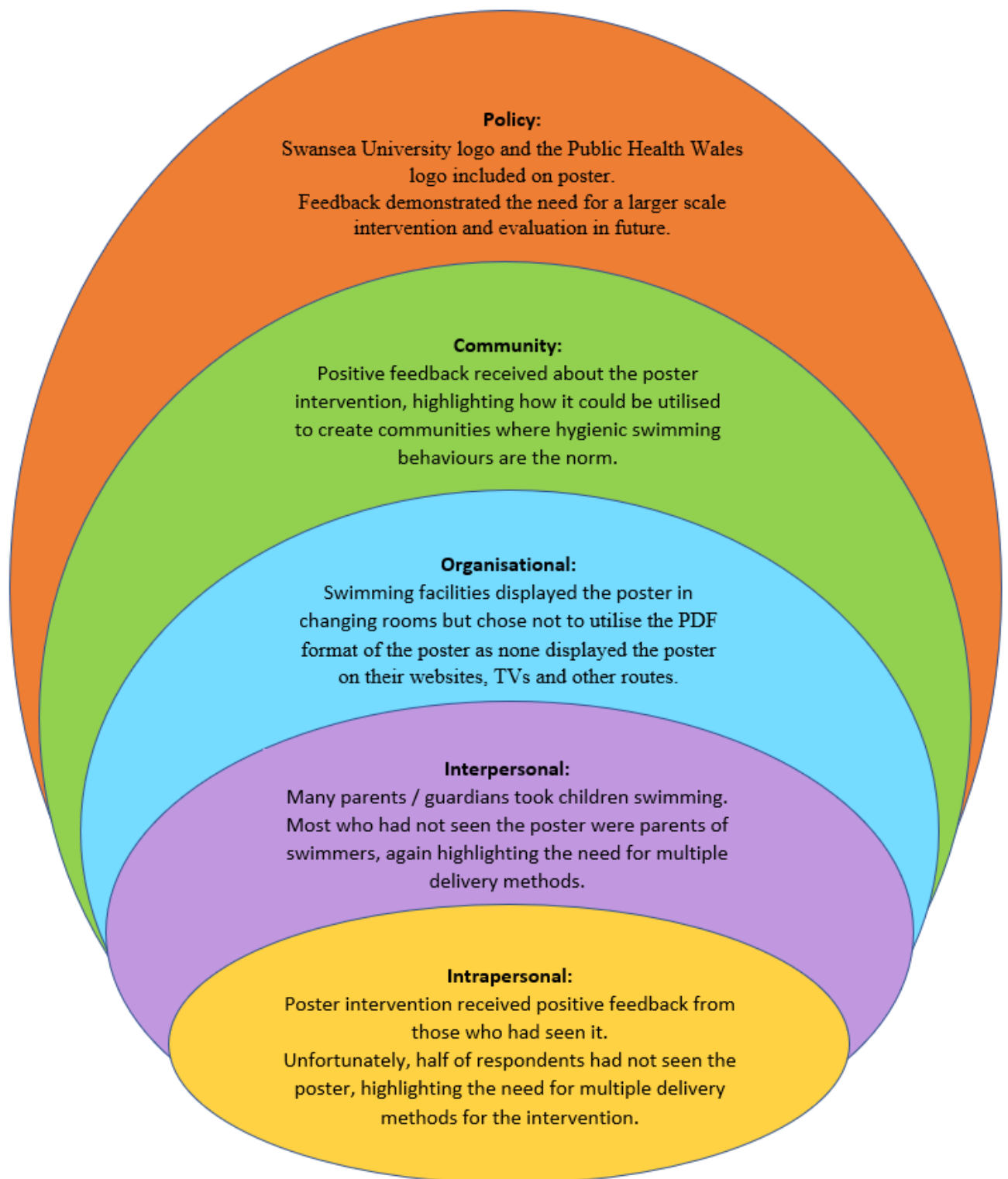
Unfortunately, no pools used the PDF versions of the posters sent to them to display the poster on their websites or social media. This could have affected the number of respondents who saw the poster and thus resulted in an increased awareness of hygienic swimming behaviours. A larger-scale evaluation of the posters would be beneficial. The next section provides a discussion of the findings presented here.

#### 6.4. Discussion of findings from phase 3

The aim of phase 3 was to develop a public health resource informed by the findings from phases 1 and 2, and then to evaluate the acceptability of the intervention amongst swimming pool users. Details of how the poster was developed and evaluated were provided in Chapter 6, section 6.2. A survey was carried out to gather feedback as to whether respondents had seen the poster and whether it was clear and easy to read, and to identify whether respondents felt that the poster had encouraged them to think about their own hygienic swimming behaviours. It has been identified that interventions to increase hand hygiene behaviours in the UK can be successful (Judah et al., 2009): therefore, it was hoped that this intervention might increase swimming pool users' intended hygiene behaviours.

Engaging with the swimming pool user community was beneficial for the development of the intervention because it allowed for the identification of the various levels of influences upon hygienic swimming behaviours. Engaging the target population helped to clarify how best to create an intervention to address some of these factors. The factors addressed included intrapersonal, interpersonal and organisational factors according to the SEM (McLeroy et al., 1988). In addition, the evaluation of the poster supported findings about the importance of community and public policy factors in relation to raising awareness of hygienic swimming behaviours. The findings of Phase 3 will now be discussed in light of the SEM, following an illustration to demonstrate how the SEM has aided understanding of the findings.

Figure 6r: Findings of phase 3 in relation to the Socio-Ecological Model



#### 6.4.1. Intrapersonal factors identified in phase 3

The poster addressed intrapersonal factors which influence behaviour by providing swimming pool users with information on the recommended hygienic swimming behaviours that help to keep the pool clean and healthy. The poster also tried to offer some brief explanations as to why these recommended behaviours are important. For example, the shower cartoon and rhyme aimed to provide information that showering before swimming is recommended and this in turn helps chlorine to target pathogens in the pool water, rather than other matter which can be introduced on a swimmer's body.

The poster focussed on the benefits of hygienic swimming behaviours, rather than demonstrating the risks associated and detailing information regarding cryptosporidium. The findings from the qualitative study highlighted that it would not be beneficial to educate swimming pool users on cryptosporidium, but rather about hygienic swimming behaviours. Findings from phase 1 of the study demonstrated that information relating to cryptosporidium specifically may have an adverse effect, such as putting people off swimming. However, it is possible that some individuals may benefit from being aware of the risks associated with not following hygienic swimming behaviours, particularly the risks from cryptosporidium entering the swimming pool water.

Just under half (n=76, 49.7%) of those who had seen the poster had not known the information about hygienic swimming beforehand. This supports the findings of phase 1 and phase 2 of this study, where current awareness of hygienic swimming behaviours varied. As highlighted previously applying the HBM (Rosenstock et al., 1988), providing information to individuals can change their perceived benefits of following hygienic swimming behaviours, or conversely can influence their perceived risks of not following hygienic swimming behaviours. The study by Galle et al. (2016) drew on the HBM and emphasised how the individual's perceived risk is important when considering protective behaviours. The authors stated that it could be concluded that swimming pool users are more likely to adopt hygienic behaviours if they are aware of the health risks from non-hygienic behaviours. Although the HBM (Rosenstock et al., 1988) aids understanding and interpretation of findings in relation to healthy behaviours and can be used to predict health behaviours, the model is focused on the individual and may not take into account wider influences on behaviour (Carpenter, 2010). This study has highlighted that a multitude of factors influence swimming pool users' hygienic behaviours: therefore, the HBM may not be able to fully predict health behaviours. The HBM also assumes that people

are rational decision-makers with regard to their health; however, personal factors such as emotions and stress can influence one's decisions (Orji, Vassileva & Mandryk, 2012).

As demonstrated by Nett et al. (2010), signage and attendants at a swimming facility did not mean that all swimming pool users followed hygienic swimming behaviours. Additionally, the poster intervention used by Lawson and Vaganay-Miller (2019) to improve hand hygiene behaviour was found to have a limited effect on the behaviour of 1149 participants observed in a public restroom at a university setting. Hand hygiene campaigns in hospital settings also demonstrated that there is no evidence of the effectiveness of poster reminders for staff to wash their hands (Gould et al., 2007). Therefore, understanding the wider influences on hygienic swimming behaviours in addition to individual factors, as the SEM does, is beneficial when developing public health interventions.

Conversely, this study showed that the poster had encouraged 87% (n=66) of the respondents (who had seen the poster) to think about their own hygienic swimming behaviours, although it is important to note this is reported intended behaviour, rather than observed behaviour as measured by Nett et al. (2010). Most respondents stated that they would be very likely or likely to shower before swimming after seeing the poster. Two respondents said that it would be unlikely that they would shower before entering the pool. Additionally, all but one of the respondents said that it was very likely that they would avoid swimming if they were experiencing diarrhoea and vomiting, would wait 48 hours before returning to swimming after their symptoms of diarrhoea and vomiting had stopped, and would inform a member of staff of any 'poo in the pool'. Unfortunately, the questionnaire did not provide the means to explore why three respondents would be unlikely to follow some of the recommended hygienic behaviours after seeing the poster. Further research would be beneficial to evaluate the poster further and to understand why it had not encouraged some individuals to consider showering before swimming. In addition, it is important to note here that most (n=45, 29%) respondents were aged between 25 and 34, with only 7% (n=11) of respondents being 55-64 years old and 4% (n=6) aged 75 and over. In addition, 65% (n=100) of respondents were female. Therefore, further research with a larger sample size could help to provide a more diverse sample of the swimming population to gather feedback on the poster from a wider audience.

One respondent to this study said that they would not avoid swimming whilst suffering with sickness and diarrhoea. This highlights a lack of awareness or a lack of perceived risk of this behaviour to avoid illness transmission in this one respondent. One faecal incident has the

potential to cause a wide-scale outbreak, as Lowe et al. (2010) concluded in their study. They found that a faecal accident on the toddler slide in a swimming pool was the most likely source of contamination with cryptosporidium in which outbreak investigations identified 106 confirmed cases, highlighting the importance of hygienic swimming, and particularly not swimming whilst suffering with diarrhoea and vomiting. However, the respondent who completed the questionnaire was an adult (required to be 18 years or older to complete the survey), and therefore may believe that they would not have an accident in the swimming pool. Nevertheless, transmission of cryptosporidium can still occur in a swimming pool setting without a faecal accident, through lack of other hygiene measures such as not showering before swimming or not washing hands after using the toilet. This finding highlights the importance of addressing intrapersonal factors such as knowledge and awareness. Other interventions may be necessary to encourage all swimming pool users to follow hygienic swimming behaviours.

Additional feedback on the poster demonstrated that it was clear and easy to read and was child friendly, and respondents were encouraged that it was also available in Welsh. Feedback provided for the poster was very positive, with 99% (n=75) of respondents who had seen the poster reporting that it was easy to read. The importance of clear and direct messages was also identified in phases 1 and 2 of this research. Again, this finding shows the importance of considering intrapersonal factors such as health literacy when trying to raise awareness of hygienic swimming behaviours. The intervention was designed to address these intrapersonal factors, such as educational level and reading level, by ensuring that the poster provided information in plain English and Welsh that was visually appealing by using the cartoon images. It is evident that health literacy can affect the effectiveness of a public health intervention, as individuals may interpret information differently if educational and literacy levels vary amongst the target population (Jones & Douglas, 2012).

As discussed previously in Chapter 4, section 4.4. health literacy relates to the individual's skills to access and understand health information. It also relates to how individuals then use their interpretation of this information to improve their health (Nutbeam, 2000). Phase 1 of this research identified the varying population groups that use swimming pool settings; therefore, it is likely that this diverse population will have varying educational levels. The poster was designed to provide simple messages, which could be understood by all, in order to address barriers such as educational levels and health literacy.



However, it is important to note here that the three phases of work conducted as part of this study had not collected socio-economic status of respondents. Also, ethnicity data was not collected. This is important to take into consideration while discussing the intrapersonal factors that influence hygienic swimming behaviours. Future work would be beneficial to explore the relevance of the poster amongst different age, ethnicities, and socio-economic groups. This could be done by conducting further surveys and collecting more demographic data, online forums or discussion groups (similar to focus groups) which aim to obtain feedback of the poster from various groups identified.

The Swansea University logo and the Public Health Wales logo were both included on the poster. This was to encourage trust and credibility in the information, as this was highlighted as being important in the first phase of this study. Lawson and Vaganay-Miller (2019) demonstrated that the use of an independent, self-designed poster to improve hand hygiene in a university setting was ineffective. Therefore, when developing this self-designed poster intervention to raise awareness of hygienic swimming behaviours, it was considered important to try to improve the credibility and trust of the information by using well-known organisational logos to help improve the acceptability of the intervention amongst swimming pool users.

Previous studies have highlighted how visual posters are often used to encourage hand hygiene in restrooms; however, it has been highlighted that these posters act as environmental cues and may not result in long-term behaviour change (Durell Johnson, Sholcosky, Gabello, Ragni, & Ogonosky, 2003). This further contributes to the evidence that there may be a need for more than just a poster intervention. Phase 1 of this research explored other ways to raise awareness of hygienic swimming behaviours, such as using an animated video in schools as a pre-swim lesson. Creating various materials, such as posters, videos, leaflets, and teaching materials for schools and swim clubs, could help to raise awareness of hygienic swimming behaviours in a more effective way.

However, it is important to note that previous literature has also highlighted the benefits of using posters and signage to raise awareness, showing that it can help to encourage hygienic swimming behaviours. Ribbers (2019) reported that interventions to increase pre-swim showering can reduce the level of pollution within the swimming pool. They found that a poster using watching eyes and a shower symbol led to an increase in the number of observed pre-swim showers amongst 596 participants. On the other hand, slightly over half of the 4370 respondents surveyed by Pasquarella et al. (2013) had read the pool rules on display at the

swimming facility. Nevertheless, they found that those who had read the rules were more likely to shower before entering the swimming pool (Pasquarella et al., 2013). These studies, along with the findings from the present research, demonstrate the benefit of displaying hygiene information, but also show that not all those who attend a swimming facility will take notice of this information.

It is evident that providing information to swimming pool users about the recommended hygienic swimming behaviours may result in a behaviour change. Previous research has identified that behaviour change models propose that raising awareness can be successful in changing behaviour. These models include the Theory of Planned Behaviour (TPB) (Ajzen, 1991) and the Transtheoretical Model of Behaviour Change (Prochaska, Johnson, & Lee, 1998). The TPB is used to predict an individual's intention to behave in a certain way at a specific time and place. The theory states that behavioural intentions are influenced by an individual's attitude towards the benefits or risks associated with a behaviour, along with one's motivational factors to perform the behaviour. Subjective norms, which relate to an individual's belief about other people's approval or disapproval of the behaviour, in addition to social norms, have control over one's behaviour. The fifth construct of the TPB refers to barriers or facilitating factors towards conducting the behaviour in question, while the sixth construct relates to an individual's perception of the ease or difficulty of following the behaviour (Ajzen, 1991). The TPB can aid interpretation of this result by highlighting how swimming pool users' motivation and ability to follow hygienic swimming behaviours can be modified by providing them with information. For example, information can help to change individuals' motivation to follow hygienic behaviours by showing them the beneficial outcomes from following such behaviours. While this theory is useful to aid interpretation of the present findings, it is important to note that it does not consider wider factors such as environmental influences on health.

The Transtheoretical Model is useful to highlight that individuals may be at different stages of behaviour change, proposing six constructs. The precontemplation stage is defined as the stage where an individual is not considering a behaviour change as they are often unaware their current behaviour may be causing a negative outcome. Therefore, this helps to understand that some swimming pool users may not be aware, for example, that the behaviour of not showering before swimming has a negative outcome. Thus, providing information to swimming pool users of the importance of showering before swimming can help them to consider changing their behaviour. The second stage of this model, called the contemplation stage, demonstrates that

some individuals may be intending to adopt a healthy behaviour. Providing information to swimming pool users can help to influence those in this stage by helping them to recognise that their current behaviours may be unhygienic. Preparation is a stage where individuals take small steps towards the intended behaviour change, and the action stage involves individuals who have recently changed their behaviour. The intention of providing information regarding hygienic swimming behaviours is to influence swimming pool users to get to this action stage. However, the model highlights two other stages – the maintenance and the termination stage – where the behaviour change has been sustained and individuals will not revert back to their unhealthy behaviour. Therefore, the aim of an intervention to raise awareness of hygienic swimming behaviours is to bring about a behaviour change but also to ensure that these hygienic behaviours are consistently followed.

Although this model can aid understanding and highlights how a tailored intervention can target people at various stages of the decision-making process, it does not take into consideration social influences or wider environmental factors, as has been highlighted by this study to influence hygienic swimming behaviours. Yet, components of this model highlight the benefit of raising awareness through providing information to individuals in order for a behaviour change to take place, thus supporting the value of the poster intervention developed to raise awareness of hygienic swimming behaviours.

#### 6.4.2. Interpersonal factors identified in phase 3

The poster aimed to raise awareness of hygienic swimming behaviours amongst those who did not go swimming themselves but took children swimming such as parents, grandparents and other adults. The poster was designed to be displayed in PDF format for websites, TVs and other routes in order to target an audience that does not necessarily visit the changing room of a swimming facility. Unfortunately, no swimming facilities used these PDFs to display the poster in different formats. It is also important to note that it might have been beneficial for swimming facilities to receive more than one copy of the ‘A Healthy Swimmer is a Happy Swimmer’ poster in order to display it in more places to capture a wider audience.

This relates to the location of the posters in the swimming pool and to having more than one means of delivery for the messages. For example, parents who do not go into the changing room with their children will not have seen the poster. This demonstrates that it is important to

consider interpersonal factors, such as the influence of parents on children, when designing public health interventions to raise awareness of hygienic swimming behaviours. Fifty-four (35%) respondents were parents of swimmers, while 48 (31%) were both swimmers and parents of swimmers. This shows that many respondents were parents and had the potential to influence their children with regard to hygienic swimming behaviours. However, in order for parents or guardians to influence their child's hygienic swimming behaviours, they must first know what the recommended behaviours are that can help to keep the swimming pool clean and healthy. As the poster had received positive feedback, it is hoped that those who had seen it may have in turn influenced their children's behaviour.

#### 6.4.3. Organisational factors identified in phase 3

It was identified that slightly under half (49.7%, n=76) of the respondents had seen the poster 'A Healthy Swimmer is a Happy Swimmer' (Appendix 4a). This could be explained by various factors, such as where in the changing rooms the posters were displayed. Also, parents who do not enter the changing room with their child would not have seen the posters, as the participating facilities employed no other means of delivery. This was evident from this study, as analysis showed that respondents were more likely to have seen the poster if they were swimmers. This also relates to the swimming facilities not utilising the PDF format of the poster, as none displayed it in PDF format on their websites, TVs and other routes to allow it to target an audience that does not necessarily visit the changing rooms.

As stated in previously in section 6.2., two swimming facilities did not take part in phase 3 of the research. This meant that the posters were not displayed in these facilities. This highlights again how organisational factors can influence hygienic swimming behaviours by demonstrating how organisational 'buy in' to the public health intervention is one of the key factors for an intervention to be successful. Segrott & Roberts (2019) highlight how it is important to take into consideration the organisations own goal and how an intervention can be incorporated into those goals to ensure successful delivery. For example, there may be differing priorities within the swimming pool settings that took part in this study, where some may prioritise hygienic swimming behaviours while others may not. Therefore, it may worth emphasising to swimming organisations that raising awareness of hygienic swimming behaviours is in their interest as it can reduce the likelihood of communicable disease outbreaks

and improve the swimming environment. In addition, it could help reduce costs associated with closures from an outbreak for the organisation.

#### 6.4.4. Community factors identified in phase 3

The positive feedback received about the poster intervention highlights how it could be utilised to create communities where hygienic swimming behaviours are the norm. Displaying the poster at many different swimming facilities in different formats using the PDF version, in addition to the large posters for display in the changing rooms, could help to create a culture within the swimming community where hygienic swimming behaviours are encouraged and supported. The poster was developed based on the views of those within the swimming community, including swimmers, parents of swimmers and swimming pool operators. It is evident that involving those which an intervention is aimed to target, in addition to those who are asked to deliver the intervention, may improve the successfulness of the intervention (Segrott & Roberts, 2019). Therefore, involving various stakeholders from the swimming community, throughout each stage of this study is likely to have contributed to the positive feedback received by respondents in phase 3.

As with phase 2, this third phase of work identified that respondents also swam at different facilities from those at which data collection took place. Again, this demonstrates how swimming facilities need to provide consistent messages across the swimming community as a whole in order to improve hygienic swimming behaviours. Additionally, consistency is a key aspect of communicating health messages in public health practice (Suggs, McIntyre, Warburton, Henderson & Howitt, 2015). This is also related to public policy, demonstrating how including hygienic swimming behaviours in public policy, with interventions to try to address the many influences identified for these behaviours, could help to improve hygienic swimming behaviours amongst the swimming community.

An important critique reported by one respondent was that it would be beneficial to have an event that promoted the new posters. This finding suggests that a 'launch event' may make people more aware of the posters and draw them to read these posters. Such an event could be beneficial to bring together the various stakeholders from within the swimming community. This could then help to create a swimming community that is encouraging and supportive of

hygienic swimming behaviours, which might facilitate these behaviours becoming a social norm.

#### 6.4.5. Policy factors identified in phase 3

Including the Swansea University and the Public Health Wales logo on the poster demonstrates the need for buy in from public organisations. Public policy may incorporate a poster such as this in to policy and guidance documents as a resource for swimming pool operators. Public policy in the UK aims to reduce the burden of communicable diseases, therefore is a potential for this intervention to be adopted into guidance provided to swimming pools by the HSE and Local Authorities, in order to help reduce the transmission of cryptosporidium within swimming facilities. This third phase of the study also identified that swimming pool users attend many different swimming facilities, from outside their local areas, therefore requiring pool operators, as part of public policy, to provide clear and consistent messages would be beneficial.

In addition, it is evident from the evaluation that further funding and research would be beneficial for a larger scale intervention and a further evaluation of the intervention. This could be funded by a public body as part of the aims of public policies, legislation and guidance documents, to reduce cases and outbreaks of communicable diseases in the UK. Furthermore, public policy needs to address the many influences on hygienic swimming behaviours identified, in order for such behaviours to be adopted by swimming pool users. As identified in this study, the design of swimming facilities also need to be considered at the policy level in order to ensure facilities are encouraging and supportive of the hygienic swimming behaviours that are being promoted by interventions such as the poster 'A Healthy Swimmer Is A Happy Swimmer'.

## 6.5. Synthesis of the findings and discussion across all three phases

The combination of three phases of this study enabled me to address my research aims; namely to explore awareness of hygienic swimming behaviours, to develop and conduct an evaluation of a public health intervention to reduce the transmission of cryptosporidium. This research has identified that there are many different influences on hygienic swimming behaviours, from interpersonal factors to public policy factors. To develop a public health intervention to raise awareness of hygienic swimming behaviours, these factors needed to be taken into consideration. Thus, demonstrating the benefits of using a mixture of methods approach in an exploratory sequential design to develop an in depth understanding of the multiple factors, which influence hygienic swimming behaviours.

Adopting this design enabled the development of a public health intervention, which was developed based on the views and perspectives of the target audience. In addition, the intervention gained recognition and credibility through being endorsed by Public Health Wales and Swansea University. Endorsement from public bodies such as Public Health Wales also raises the possibility in the future for the intervention to be evaluated with a larger sample and over a longer period of time. If proven to be effective, wider dissemination may be possible across swimming pool settings in Wales.

Findings from phase 1 identified the need to raise awareness of hygienic swimming behaviours with swimmers / parents of swimmers and the need for more health information in the swimming pool settings. A number of factors were identified besides lack of information, which influenced whether hygienic swimming behaviours were being followed or not. Phase 1 provided an insight into why swimmers' may or may not follow hygienic swimming behaviours. For example, some participants did state they were aware of hygienic swimming behaviours but did not follow them for various reasons. This demonstrates that providing information to swimming pool users may not be sufficient to encourage hygienic swimming behaviours. Phase 2, therefore explored with a larger sample awareness of hygienic swimming behaviours amongst swimmers / parents of swimmers and how swimmers / parents of swimmers preferred to receive information regarding these behaviours.

The findings from this second phase supported those from Phase 1 but in addition identified the importance of taking an interpersonal factor, age into consideration. This second phase highlighted how the most preferred means of receiving information about hygienic swimming behaviours was through a poster displayed in the changing rooms of the swimming pool

settings, yet stratifying by aged demonstrated that those aged 18 to 24 years preferred information to be provided on the TV screens in reception areas.

These findings were applied to the development of a public health intervention, which was grounded in the views of not only the swimming community but also of the pool operators. The poster was developed so that it could be used in the changing rooms, but also as PDF versions to be displayed on TV screens in reception and on social media. However, the findings from Phase 3 indicated that although the poster was received very positively, the need for sustained engagement with the pool operators was apparent as all four settings did not display the posters in all its formats. This would appear to tie in with public policy, with there being no regulation in the UK which specifies that swimming facilities must provide information to their pool users. The three phases to this study demonstrated the value in all swimming facilities providing clear, succinct and consistent messages to swimming pool users regarding their role in helping pool operators to keep the swimming pool clean and healthy

In addition, as only 49.7% (n=76) of respondents had seen the poster there is a need for a sustained campaign of promoting awareness of the need for hygienic swimming behaviours. Going forward this could be embedded within swimming clubs, aqua natal classes, nurseries and the schools so that future generations of swimmers are socialised into hygienic swimming behaviours from a young age.

This study has highlighted the need for a multifaceted approach to public health interventions. As an example, in addition to providing information to swimmers / parents of swimmers, swimming facilities need to be designed to promote, encourage and support hygienic swimming behaviours. Although not feasible for this study, a future study concerning the design of swimming facilities and the effect upon hygienic swimming behaviours would be beneficial to understand this phenomenon further.

To conclude, adopting this phased sequential design enabled the findings from each phase to inform the next and in so doing enabled a public health intervention to be developed based on the views of the target audience and enabled the research aims to be fully met.



## 6.6. Summary

To summarise, this chapter has explained the development of a public health intervention based on the findings from phase 1 and 2 of this study. The methods used to evaluate the poster have been provided (section 6.2.) and the results of the evaluation presented in section 6.3. The chapter concluded with a discussion of the findings of this third phase and a synthesis of the findings from all three phases in this study. The factors that influence hygienic swimming behaviours have been explored and interpreted throughout this thesis. It is evident that there is a need to address many of these factors if a public health intervention to raise awareness of hygienic swimming behaviours is to be successful. The poster was designed using cartoon images and rhymes to demonstrate the recommended hygienic swimming behaviours and to provide some explanation as to why they are beneficial, as described in section 6.2.2.

Half of the respondents reported that they had seen the poster 'A Healthy Swimmer is a Happy Swimmer'. Those who had seen the poster gave positive feedback in terms of it being easy to read and informative. The majority of these respondents also stated that the poster had encouraged them to think about their own hygienic swimming behaviours, which was the aim of the poster. Unfortunately, no pools used the PDF versions of the posters on their websites or social media. This could have affected the number of respondents who saw the poster and further research is needed to explore the potential impact of this on raising awareness of hygienic swimming behaviours. A larger scale intervention and evaluation using the poster 'A Healthy Swimmer is a Happy Swimmer' would be beneficial.

The poster developed as part of this research was well received by swimming pool users who had seen it, and the evaluation has shown its potential to help raise awareness. Previous research has also shown the importance of recognising the factors which influence certain behaviours, and how there is a need to address more than one of these factors for a behaviour change to take place.

The concluding chapter follows next and will discuss the limitations of this study, in addition to recommendations for future research and practice.

## 7. Chapter Seven: Conclusion and Recommendations

### 7.1. Introduction

This concluding chapter provides a reminder of the aims of this study, in addition to a summary of the main findings from the three phases. The implications of the findings for public health will also be discussed, along with recommendations for practice and policy. Recommendations for research are also provided and the limitations of this study are presented. The chapter closes with an explanation of how this study has made an original contribution to the existing body of knowledge with regard to hygienic swimming behaviours and ways in which to raise awareness of such behaviours.

### 7.2. Reminder of the aims of the study

Informed by the shortfalls identified in the existing literature identified in Chapter 2, the aims of this study were to explore awareness of hygienic swimming behaviours and to develop and evaluate a public health intervention to raise awareness of these behaviours, in order to reduce the transmission of cryptosporidium in swimming pools. Three phases of work were conducted to address these aims using a mixture of methods in an exploratory sequential design (Chapter 3).

The first phase (Chapter 4) adopted a qualitative approach and explored swimmers' and parents of swimmers' awareness of hygienic swimming behaviours and cryptosporidium. An exploration of how swimmers and parents of swimmers would like to receive health information was also carried out. This first phase gathered information on public health measures currently in place at swimming pools and explored swimming pool operators' views about a public health intervention. The views of health care professionals were also explored to enhance the data gathered on the need for and nature of a public health intervention.

The second phase (Chapter 5) sought to verify the findings from phase 1 with a larger sample of swimmers and parents of swimmers. A further exploration of swimmers' and parents of swimmers' awareness of hygienic swimming behaviours was conducted. This second phase

also verified how a sample of the swimming population preferred to receive information regarding hygienic swimming behaviours.

The findings from phases 1 and 2 of this study informed the development of a public health resource to raise awareness of hygienic swimming behaviours. The intervention developed was a poster with cartoon images and rhymes to communicate in easy and simple terms the recommended hygienic behaviours for swimming pool users. The poster intervention was piloted and evaluated amongst a sample of the swimming pool user population (Chapter 6).

### 7.3. Summary of main findings

The findings of phase 1 demonstrated that there are many different factors that influence hygienic swimming behaviours. Understanding of these factors was aided through the application of the SEM (McLeroy et al., 1988) with the factors ranging from intrapersonal and interpersonal to organisational, community and policy level factors,. The intrapersonal factors identified included current awareness of hygienic swimming behaviours, personal habits and routines and individual beliefs in relation to hygienic swimming. Peer and parental influences were identified at the interpersonal level, while organisational factors such as current efforts to educate swimming pool users and the cleanliness of facilities were identified. Swimming pool users' social norms were identified as an influence at the community levels, while the design of swimming facilities was highlighted as important at a policy level. In addition, other policy factors were identified, such as the need for a public health intervention to raise awareness of hygienic swimming behaviours while considering the credibility and trust of public health messages.

The second phase of work demonstrated that the most preferred way of receiving information regarding hygienic swimming behaviours by respondents was a poster on the changing room walls of swimming facilities. However, when stratified by age, the most preferred option among 18-24 year olds was information on TV screens in reception. This highlighted the need to develop a public health intervention that could be delivered in different formats to capture the varied groups that attends swimming facilities. In addition, all respondents, apart from six who provided a neutral response or no answer, stated that they agreed that swimming facilities should provide information to swimming pool users on how they can help to keep the pool clean and healthy. Thus, the findings from phase 1 and phase 2 informed the development of a

poster which could be displayed in changing rooms, and also on TV screens in the reception areas of swimming facilities. In addition, the poster could be displayed on websites, social media and other electronic avenues. The poster also contained a QR code, which, when scanned by those viewing it, opened up a YouTube video that provided an animated version of the poster.

The poster intervention was very well received by those who had seen the poster during the evaluation survey. Positive feedback was provided in terms of the poster being easy to read and informative. The majority of respondents also stated that the poster had encouraged them to think about their own hygienic swimming behaviours. This demonstrating the benefit of an exploratory sequential design, that involved swimmers / parents of swimmers at each stage of the research and intervention development, which has been highlighted to play an important role when developing public health interventions (Segrott & Roberts, 2019).

#### 7.4. Limitations

While the findings of this study contribute to current literature and provide a new insight into hygienic swimming behaviours, in addition to providing a new public health resource, it is important to note there are limitations to this study. Most of the respondents were female. This is important, as gender could have influenced the preferred way of receiving health information and might also have influenced the feedback received on the poster. Additionally, most of the participants in phase 1 were aged between 18 and 24 years or 55 and over. There were few participants who represented the 25-54 years age group. In addition, ethnicity data was not collected and posters were provided only in English and Welsh. Therefore, those unable to read in English or Welsh were unable to participate in the study and access the information on the poster.

The sampling method used for the quantitative phases of the study was a non-random sample, and therefore may not be as representative of the swimming pool user population as a random sample would have been. This highlights the potential for data collection bias, especially because I was required to assist in the recruitment of participants during all three phases, as the recruitment posters and cards alone did not generate a large enough sample of the population. The study design also has the limitation of responder bias in terms of participants reporting socially desirable answers during all three phases. Therefore, the true picture of hygienic

swimming behaviours may be different from what has been reported. An observational study would be beneficial to address this by observing hygienic swimming behaviours. However, there would be many ethical considerations regarding a study of this nature.

Thus, it is important to take into consideration the design limitations of this study as highlighted in this section, with the need for reflection on the size and limited geographical scope of the sample, the limited age ranges of the samples in each phase, and the possible bias identified in chapter 5 in relation to frequent swimmers / parents of swimmers in phase 2. In addition, the lack of demographic data, including ethnicity and socio-economic status in the three phases of this study need to be highlighted as a limitation.

Unfortunately, time constraints of the PhD study did not allow for public engagement while developing the poster intervention. Although the poster was developed based on evidence gathered from phase 1 and 2 of this study, it would have been beneficial to engage stakeholders in the specific development of the poster. A consultation group of stakeholders to help design the intervention would have been useful. Another limitation identified during the design phase of the intervention was the lack of testing of the poster for literacy levels and acceptability.

In addition, the intervention developed focused on raising individual awareness, and it is acknowledged that awareness does not always result in a behaviour change. It is evident from health behaviours models and theories that there are many different components / stages to behaviour change, with awareness usually being the first stage. Also, it is important to take into consideration that the poster did not address all of the influences on hygienic swimming behaviours identified in this study. As discussed throughout this thesis, the design of swimming facilities has been highlighted to be important in supporting and encouraging hygienic swimming behaviours. Therefore, there is a need for a holistic approach to improving hygienic swimming behaviours, which includes addressing the influences on all levels of the SEM (McLeroy et al., 1988). Of note, these design influences have been communicated to pool operators, and it is hoped to provide further dissemination of these organisational and public policy level factors in the future.

The evaluation of the poster was conducted on a small scale due to time constraints. The evaluation identified that only half the respondents had seen the poster, which is a limitation in terms of being able to fully evaluate its acceptability. However, this may also be viewed as a positive aspect, as the evaluation identified the need to deliver hygienic swimming messages in various ways to ensure that they reach the intended audience. With this in mind, it is

important to highlight the benefit of adaptation and re-evaluation of the poster in any future research / public health interventions within the existing research settings, or new swimming pool settings, to help improve the success of the intervention (Movsisyan et al., 2019).

## 7.5. Implications for Public Health

This study identified that there is a multiplicity of factors which influence hygienic swimming behaviours. These factors influence individual hygienic swimming behaviours and those of other swimmers at various levels. The application of the SEM (McLeroy et al., 1988) to the findings was useful in highlighting the range of factors which influence hygienic swimming behaviours. In addition, a range of interventions was identified that may be needed to change pool users' hygienic behaviours and ultimately the culture and social norms of swimming facilities regarding hygienic swimming behaviours. As such, recommendations for practice, policy and research have been identified from the findings of this study.

### 7.5.1. Recommendations for research

- Conduct national studies with larger and more diverse samples to further explore awareness of hygienic swimming behaviours and ways to raise awareness of these behaviours.
- Further evaluation would be needed with a larger sample size to determine whether the location within the swimming pool itself (i.e. where exactly the posters are located in the changing room) has an effect on whether respondents have seen the poster or not.
- Conduct a large-scale evaluation of the poster 'A Healthy Swimmer is a Happy Swimmer', ensuring that the poster is displayed on changing room walls, in reception areas (including handouts), and on websites, social media accounts and TV screens in reception in swimming facilities.

- Continue to explore, develop and evaluate public health interventions to raise awareness of hygienic swimming behaviours to ensure that materials are current, topical and effective.

#### 7.5.2. Recommendations for practice and policy

- Ensure that swimming facilities are encouraging and supportive of hygienic swimming behaviours.
- Consider hygienic swimming behaviours while designing swimming facilities.
- Consider the use of the poster ‘A Healthy Swimmer is a Happy Swimmer’ in all swimming pool settings across Wales at the policy level.
- Adoption of the poster by swimming pool organisations to help raise awareness of hygienic swimming behaviours amongst their swimming pool users.
- Implement the intervention developed in swimming clubs, lessons and other groups within swimming facilities.
- Use of the resources developed as part of this study (poster and YouTube animation) to help raise awareness of hygienic swimming behaviours in schools.

#### 7.6. Contribution to the body of knowledge and concluding remarks

This study explored hygienic swimming behaviours and ways to raise awareness of these behaviours. This research was necessary due to the lack of studies in the UK which have specifically addressed this topic and therefore makes an original and important contribution to the existing body of knowledge. It is evident that outbreaks of cryptosporidiosis are associated with swimming facilities, particularly leisure centres. The best way to reduce outbreaks and the number of people who become ill due to cryptosporidium or other pathogenic organisms from swimming pools is by ensuring that these pathogens do not enter the swimming pool in the first instance. Therefore, education of swimming pool users is key. A review of UK policy

has identified that there is no regulation with regard to swimming pools and the provision of information to swimming pool users about hygienic swimming behaviours, and therefore, as this study identified, the efforts from swimming pool organisations to provide information vary.

The exploratory sequential design of this study allowed for the views of swimmers / parents of swimmers, in addition to pool operators, Lead Officers in Communicable Disease and Health Professionals, to inform the development of a poster intervention to raise awareness of hygienic swimming behaviours. Conducting this study in three phases has allowed for a holistic account of influences of hygienic swimming behaviours to be captured amongst a sample of the swimming pool users' population. This study has contributed to the existing knowledge of hygienic swimming behaviours by identifying that levels of awareness amongst swimming pool users varies. This study also demonstrates that stakeholders report to be supportive of information being provided to swimming pool users about hygienic swimming behaviours.

An intervention was developed based on evidence gathered as part of this research, in addition to previous literature, which gained national accreditation. The study developed a poster which could be displayed in changing rooms, TV screen, etc., which is based on findings from the previous phases of work carried out in the research journey. I have also communicated and fed back other influences identified, to pool operators and the health professionals involved in this research, as a means to influence these other factors which were not addressed by the poster intervention. The findings in relation to the design and cleanliness of the swimming facilities were communicated to stakeholders, demonstrating that this study has considered all influences identified as important. In addition, while this study is focused on reducing the transmission of cryptosporidium within swimming facilities, the intervention developed can help to reduce the transmission of other communicable diseases within these facilities. Thus, creating a cleaner and healthier environment for the benefit of all swimming pool users.

The findings of this study have been communicated to pool operators and public health stakeholders following the first and second phase of work in a report style format. The overall findings will be communicated to the same group in the near future. Various conferences (Appendix 5) have been attended throughout the research journey where findings of phase 1 and 2 have been disseminated to a vast audience within the public health and environmental health sectors. It is hoped to attend and present the findings of all three phases at a variety of public health and environmental health conferences in the future. It is hoped that the



intervention will be promoted through these means of dissemination, in addition to highlighting the need for consideration of hygienic swimming behaviours at the policy level, and to be included in designing supportive and encouraging swimming facilities for these behaviours. In addition, the anonymised findings will be submitted to scientific journals for publication. The findings of the first two phases, along with the intervention, have also been communicated to the public at two events, the Soapbox Science event and the Pint Of Science event. Therefore, public engagement has been a key factor throughout this research journey.

Swimming is a very beneficial activity for the entire population: therefore, it is important to encourage the use of swimming facilities and to encourage all who use them to help keep themselves and others healthy. A resource has been created as part of this study, and it is hoped that it will be used by swimming facilities across Wales, and potentially further, to encourage people to swim, and to do so hygienically.

Certainly, the poster developed had very positive feedback both in terms of the evaluation from swimmers/parents of swimmers and from professionals from Public Health Wales. The endorsement from Public Health Wales and the permission to include their logo on the poster demonstrate the value and importance of the message. In addition, the Pool Water Treatment Advisory Group has also now endorsed the poster and have given permission for their logo to be included. The Pool Water Treatment Advisory group develops guidance and codes of practice in order to raise the standards in pool water treatment in the UK. They also provide resources to pool operators in relation to the control of cryptosporidium. A colleague from Public Health Wales, with a keen interest in cryptosporidium, has approached Public Health England, who are now considering endorsing the poster intervention demonstrating the impact that this research is having locally and nationally.

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## Appendices

Appendix 1: Literature Review

Appendix 1a: Research critique framework



Figure 1: - Research critique framework

(Singh, 2013)

## Appendix 1b: Studies reviewed

### *Outbreak studies (ordered by date of publication, oldest first)*

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Coetsee et al	Outbreak in Staffordshire	2008	Staffordshire	Outbreak investigation following an increase in laboratory-confirmed cases	Retrospective cross-sectional study.	Convenience sample. 39 confirmed cases from 36 households. 18 probable cases identified in the 36 households. Total of 57 cases.	Questionnaire by interview	EpiData (Version 2). Descriptive analysis.	Six confirmed cases admitted to hospital for treatment. Swimming parties at pool A along with inadequate filtration systems and high bather loads contributed to the most likely cause of the outbreak. Incidence higher in younger age group who swam often at a variety of pools. Incidence of infection was highest in younger age groups who swam often and at a variety of different swimming pools. (0-19 years old highest categories).	Confounding factors such as other risk factors for exposures were considered. Confirms the importance of hygiene behaviours to avoid secondary spread in households as well as hygienic swim behaviours.	Can only identify the swimming pool as the most likely cause. Does not provide a definitive answer. Recall bias and responder bias. No questionnaire provided. Did they ask about hygienic swim behaviours? It says they gave infection control advice but didn't state what this was.
Lowe et al	Outbreak in Merthyr Tydfil	2010	Merthyr Tydfil	Outbreak investigation after reports of people becoming unwell following a party at swimming pool A.	Retrospective cohort study	Convenience sample. No indication of how many individuals were initially screened before recruiting 106 cases (45 with lab confirmation).	Questionnaire by interview	EpiData (version 3.1), Stata (version 10.1) and Microsoft Excel 2003. Descriptive statistics and inferential statistics.	106 confirmed cases. 1 child was hospitalised. Poor management of swimming pool. A faecal accident on the toddler slide was the likely source of contamination.	Thorough glossary and explanation of terms provided. Questionnaire provided in appendix to scrutinise. Detail discussion. All tables provided to scrutinise results.	States that published literature was searched and used to develop the methodology but there is no literature review section provided. Recall bias and responder bias.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
McCann et al	Outbreak at a Swimming Club	2014	Manchester	Identify risk factors for infection in members of a swimming club following an outbreak.	Retrospective cohort study	Convenience sample. 129 people contacted. 48 cases fitted the probable case definition and 53 non-cases were recruited (a response rate of 78%).	Questionnaire by interview	Epi Data Entry and Stata. Descriptive and univariate analysis. Multivariate logistic regression model of predictors of illness estimated.	There was a strong association between illness and attendance at the gala on 6 September 2010 [odds ratio (OR) 28, P<0.0001]. Standards of cleanliness and repair were satisfactory. No recorded incidents of a faecal contamination. There is a lack of knowledge in swimmers and coaches about the risks of spread of cryptosporidiosis within pools and the importance of exclusion in preventing outbreaks. In this outbreak, parents and coaches were often reluctant to comply with the recommended exclusion as this could adversely affect performance.	Identifies response rate, good response rate. Provides an explanation / background context to the study. Interesting finding that parents and coaches did not want to comply with outbreak control measures as this could affect the swimmers' performance.	No questionnaire provided. Recall bias and responder bias not discussed. States there is a lack of knowledge but no explanatory figures included to show evidence of this.

*Hygienic Swimming Behaviours studies (ordered by date of publication, oldest first)*



Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
McClain, Bernhardt, & Beach	Assessing Parent's Perception of Children's Risk for Recreational Water Illnesses (RWI's)	2005	Atlanta, USA	Development of a scale measuring parents' perceived risk of their children contracting RWI.	Cross-sectional study.	Convenience sample. 263 parents of children under 12. 256 after exclusions.	Self-administered questionnaire.	No software stated. Exploratory factor analysis. Correlations. P values stated and non-significant results reported. Hypothesis stated. Mean scores for the scales discussed briefly.	Need to be aware of the hazard to know you're at risk before you can adopt preventative behaviour. Parents who are most actively engaged in preventing RWI may already recognise that swim nappies are not effective in containing leakage from a loose stool. May be low levels of awareness about RWI prevention among parents.	Discusses limitations. Provides an insight from the different view of following hygienic swim behaviours to prevent risk of infection - focuses on the preventative behaviour.	No descriptive statistics provided to summarise the participants, etc. Doesn't ask questions around the perception of showering which is a limitation. convenience sample was largely well-educated, above-average earners. Long questionnaire.
Nett et al	Non-hygienic behaviour, knowledge, and attitudes among interactive splash park visitors.	2010	Idaho, USA	Examine the influence of signage and hygiene attendant presence on rates of nonhygienic behaviour among children at splash parks and knowledge and attitudes of their adult supervisors.	Cross-sectional study.	Convenience sample. 145 children observed. Completed 551 (98%) questionnaires among 564 adult supervisors approached	Questionnaire by interview. Observation	Kappa statistic for multiple rates for observational sessions. SAS Enterprise Guide 3.0.2.414. Group and individual observations, Pearson's chi-Logistic regression. Adjusted odds ratio. P values.	Nonhygienic behaviours observed: Children exposing their buttocks to the splash park water features (46%, n=67/145). Children in nappies on splash pad. Placing open mouth to water (23%). Close proximity of changing nappies. Traditional nappies being worn (38%). Responses indicated a lack of understanding. Washing the children's hands with soap and water after leaving the splash park at least sometimes (n = 441 [80%]). Bathing children they supervise with soap before entering the splash park at least sometimes (n = 151 [27%]). Does not show signage and attendants make a difference for non-hygienic behaviours or influencing supervisors.	Limitations discussed. Observing behaviour is the best, no responder bias if children are unaware they are being observed. True picture of how often nonhygienic behaviours occur.	Only oral consent for questionnaire and no consent obtained for observation. Ethical issues not discussed in terms of conducting an observational study.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
CDC	Promotion of Healthy Swimming after a State-wide Outbreak	2012	Utah, USA	Assess knowledge of healthy swimming.	Cross-sectional study.	Convenience sample. Of the 642 adults contacted, 499 (78%) completed interviews. Postal survey 7,004 households; an adult from 4,556 (65%) households returned the survey.	Self-administered questionnaire.	Chi-squares, p values. Descriptive statistics. Confidence intervals reported in tables. Weighted percentages.	<p>If participants had children they were more likely to have sought information about the outbreak and had seen the posters at the pool. In the BRFSS call-back survey, 91.3% of respondents reported being aware of the 2007 outbreak (Table 1). A greater percentage of women (36.2%) than men (16.7%) recalled seeing healthy swimming campaign posters at pools. Greater percentages of adults with children in their households compared with those with no children in their households sought information about the outbreak (24.6% versus 9.5%) and saw posters at pools (35.3% versus 16.1%). Conversely, a greater percentage of those without children recalled seeing television advertisements (51.4%) compared with those with children (34.1%). Among all respondents, 96.1% correctly indicated that "it is not OK to swim if you have diarrhea," and 70.4% correctly indicated that "chlorine does not kill germs instantly". In the 2009 Health Styles survey, 100% of Utah residents but only 78.4% of residents of other states correctly indicated that "not swimming when you have diarrhea" protects others from RWIs. 85.8% of Utah residents compared with 65.9% of residents of other states correctly indicated that "chlorine does not kill germs instantly."</p>	Limitations identified. Adds to very limited current literature.	No baseline data for participants knowledge before campaign. Non-random sample. No cause and effect relationship examined due to the design, no direct evidence the campaign caused an increase in knowledge. Knowledge doesn't equal behaviour. No specific literature review.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Pasquarella et al	Swimming pools and health-related behaviour	2013	Italy	Evaluate the behaviour of swimming pool users in five Italian cities, to analyse which variables are associated with the lack of showering, and to evaluate awareness of the importance of showering.	Cross-sectional study.	Convenience sample. 4750 questionnaires were distributed. 4370 were collected (91.7%); 14 of which were not included in the analysis because they were not completed.	Self-administered questionnaire.	Microsoft Excel, PASW Statistics Version 18. Descriptive analysis. Bivariate analysis (chi-square, odds ratio, 95% confidence intervals).	58.1% had read the pool rules. Compliance with showering before was higher among those who had read the pool rules. Only a very low percentage (5.2%) of subjects knew the reason for pre-swim showering. Sixty-five percent of interviewees always showered before entering the pool. The main reason given for pre-swim showering was 'to wash oneself' (50.5%); or 'to get used to the temperature of the water' (44.3%); and 5.2% answered 'for both reasons'. Risk factors significantly associated with lack of showering were: female sex (odds ratio (OR) 1.37, 95% confidence interval (CI) 1.2e1.59), age 14e17 years (OR 5.09, 95% CI 3.40e7.64); not reading the swimming pool rules (OR 1.24, 95% CI 1.10e1.41); living in Central Italy (OR 3.3, 95% CI 2.65e4.1) or Southern Italy (OR 1.35, 95% CI 1.18e1.55); and previous/current attendance of a swimming course (OR 1.7, 95% CI 1.48e1.97).	Non-significant results were also reported.	Ethical approval was not sought even though children were surveyed too. No explanation included as to why no ethical approval. No ethics discussed.
Amodio et al	Knowledge, risk perception and behaviours in swimming pool users of Palermo City.	2014	Sicily, Italy	Assess knowledge, risk behaviours and behaviours of a sample of swimming pool users in Palermo.	Cross-sectional study.	Convenience sample. 546 subjects asked to take part in the study and 498 (91.2%) of them participated.	Self-administered questionnaire.	Epilnfo 3.5.1. Absolute and relative frequencies. Descriptive frequencies including confidence intervals. Chi-square. Logistic regression. P values reported.	Even if rules and regulations are available, at least one unhealthy behaviour may occur in more than 50% of participants. Swimmers had a low perception of risk of acquiring infectious diseases. Self-reported knowledge of rules and high risk perception were good predictors for healthy behaviours. Overall, 209 subjects (42%) have healthy behaviours (data not shown) whereas the remaining 289 (58%) had a mean of 1.991.2 unhealthy behaviours. Taking a shower before bathing a Yes, always 478 (96.2).	Clear and easy to read. Pilot was carried out with a sample of 30 swimmers for the questionnaire. Limitations discussed.	Bias, sampling and responder. Convenience sample. Created their own scoring system when assessing answers of participants on knowledge and behaviours.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Chan & MacLeod	A Comparison of Recreational Water Illness Awareness and Frequency of Swimming	2014	Canada	Determine whether the frequency of swimming had an influence on swimming pool hygiene knowledge	Cross-sectional study.	Convenience sample. 200 surveys issued, 167 valid and analysed.	Self-administered questionnaire.	Microsoft Excel 2010, NCSS 9. Descriptive Statistics. Two-sample t-test and one-way ANOVA	No observed difference in mean score value between people who swam more frequently than those who swam less. 94% of respondents believed poor pool water maintenance can cause illness, and 91% believed that pool water quality was different from drinking water quality. Despite these responses indicating swimmers perceiving a potential health risk to swimming, knowledge regarding swimming hygiene and avoidance remained low. Common response during the survey was that participants often did not know the answer, and were eager to find out answers afterwards. Furthermore, swimmers were often surprised by the length of avoidance after diarrheal illness. The questions with content regarding duration of avoidance after diarrheal illness, showering after using the bathroom, and showering before entering a pool, were most frequently answered incorrectly.	Previous literature identified. Sampling bias identified. Limitations identified. Survey was piloted. Ethics discussed.	In recommendations, no mention of qualitative work to explore the topic further rather than conducting another survey. Identified many swimmers attending the facility where data collection took place could not read English and therefore could not take part in the survey.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Zwilling	Influencing Hygienic Swimming Behaviours of Recreational Swimmers	2014	Netherlands	This study aims to influence behaviour of recreational swimmers by minimal interventions, with the result that more bathers take a shower before swimming.	Sequential design. Questionnaire informed the intervention (observational study). Post questionnaire to find out whether they had seen the intervention and to evaluate it.	Convenience sample. No sample size for pre study. 3188 observed during the main study. 993 observed at intervention 'routing game', 1193 observed at intervention 'information' and 1002 at intervention 'social norm'. For the post questionnaire, 22, with the intervention 'routing game'. Intervention 'information' 29 persons. 11 persons with intervention 'social norm'.	Self-administered questionnaire.	SPSS. Descriptive. Chi-square. Significance and effect sizes.	Preliminary study: 63.8% said they generally took a shower before entering the pool. Main reason was for hygiene (34.8%). Social influence seems to play a role in whether they shower. Main study. All participants were observed unknowingly, in order to let them conduct their normal behaviour. One intervention had an increase in the number of people who showered, the other two did not. BUT effect size was minimal. The intervention 'routing game' at location A did not have an effect: even less subjects took a shower, $\chi^2(1, n = 993) = .08, p = .42$ . At intervention 'information', the percentage of recreational swimmers who took a shower rose from 23.5% to 28% and this effect was significant: $\chi^2(1, n = 1192) = 3.24, p < .05$ , however the effect size was low: $\Phi = .052$ . With intervention 'social norm', no significant effect was found: $\chi^2(1, n = 1002) = .56, p = .47$ . Of the respondents at intervention 'routing game', 63.6% said they did see the intervention. This was 31% at intervention 'information' and 45.5% at intervention 'social norm'. Thus, intervention 'information' was seen the least of the three interventions. However, this intervention had the best effect: significantly more recreational swimmers took a pre-swim shower after the implementation of this intervention. The percentages of respondents of this questionnaire that said they had taken a pre-swim shower differed, this was 63.3%, 27.6% and 72.2% for the interventions 'routing game', 'information' and 'social norm', respectively.	Good introduction. Brief literature review provided and theoretical framework. Preliminary study undertaken first before the main intervention study. Limitations identified. Questionnaires provided in appendix.	Baseline measurement and post measurements conducted at different times - post was when the outdoor pool was also open. Observed subjects low when outdoor pool open, could not observe indoor and outdoor simultaneously. Researcher bias identified, method of observation less reliable with one researcher. Small sample size of pre-lim and post measurement studies. Several subjects reported that they had not noticed the intervention.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Galle et al	Health-related behaviours, influence of Knowledge of Regulations and Awareness of Health Risks	2016	Rimini, Italy	Investigate the compliance of swimming pool users to healthy behaviours and how their habits change in relation to the declared knowledge of swimming pool regulations and the awareness of health risks, aside from some other individual variables (age, gender, educational	Cross-sectional study.	Convenience sample. 600 questionnaires were distributed. 184 adults and 184 children / adolescents.	Self-administered questionnaire.	Multivariate Logistic Regression. SPSS. P value level set 0.05.	Demographics provided. Tables provided with results. Good results section. Adhesion to the rules seem related to age. 14-17 and 18-39 worst compliance. Behaviours which shows lowest compliance were pre-swim showers and use of footbaths. 16.3% of adults report at least one episode of urination inside the pool.	Good introduction, statement of gap in literature. Questionnaire piloted. Aim clearly stated. 62% response rate reported.	No comprehensive literature review. Excluded occasional users (less than at least once a week), but they do address this in the discussion. Small sample size. Two different questionnaires used, adults and children / adolescents therefore cannot be compared. Questionnaire not in appendix.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Ribbers	A research about the effects of watching eyes on pre-swim shower behaviour	2016	Netherlands	Increase pre-swim shower behaviour by using watching eyes, and therefore reduce the pollution of swimming pool water.	Experimental design. Observational and survey. (Tested water quality too).	Convenience sample. 596 observed. 116 observed during control condition, 137 during the 'eyes-only'. 181 during the 'eyes + symbol' condition, and 162 swimming observed during the 'symbol-only' condition. 125 filled out a questionnaire. 29 during the control condition, 31 during the 'eyes-only' condition, 30 during the 'eyes + symbol' condition, and 35 during the 'symbol-only' condition.	Self-administered questionnaire. Observational measures. Water quality measures.	SPSS. Descriptive. Chi-square. ANOVA. Effect sizes. P values.	Interventions to increase pre-swim showering can reduce pool pollution. Watching eyes intervention with a symbol led to an increase in pre-swim showering. Observations: In total, 44,5% of the 596 participants took a pre-swim shower during observations. The pre-swim shower rate in the control condition was 35,3%, and 45,3% in the 'eyes-only' condition, 45,3% in the 'eyes + symbol' condition, and 49,4% in the 'symbol-only' condition, indicating that pre-swim shower behaviour is likely to increase in the intervention conditions. Influences observed - demographics, other people showering, company, carrying belongings, time of day, outside temperature. Questionnaire: In total, 76,6% of the respondents stated that they had taken a pre-swim shower before entering the swimming pool. Both the control condition and the three intervention conditions are relatively equal to each other, indicating that there are no significant differences between the conditions. 47.6% of the participants stated that they had seen the information board, with 27.1% of the participants describing the right information board. From the 27.1% of the participants that described the right information board, 75.0% of the participants described the right goal of the board (take a shower).	Theoretical framework / brief literature review provided. P values interpreted and did say marginal significance. Limitations discussed fully. Discussion links to previous studies.	Did not mention responder bias for the questionnaires. Not generalizable to communal pools, experiment undertaken in a holiday park.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Low & Heacock	The Evaluation of Factors Affecting the Pre-Swim Shower Behaviours of Pool Patrons	2018	Canada	Identify factors associated with a higher pre-swim shower frequency.	Cross-sectional study.	Convenience sampling. 82 responses. 78 participants.	Self-administered questionnaire.	Microsoft Excel for Mac and Google Forms, NCSS 12. Descriptive statistics. One-Way ANOVA test, Chi-Square test, and the independent t-test.	37 respondents (47%) replied that they “almost always take a pre-swim shower”, and 17 respondents (22%) replied that they “occasionally take a pre-swim shower”, and 24 participants (31%) replied that they “rarely/never take a pre-swim shower”. Knowledge on Pool Related Illnesses was 55.29% and the median score was 58%. The results indicate that there is no statistically significant association between these variables and a patron’s pre-swim shower frequency. Did show that those who scored higher on the knowledge of pool related illnesses section also scored higher on the pool hygiene section. Suggests that there is no association between having read the pool rules and pre- swim shower frequency. 48.7% responded if “rules were made clearer” and another 42.3% selected if “more signage was posted”.	Ethics discussed. Limitations of the study identified. Literature review provided.	Survey could only be accessed online. Low sample size. Did not assess whether participants knew why pre-swim showering is important.



*Studies reviewed from supplementary search strategy (ordered by date of publication, oldest first)*

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Collection	Data analysis	Findings	Strengths	Weaknesses
Judah et al	Experimental Pretesting of Hand-Washing Interventions in a Natural Setting	2009	England	To pre-test interventions derived from different domains of behaviour change theory to determine their effectiveness at increasing hand washing with soap in a natural setting.	Cross-sectional study	Convenience sampling. 32 days of data, measuring more than 108000 male restroom uses and more than 90000 female restroom uses.	Wireless devices in highway service station restrooms to record entry and soap use.	Rates. Means. Univariate logistic regression. Correlations. P values. Standard deviations.	In general, most of the interventions increased levels of hand washing compared with the blank control condition. Unexpectedly, they also found that men and women responded to health promotion messages in different ways. The knowledge activation domain was most effective for women, with a relative increase in soap use of 9.4% compared with the control condition (P=.001). For men, disgust was the most effective, increasing soap use by 9.8% (P=.001). Disgust was not significantly better than the control condition for women, nor was knowledge activation for men. Messages based on social norms and social status were effective for both genders.	Unobtrusive monitoring allowed for the avoidance of the biases inherent in structured observation or self-reporting of behaviour. Pretesting potential interventions can generate options that are more likely to be effective.	Differences in effectiveness between messages and domains were relatively small. Although the sign was in a prominent location and the message was flashing, only one quarter of women and one third of men in the exposure survey reported seeing it.
Schmidt et al	Formative research on the feasibility of hygiene interventions for influenza control in UK primary schools	2009	London	Establish the current need for enhanced hand hygiene interventions, identify barriers to their implementation and to test their acceptability and feasibility.	Qualitative Study	Purposive sampling. Interviewed four head teachers and six class teachers. Four primary school classes. 3 school nurses interviewed.	Semi-structured interviews, group discussions and semi-structured essay questions.	Thematic content analysis	Identified many barriers to implementing intensive hygiene interventions, in particular time constraints and competing health issues. Teachers' motivation to teach hygiene and enforce hygienic behaviour was primarily educational rather than immediate infection control. Children of all age groups had good knowledge of hygiene practices and germ transmission. The pilot study showed that intensive hand hygiene interventions are feasible and acceptable but only temporarily during a period of a particular health threat such as an influenza pandemic, and only if rinse-free hand sanitisers are used.	Ethical approval discussed, including informed consent from parents. Explored views from different stakeholders.	No risks to the researcher or participants were discussed in the ethics paragraph. Interviews with teachers and nurses were not tape recorded, just notes written, researcher recall bias.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Fleischmen et al	Sensor recorded changes in rates of hand washing with soap in response to the media reports of the H1N1 pandemic in Britain	2011	England	To examine how the frequency of information regarding a real disease threat influences hand washing with soap.	Cross-sectional study	Convenience sampling. The data for this study spans over 1 million lavatory uses.	Meltwater media monitoring. Wireless devices in highway service station lavatories in England from May 2009 to January 2010.	Means. Moving average. Zero-order correlations and partial correlations.	Hand-washing rates were positively related to both H1N1 coverage in blogs and the news.	Brief literature review. Context. Ethical considerations discussed. The study used a sensor system rather than self-report or observation, reduces responder bias in terms of socially desirable behaviours.	Sensor malfunctions during the experiment, missing data. The study could have benefited from recording hand washing before the media regarding H1N1 began. Correlation, does not show a causal relationship.
Yardley et al	Evaluation of a Web-Based Intervention to Promote Hand Hygiene: Exploratory Randomized Controlled Trial	2011	Southern England	Estimate the behavioural effects of the intervention in preparation for a large trial of intervention effects on actual infection rates.	Pragmatic trial	517 nonblinded adults recruited through primary care were automatically randomly assigned to a fully automated intervention comprising 4 sessions of tailored motivational messages and self-regulation support (n = 324) or to a no-intervention control group (n = 179)	Self-administered questionnaire.	Independent t test, effect size using Cohen d). Mixed-effects regression model. Mediation analysis. Confidence intervals. MANOVAs.	Participants given access to the Web-based intervention had higher levels of reported hand-washing frequency and intentions for frequent hand-washing in the future than those in the control group (with or without baseline measurement). Hand-washing rates in the intervention group were higher at 4 weeks than in the control group (mean 4.40, n = 285 and mean 4.04, n = 157, respectively; $P < .001$ , Cohen $d = 0.42$ ) and remained higher at 12 weeks (mean 4.45, n = 282 and mean 4.12, n = 154, respectively; $P < .001$ , Cohen $d = 0.34$ ). These findings provide encouraging evidence that hygienic behaviour may be effectively promoted by a theory-based online intervention.	Description of how the intervention was developed. Theoretical framework identified and explained in the introduction. Ethical approval mentioned. Consent form. Good discussion on analysis. Some limitations identified.	Participants in both groups had been exposed to considerable media and government coverage of the need for hand hygiene during the pandemic - this could be a confounder. Self-reported handwashing assessed. Uptake rate was less than 1 in 10, and our sample overrepresented affluent, middle-aged women.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Chittleborough et al	Factors influencing hand washing behaviours in primary schools	2012	South West England, UK	The process evaluation designed to collect data on hand washing facilities, knowledge, attitudes and behaviours related to hand washing, and how the intervention was implemented and received across schools.	Qualitative Study	Random sampling and convenience sampling. Focus groups (n=16, ages 6 to 11, semi-structured interviews (n=16 teachers) and observations of hand washing facilities (n=57).	Focus groups with pupils and semi-structured interviews with teachers. Observation of facilities.	Thematic analysis.	Themes: Time, Facilities, Societal Norms, Encouragement and reminders, Education and Information, Awareness and knowledge. Influencing through education, may be necessary, but probably not sufficient to ensure good hygiene practices. Time, opportunity, facilities, social norms are important too. Control and intervention groups showed no differences in understanding when and how to wash their hands, and hand washing contributes to infection control. Reminders and explanations for the importance of hand hygiene were thought to have a positive impact.	Researcher was independent from the original intervention trial. Limitations identified. Qualitative work to explore and better understand hand hygiene compliance as well as evaluating the intervention.	Occasionally, pupils participating in the focus group represented all those who had returned their parental consent forms, or were selected by the teacher in which case the basis for selection was unknown. Trial took place during an influenza pandemic.
Miler et al	Development of an intervention to reduce the transmission of respiratory infections and pandemic flu.	2012	UK	Confirm whether the behavioural determinants we had identified from theory were related as predicted to intentions and to establish the validity of our measures of behavioural intentions.	Cross-sectional study	Convenience sample, but randomly assigned to intervention group or not. 102 people logged onto the website; 34 were randomised to low-threat/no coping messages, 24 to low-threat/coping messages, 23 to high-threat/no coping messages and 21 to high-threat/coping messages. Of these, 84 people (82.4%) completed the measures of intention, comprising 32 (94.1%) in the low-threat/no coping messages group, 21 (87.5%) in the low-threat/coping messages group, 19 (82.6%) in the high-threat/no coping messages group and only 12 (57.1%) in the high-threat/coping messages group.	Self-administered questionnaire.	Mean scores from scales. Bivariate and partial correlations for analysis of relationships to intentions. MANOVA. Multiple and logistic regression. P values.	Most of the behavioural determinants identified had at least medium strength associations with hand-washing intentions. Hand-washing intentions tended to be stronger in those receiving high-threat messages and coping messages. Perceived risk was related to hand-washing intentions. Those receiving coping messages had a likelihood 2.44 times greater [95% confidence interval (CI): 0.96–6.18] of intending to increase their frequency of hand washing. In contrast, threat condition had very little effect on intended increases in hand-washing frequency (odds ratio ¼ 0.93, 95% CI: 0.36–2.38).	Informed consent stated. Detailed sections. Appendices to examine questionnaires. Acknowledges that this is an exploratory pilot study and further research and improvements are needed. Theoretical framework identified.	Methodical issues, inconsistent responding to different dimensions of perceived control. Reliable measures need to be better developed. Selective dropout of participants. Intended behaviour rather than actual behaviour.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Chittleborough et al	Implementation of an educational intervention to improve hand washing in primary schools	2013	South West England, UK	The purpose of this study was to examine the reach, dose, fidelity, acceptability, and sustainability of the implementation of an educational hand washing intervention in primary schools, and to explore views regarding acceptability and sustainability of the intervention.	Mixed-methods	Random sampling and convenience sampling. With schools (n=178 schools). Four intervention & four control schools selected for sub-study: interviews with HPA and university staff coordinating intervention delivery to all schools (n=8 interviews), and direct observation. Focus groups were conducted with pupils from one lower KS2 class and one upper KS2 class in each of the four selected intervention schools.	Log sheets, focus groups and semi-structured interviews.	Stata. Generalised linear model. Relative risk. Confidence intervals. Thematic analysis.	The educational package was delivered in 61.4% of schools (85.2% of intervention schools, 37.8% of control schools following completion of the trial). Teachers and pupils reacted positively to the intervention, although concerns were raised about the age-appropriateness of the resources. Teachers adapted the resources to suit their school setting and pupils. Staff coordinating the intervention delivery had limited capacity to follow up and respond to schools. The hand washing intervention was acceptable to schools, but its reach outside of a randomised trial, evidenced in the low proportion of schools in the control arm who received it after the trial had ended, suggests that the model of delivery may not be sustainable.	Ethical approval mentioned, including informed consent. Discussion links to previous research. Uses mixed methods to explore intervention reach, dose, fidelity, acceptability and sustainability. Builds on the previous process evaluation. Researcher not involved in original trial.	Ethical considerations not detailed. No literature review. Observations limited to the four intervention schools.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Little et al	An internet-delivered handwashing intervention to modify influenza-like illness and respiratory infection transmission	2015	England	Aimed to assess whether an internet-delivered intervention to modify handwashing would reduce the number of RTIs among adults and their household members. (Follows the study by Yardley et al., 2011).	Randomised trial.	Random sampling. enrolled 20 066 participants and randomly assigned them to receive intervention (n=10 040) or no intervention (n=10 026). 16 908 (84%) participants were followed up with the 16 week questionnaire (8241 index participants in intervention group and 8667 in control group).	Self-administered questionnaire.	Odds ratio. P values. Means. Standard deviations. Confidence intervals. Logistic model.	The intervention reduced transmission of RTIs (reported within 1 week of another household member) both to and from the index person. Among more than 20 000 adults, the study findings demonstrate that a simple free-standing internet-based behavioural intervention to increase handwashing behaviour among adults effectively reduces acute respiratory infections (risk ratio 0.86, 95% CI 0.83–0.89; p<0.0001), equivalent to a 14% reduction. The study findings also showed reduced transmission of acute respiratory infections to other family members, reduced gastrointestinal infections.	Consent mentioned. Role of the funding source outlined. Limitations outlined. Randomised sampling method.	There are some potential limitations to the study, in particular, a free-standing website would be expected to attract individuals more interested in preventing infections.
Crosby, Laird & Younie	Creation and evaluation of learning resources to improve understanding of handwashing practice	2019	England	Investigate whether taking an integrated interactive approach to learning (using a number of varied specifically designed resources) engaged and aided EYFS children's understanding of handwashing and principles of health hygiene.	Case study (6 case studies) (quantitative and qualitative)	Purposive sampling. 6 primary schools. 115 parents, 24 teachers: questionnaire. Observation of children in 6 case studies. 6(?) teachers interviewed.	Self-administered questionnaire. Semi-structured observations. Interviews.	SPSS. Descriptive analysis. Pearson Chi-Squared test, Fisher's Exact Test.	The results from the questionnaires found that children were engaged with the book, with 100% of parents from every CS either strongly agreeing/agreeing. Similarly, the responses from the teacher questionnaires were also positive. In 4/5 of the CSs, 100% of teachers either strongly agreed/agreed. Large range (18.75%–97%) of opinions on the usefulness of the website dependent on location (similar with teachers). After finishing the book, one child commented: 'I want to wash my hands!'. Children also appeared very engaged in the handwashing activity, particularly when seeing the gel on their hands under the UV light. Across all CSs, when completing the handwashing activity, the children that had already read the book had a much greater understanding of what germs were and how to remove them than the children that had not read the book. One child in particular 'loved this book and has been washing his hands loads'. Teachers reported very positive feedback about the workshops.	Case study design, able to compare, using quantitative and qualitative methodologies.	Non-random sampling technique. No limitations identified. Lack of detail on the intervention itself.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Data Collection	Data analysis	Findings	Strengths	Weaknesses
Lawson & Vaganay-Miller	The Effectiveness of a Poster Intervention on Hand Hygiene Practice and Compliance When Using Public Restrooms in a University Setting	2019	UK	Aim of this study was to evaluate the effectiveness of a poster intervention aimed at improving hand hygiene practice and compliance when using public restrooms in a university setting.	Cross-sectional study. Experimental design?	Convenience sampling. 1149 research subjects (members of the university population) were observed over a 60 day period in the public restrooms selected as the research location. This included 685 research subjects who were observed during the pre-intervention observation period (555 males, 130 females), and 464 research subjects (343 males, 121 females) observed during the post-intervention observation period.	Thermal video footage	SPSS. Descriptive and inferential statistics. Chi square. P values. Confidence intervals.	During the pre-intervention observation period, 51.09% of the university population practiced basic hand hygiene compliance (washed hands with water, soap and dried afterwards), and 7.88% practiced adequate hand hygiene compliance (washed hands with water and soap for 20 s or more and dried afterwards for 20 s or more). During the post-intervention observation period, 55.39% of the university population were observed practicing basic hand hygiene compliance, and 7.97% practicing adequate hand hygiene compliance. Gender differences revealed that more females practiced basic hand hygiene in the post-intervention observation period (62.81%) than during the pre-intervention period (49.23%) and this was statistically significant ( $Z = 13.49$ , $p < 0.01$ ). Discussion: The poster intervention had a limited effective on improving the basic and adequate hand hygiene compliance of the general population when using public restrooms.	Ethical approval granted mentioned. Good visual diagrams included in the methods to show where the poster interventions were displayed in the restrooms and where the thermal imaging cameras were located. Limitations identified. Cameras for monitoring hand hygiene practice and compliance useful, as a large number of people can be observed simultaneously and a range of behaviours can be reliably recorded.	No ethical considerations discussed. Systematic error regarding the analysis of the observed data as only one observer (the researcher) was used. Only one set of male and female restrooms were observed due to time, ethical and cost restrictions. Not possible to determine whether the people observed each day during both observation periods were not the same members of the university population due to the anonymous nature of the thermal footage recorded.

Author	Title (brief)	Year	Location	Aim	Method	Sampling	Collection	Data analysis	Findings	Strengths	Weaknesses
Rutter et al	Effectiveness and Efficiency of Persuasive Space Graphics (PSG) in Motivating UK Primary School Children's Hand Hygiene	2020	UK	How effective are "123" persuasive space graphics (PSG) at motivating hand hygiene? How efficient are "123" persuasive space graphics (PSG) in communicating hand hygiene.	Mixed methods.	Three schools, 1 museum (27 schools invited). Publicly available documents (1). 187 days pre and 116 days post, school 2 had a data collection error (2). School 1 and Museum, 214 children pre and 207 children post (3). 134 children interviewed (4). 23 staff interviewed (5).	Document analysis (1), counting product consumption (2), counting microbial presence (3), interviews with children (4), interviews and focus groups with staff (5).	Annual reports for Museum and Ofsted reports for school used to identify demographic characteristics (1). Various methods to count soap consumption, % change (2). Microbiological analysis of agar plates (3). Quantitative and qualitative analysis (4&5).	Analysis only indicates who the PSG potentially reached, and not who they did reach within the settings (1). The results show a large increase, between 41% and 60%, in soap consumption in the schools following design installation. Museum: proportionately more children washed their hands when the PSG were present. It should be noted though that the increase in frequency of handwashing that can be attributed to the presence of the PSG is less than in the school settings. (2). For school 1, the number of samples with high colony counts decreased after installation of the PSG (from a mean colony count of 186 to 151 and a median colony count of 111 to 112, one-tailed t-test = $t(270)$ , 1.861, $p = 0.032$ . In the museum setting the spread increased post-installation (from a mean colony count of 220 to 260 and a median colony count of 181 to 209). The result is not statistically significant. This could be explained by the fact that, unlike the school settings, different children participated in the pre- and post-installation sample (3). In total, 60% (81/134) of children reported that the designs had changed their behaviour in the toilets. Positive changes included now washing hands (26), using soap and/or the dryer (35), closing the toilet lid (8), flushing the toilet (1), keeping the facilities clean (1), and no longer "messing about" (1). Two children reported a negative consequence of wanting to avoid contact with surfaces. It could be that those who did not report an attitude change did not do so because they already wash their hands, and indeed 35% (47/53) of those who stated that their attitude had not changed claimed they had washed their hands when using the toilet facilities immediately prior to the interview (4). Children washing their hands more, keeping toilets cleaner and asking teachers hand hygiene questions, visually appealing (5).	Ethics discussed. Identifies that the evaluation is potentially only transferable for children aged 4-11 from the North of England. Social norms identified.	Could not identify the demographics of those the intervention did research, but who could have been reached. Soap consumption measurements varied and relied on staff at the settings. Sampling strategy for school 1 and museum were different in study 3 and are therefore not comparable.



## Appendix 2: Phase 1 study documents

### Appendix 2a: Recruitment poster

# Are you interested in taking part in a study looking at hygienic swimming behaviours?


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**Who?**  
Anyone who swims or are parents of children who swim, and are over the age of 18!

**Where?**  
The interview will take part in a private room in this building.

**What?**  
You will be asked to take part in an informal interview to give your views on hygienic swimming behaviours.

**Why?**  
To understand what swimmers and parents of swimmers know about hygienic swimming behaviours and explore ways they would like to receive information. This will then help develop an intervention to raise awareness of hygienic swimming behaviours.






**For more information:**

If you want to find out more about taking part in this study, or have any questions about the research, please email Hannah at [REDACTED]

or

complete the reply slip, put it in an envelope and drop it in the box at reception, Hannah will get in touch.



This study has been approved by the Human and Health Sciences Ethics Committee, Swansea University.

Appendix 2b: Recruitment email

## Subject: Hygienic Swimming Behaviours Research Study

Dear Swimmers / Parents of Swimmers,

I am contacting you to invite you to take part in my PhD research study. Please see attached the recruitment poster which you may have seen in the reception area.

You are invited to take part in an informal interview to provide your views on hygienic swimming behaviours. You will also be asked about how you would like to receive information about these behaviours.

The purpose of this study is to develop a public health awareness intervention to make swimmers more aware of the importance of following hygienic swimming behaviours to stop illnesses spreading from one person to the other through the swimming pool water.

If you would like to take part or get more information about the research, please email me on [REDACTED] or please complete the attached reply slip and return to reception when you are swimming next. There are envelopes and a box at reception for you to return this slip so that your details are kept confidential.

Best wishes,

[REDACTED]

## Hygienic Swimming Behaviours Research Study Reply Slip

Please provide the following details if you are interested in taking part in the above research study.

Name: .....

Address: .....

Telephone:.....

E-Mail:.....

Are you wishing to take part as a Swimmer  or Parent of a swimmer  ?  
(Please tick)

**Please use the envelopes provided and return to reception and deposit in the secure box available or email to [REDACTED]**

**Thank you for your interest.**

Your information will be stored and used in accordance with the Data Protection Act 1998.

## Participant Information Sheet (Swimmers)

### Hygienic Swimming Behaviours Research Study

Dear Participant,

Please take time to read through the following information before you decide to take part in the study. Please do not hesitate to ask any questions before taking part in the study.

I am inviting you to take part in a study which will involve a discussing about what you know about hygienic swimming behaviours. We will also discuss how you think it would be best to receive information about hygienic swimming behaviours. You are welcome to take this information sheet home with you to talk about this study with others.

#### What is the purpose of this study?

You have been invited to take part in a confidential, face to face interview as part of a PhD research study exploring swimmers and parents of swimmers' awareness of hygienic swimming behaviours. I want to find out about what behaviours people follow to help keep the swimming pool clean and healthy. The study also aims to explore how swimmers / parents would like to receive information about these behaviours. The interview discussion will help provide information to develop a public health intervention to raise awareness of hygienic swimming behaviours to keep swimmers healthy.

#### Why have I been invited?

You have been invited to take part as you are a swimming pool user or a parent of a swimming pool user. The information you give will be invaluable in gaining a better insight into what swimmers / parents of swimmers know of hygienic behaviours. This information can help develop a intervention to raise awareness of hygienic swimming behaviours which will be accessible to you and other swimmers / parents of swimmers.

#### Do I have to take part?

It is up to you whether you want to take part in the study. This information sheet aims to give you all the information you need about the study. You are free to take time to consider whether you would like to take part, discussing with friends or family whether you would like to take part or not.

If you decide to take part, I will contact you to arrange a convenient time for us to conduct the interview. I will also ask you to sign a consent form to show you are happy to take part before we start the interview. You can withdraw from the study at any time without giving reasons up until the information has been anonymised and that you will not be penalised for withdrawing nor will you be questioned on why you have withdrawn.

### What will happen to me if I take part?

You will be asked to take part in an informal interview with me, the researcher, to discuss your thoughts on hygienic swimming behaviours and the ways you think it's best to receive health information. You will be asked to sign a consent form before we start to confirm that you are happy to take part in this study.

The interview will be an open discussion and I will ask specific questions during some points of the interview if there is any information I feel has not been discussed which is important to the study. You are free to ask me any questions after the interview. The interview should last approximately 60 minutes and will take place in a private room within the swimming pool setting.

With your permission, the interview will be audio-recorded and some hand-written notes may be taken. The interview will be transcribed into a written format and this will be anonymised meaning that all personal details will be removed. All forms that you complete, the audio recording and transcript of the interview will be stored securely.

### What are the possible disadvantages of taking part?

If you are a parent of a swimmer, there may be a chance of you may becoming upset by recalling a time where your child may have been unwell and had a toileting accident in the pool.

If at any time our discussion is making you feel uncomfortable or upset, we can pause the discussion or we can stop the interview. We can carry on the interview at another time if you wish, or you can decide to leave the study. You do not need to answer all questions if you feel uncomfortable discussing something in particular. I will provide you with information about sources of support if you feel you need them following the interview.

### What are the possible benefits of taking part?

You will have the opportunity to find out about how you can help protect yourself and your family from swimming related illnesses. I will provide you with an information leaflet at the end of the interview which provides advice on hygienic swimming practices. A debrief sheet will also be given to you which has details of useful websites if you wish to get more information about the topics we will discuss during the interview.

The information you give will be used to develop a public health awareness intervention which will be piloted in your area; this will hopefully mean that more people will be aware of hygienic swimming behaviours.

### What happens when the research study stops?

Once the interview has finished, I will not contact you again. However, you are free to contact me at any time about the study or for any advice in relation to hygienic swimming behaviours (please see the end of this sheet for my contact details).

### What if there is a problem?

Please do not hesitate to contact me immediately if you have any concerns about this research (contact details are provided at the end of this sheet) and I will do my best to answer your questions. You can contact my academic supervisor, Dr Jaynie Rance (contact details are provided at the end of this sheet) if you do not feel it is appropriate to contact me directly. Please inform us of any issues about how we have dealt with you during this study and we will aim to address any of your concerns.

### What will happen if I do not want to carry on with the study?

If you decide at any time that you no longer want to take part in the study, or you do not want the information you provide during the interview to be used in the study, you can contact me at any time to inform me. You do not need to give reasons for withdrawing from the study. The information you provide will not be able to be withdrawn from the study once the information has been anonymised.

### Will my taking part in the study be kept confidential?

Ethical considerations will be followed during all aspects of the study to ensure that you will remain anonymous and that the information you provide will be kept confidential. The audio-recorder and written notes will be stored in a lockable cabinet and data will be stored on a password secured computer at Swansea University.

### What will happen to the results of the study?

Once the interview has finished, I will transfer the audio-recording into a written format on the computer. Any information such as names and locations, which could identify you, or anyone else that take part in the study, will be removed. The interviews from all swimmers or parents will be analysed together and key information about swimmers' awareness of hygienic swimming behaviours and ways swimmers would like to receive health information will be drawn from the interview data. Quotes from the interviews will be used in the PhD thesis, and any other publications, but will be anonymised. You will not be able to be identified in any report or publication.

### Who is organising and funding the study?

The study is being carried out by Hannah Jones who is currently a PhD student at Swansea University's College of Human and Health Sciences. The study is being funded by the College of Human and Health Sciences, Swansea University.

### Who has reviewed the study?

The College of Human and Health Sciences Ethics Committee at Swansea University have reviewed this study to protect your safety, rights, wellbeing and dignity.

### Who should I contact for further information?

#### **Chief Investigator:**

*Hannah Jones*

Email: [REDACTED]

#### **Academic Supervisors:**

*Dr Jaynie Rance*

Email: [REDACTED]

Telephone: [REDACTED]

*Professor Joy Merrell*

Email: [REDACTED]

Telephone: [REDACTED]

# Participant Information Sheet (Pool Operators)

## Hygienic Swimming Behaviours Research Study

Dear Participant,

Please take time to read through the following information before you decide to take part in the study. Please do not hesitate to ask any questions before taking part in the study.

I am inviting you to take part in a study which will involve a discussing about what you know about hygienic swimming behaviours. We will also discuss how you think it would be best for swimmers to receive information about hygienic swimming behaviours. You are welcome to take this information sheet home with you to talk about this study with others.

### What is the purpose of this study?

You have been invited to take part in a confidential, face to face interview as part of a PhD research study exploring swimmers and parents of swimmers' awareness of hygienic swimming behaviours. I want to find out about what behaviours people follow to help keep the swimming pool clean and healthy. The study also aims to explore your opinion on how swimmers / parents should receive information about these behaviours. The interview discussion will help provide information to develop a public health intervention to raise awareness of hygienic swimming behaviours to keep swimmers healthy.

### Why have I been invited?

As a Swimming Pool Operator, you have been invited to discuss what you think about hygienic swimming behaviours. You will also be asked about the ways you think it would be best for swimmers to receive information relating to hygienic swimming behaviours. The information you give will be invaluable in gaining a better insight into the means of raising awareness of hygienic swimming behaviours amongst swimmers. This information can help develop an intervention to raise awareness of hygienic swimming behaviours which will be targeted at swimmers / parents of swimmers who use your facilities.

### Do I have to take part?

It is up to you whether you want to take part in the study. This information sheet aims to give you all the information you need about the study. You are free to take time to consider whether you would like to take part, discussing with friends or family whether you would like to take part or not.

If you decide to take part, I will contact you to arrange a convenient time for us to conduct the interview. I will also ask you to sign a consent form to show you are happy to take part before we start the interview. You can withdraw from the study at any time without giving reasons up until the information has been anonymised and that you will not be penalised for withdrawing nor will you be questioned on why you have withdrawn.



### What will happen to me if I take part?

You will be asked to take part in an informal interview with me, the researcher, to discuss your thoughts on hygienic swimming behaviours and the ways you think it's best for swimmers to receive health information. You will be asked to sign a consent form before we start to confirm that you are happy to take part in this study.

The interview will be an open discussion and I will ask specific questions during some points of the interview if there is any information I feel has not been discussed which is important to the study. You are free to ask me any questions after the interview. The interview should last approximately 60 minutes and will take place in a private room within the swimming pool setting.

With your permission, the interview will be audio-recorded and some hand-written notes may be taken. The interview will be transcribed into a written format and this will be anonymised meaning that all personal details will be removed. All forms that you complete, the audio recording and transcript of the interview will be stored securely.

### What are the possible disadvantages of taking part?

It may be possible that you will recall a time where the pool has had to be closed because of a faecal accident. The study does not aim to judge your procedures, therefore please do not feel anxious if at times your emergency operating procedures have not been followed correctly.

If at any time our discussion is making you feel uncomfortable, we can pause the discussion or we can stop the interview. We can carry on the interview at another time if you wish, or you can decide to leave the study. You do not need to answer all questions if you feel uncomfortable discussing something in particular. I will provide you with information about sources of support if you feel you need them following the interview.

### What are the possible benefits of taking part?

The information you give will be used to develop a public health awareness intervention which will be piloted in your area; this will hopefully mean that more people will be aware of hygienic swimming behaviours. This will hopefully benefit you as a Swimming Pool Operator as hygienic swimming behaviours can help keep swimming related bugs out of the pool, and could also help reduce the amount of pool closures due to an outbreak of communicable disease.

### What happens when the research study stops?

Once the interview has finished, I will not contact you again unless I cannot hear something clearly on the audio tape and you have given permission for me to contact you. However, you are free to contact me at any time about the study or for any advice in relation to hygienic swimming behaviours (please see the end of this sheet for my contact details).

### What if there is a problem?

Please do not hesitate to contact me immediately if you have any concerns about this research (contact details are provided at the end of this sheet) and I will do my best to answer your questions. You can contact my academic supervisor, Dr Jaynie Rance (contact details are provided at the end of this sheet) if you do not feel it is appropriate to contact me directly. Please inform us of any issues about how we have dealt with you during this study and we will aim to address any of your concerns.

### What will happen if I do not want to carry on with the study?

If you decide at any time that you no longer want to take part in the study, or you do not want the information you provide during the interview to be used in the study, you can contact me at any time to inform me. You do not need to give reasons for withdrawing from the study. The information you provide will not be able to be withdrawn from the study once the information has been anonymised.

### Will my taking part in the study be kept confidential?

Ethical considerations will be followed during all aspects of the study to ensure that you will remain anonymous and that the information you provide will be kept confidential. The audio-recorder and written notes will be stored in a lockable cabinet and data will be stored on a password secured computer at Swansea University.

### What will happen to the results of the study?

Once the interview has finished, I will transfer the audio-recording into a written format on the computer. Any information such as names and locations, which could identify you, or anyone else that take part in the study, will be removed. The interviews from all swimmers or parents will be analysed together and key information about swimmers' awareness of hygienic swimming behaviours and ways swimmers would like to receive health information will be drawn from the interview data. Quotes from the interviews will be used in the PhD thesis, and any other publications, but will be anonymised. You will not be able to be identified in any report or publication.

### Who is organising and funding the study?

The study is being carried out by Hannah Jones who is currently a PhD student at Swansea University's College of Human and Health Sciences. The study is being funded by the College of Human and Health Sciences, Swansea University.

### Who has reviewed the study?

The College of Human and Health Sciences Ethics Committee at Swansea University have reviewed this study to protect your safety, rights, wellbeing and dignity.

Who should I contact for further information?

**Chief Investigator:**

*Hannah Jones*

Email: [REDACTED]

**Academic Supervisors:**

*Dr Jaynie Rance*

Email: [REDACTED]

Telephone: [REDACTED]

*Professor Joy Merrell*

Email: [REDACTED]

Telephone: [REDACTED]

# Participant Information Sheet (Lead Officers)

## Hygienic Swimming Behaviours Research Study

Dear Participant,

Please take time to read through the following information before you decide to take part in the study. Please do not hesitate to ask any questions before taking part in the study.

I am inviting you to take part in a study which will involve a discussing about what you know about hygienic swimming behaviours. We will also discuss how you think it would be best for swimmers to receive information about hygienic swimming behaviours. You are welcome to take this information sheet home with you to talk about this study with others.

### What is the purpose of this study?

You have been invited to take part in a confidential, face to face interview as part of a PhD research study exploring swimmers and parents of swimmers' awareness of hygienic swimming behaviours. I want to find out about what behaviours people follow to help keep the swimming pool clean and healthy. The study also aims to explore your opinion on how swimmers / parents should receive information about these behaviours. The interview discussion will help provide information to develop a public health intervention to raise awareness of hygienic swimming behaviours to keep swimmers healthy.

### Why have I been invited?

As a Lead Officer in Communicable Disease for the Local Authority, you have been invited to discuss what you think about hygienic swimming behaviours. You will also be asked about the ways you think it would be best for swimmers to receive information relating to hygienic swimming behaviours. The information you give will be invaluable in gaining a better insight into the means of raising awareness of hygienic swimming behaviours amongst swimmers. This information can help develop an intervention to raise awareness of hygienic swimming behaviours which will be targeted at swimmers / parents of swimmers who use swimming pool facilities in your Local Authority area.

### Do I have to take part?

It is up to you whether you want to take part in the study. This information sheet aims to give you all the information you need about the study. You are free to take time to consider whether you would like to take part, discussing with friends or family whether you would like to take part or not.

If you decide to take part, I will contact you to arrange a convenient time for us to conduct the interview. I will also ask you to sign a consent form to show you are happy to take part before we start the interview. You can withdraw from the study at any time without giving reasons up until the information has been anonymised and that you will not be penalised for withdrawing nor will you be questioned on why you have withdrawn.

### What will happen to me if I take part?

You will be asked to take part in an informal interview with me, the researcher, to discuss your thoughts on hygienic swimming behaviours and the ways you think it's best for swimmers to receive health information. You will be asked to sign a consent form before we start to confirm that you are happy to take part in this study.

The interview will be an open discussion and I will ask specific questions during some points of the interview if there is any information I feel has not been discussed which is important to the study. You are free to ask me any questions after the interview. The interview should last approximately 60 minutes and will take place in a private room, such as an office or meeting room.

With your permission, the interview will be audio-recorded and some hand-written notes may be taken. The interview will be transcribed into a written format and this will be anonymised meaning that all personal details will be removed. All forms that you complete, the audio recording and transcript of the interview will be stored securely.

### What are the possible disadvantages of taking part?

It may be possible that you will recall a time where you have dealt with a case of communicable disease where someone has been very ill and you may have found the investigation difficult.

If at any time our discussion is making you feel uncomfortable, we can pause the discussion or we can stop the interview. We can carry on the interview at another time if you wish, or you can decide to leave the study. You do not need to answer all questions if you feel uncomfortable discussing something in particular. I will provide you with information about sources of support if you feel you need them following the interview.

### What are the possible benefits of taking part?

The information you give will be used to develop a public health awareness intervention which will be piloted in your area; this will hopefully mean that more people will be aware of hygienic swimming behaviours. This will hopefully benefit you as a Lead Officer as hygienic swimming behaviours can help reduce the number of cases and outbreaks of communicable disease such as Cryptosporidium. The awareness intervention could also help reduce the amount of pool closures due to an outbreak of communicable disease.

### What happens when the research study stops?

Once the interview has finished, I will not contact you again unless I cannot hear something clearly on the audio tape and you have given permission for me to contact you. However, you are free to contact me at any time about the study or for any advice in relation to hygienic swimming behaviours (please see the end of this sheet for my contact details).

### What if there is a problem?

Please do not hesitate to contact me immediately if you have any concerns about this research (contact details are provided at the end of this sheet) and I will do my best to answer your questions. You can contact my academic supervisor, Dr Jaynie Rance (contact details are provided at the end of this sheet) if you do not feel it is appropriate to contact me directly. Please inform us of any issues about how we have dealt with you during this study and we will aim to address any of your concerns.

### What will happen if I do not want to carry on with the study?

If you decide at any time that you no longer want to take part in the study, or you do not want the information you provide during the interview to be used in the study, you can contact me at any time to inform me. You do not need to give reasons for withdrawing from the study. The information you provide will not be able to be withdrawn from the study once the information has been anonymised.

### Will my taking part in the study be kept confidential?

Ethical considerations will be followed during all aspects of the study to ensure that you will remain anonymous and that the information you provide will be kept confidential. The audio-recorder and written notes will be stored in a lockable cabinet and data will be stored on a password secured computer at Swansea University.

### What will happen to the results of the study?

Once the interview has finished, I will transfer the audio-recording into a written format on the computer. Any information such as names and locations, which could identify you, or anyone else that take part in the study, will be removed. The interviews from all swimmers or parents will be analysed together and key information about swimmers' awareness of hygienic swimming behaviours and ways swimmers would like to receive health information will be drawn from the interview data. Quotes from the interviews will be used in the PhD thesis, and any other publications, but will be anonymised. You will not be able to be identified in any report or publication.

### Who is organising and funding the study?

The study is being carried out by Hannah Jones who is currently a PhD student at Swansea University's College of Human and Health Sciences. The study is being funded by the College of Human and Health Sciences, Swansea University.

### Who has reviewed the study?

The College of Human and Health Sciences Ethics Committee at Swansea University have reviewed this study to protect your safety, rights, wellbeing and dignity.

Who should I contact for further information?

**Chief Investigator:**

*Hannah Jones*

Email: [REDACTED]

**Academic Supervisors:**

*Dr Jaynie Rance*

Email: [REDACTED]

Telephone: [REDACTED]

*Professor Joy Merrell*

Email: [REDACTED]

Telephone: [REDACTED]

# Participant Information Sheet (Health Professionals)

## Hygienic Swimming Behaviours Research Study

Dear Participant,

Please take time to read through the following information before you decide to take part in the study. Please do not hesitate to ask any questions before taking part in the study.

I am inviting you to take part in a study which will involve a discussing about what you know about hygienic swimming behaviours. We will also discuss how you think it would be best for swimmers to receive information about hygienic swimming behaviours. You are welcome to take this information sheet home with you to talk about this study with others.

### What is the purpose of this study?

You have been invited to take part in a confidential, face to face interview as part of a PhD research study exploring swimmers and parents of swimmers' awareness of hygienic swimming behaviours. I want to find out about what behaviours people follow to help keep the swimming pool clean and healthy. The study also aims to explore your opinion on how swimmers / parents should receive information about these behaviours. The interview discussion will help provide information to develop a public health intervention to raise awareness of hygienic swimming behaviours to keep swimmers healthy.

### Why have I been invited?

As a Health Professional with an expertise in Infection Control / Cryptosporidium, you have been invited to discuss what you think about hygienic swimming behaviours. You will also be asked about the ways you think it would be best for swimmers to receive information relating to hygienic swimming behaviours. The information you give will be invaluable in gaining a better insight into the means of raising awareness of hygienic swimming behaviours amongst swimmers. This information can help develop an intervention to raise awareness of hygienic swimming behaviours which will be targeted at swimmers / parents of swimmers who use swimming pool facilities in your area.

### Do I have to take part?

It is up to you whether you want to take part in the study. This information sheet aims to give you all the information you need about the study. You are free to take time to consider whether you would like to take part, discussing with friends or family whether you would like to take part or not.

If you decide to take part, I will contact you to arrange a convenient time for us to conduct the interview. I will also ask you to sign a consent form to show you are happy to take part before we start the interview. You can withdraw from the study at any time without giving reasons up until the information has been anonymised and that you will not be penalised for withdrawing nor will you be questioned on why you have withdrawn.



### What will happen to me if I take part?

You will be asked to take part in an informal interview with me, the researcher, to discuss your thoughts on hygienic swimming behaviours and the ways you think it's best for swimmers to receive health information. You will be asked to sign a consent form before we start to confirm that you are happy to take part in this study.

The interview will be an open discussion and I will ask specific questions during some points of the interview if there is any information I feel has not been discussed which is important to the study. You are free to ask me any questions after the interview. The interview should last approximately 60 minutes and will take place in a private room, such as an office or meeting room.

With your permission, the interview will be audio-recorded and some hand-written notes may be taken. The interview will be transcribed into a written format and this will be anonymised meaning that all personal details will be removed. All forms that you complete, the audio recording and transcript of the interview will be stored securely.

### What are the possible disadvantages of taking part?

It may be possible that you will recall a time where you have dealt with a case of communicable disease where someone has been very ill and you may have found the investigation difficult.

If at any time our discussion is making you feel uncomfortable, we can pause the discussion or we can stop the interview. We can carry on the interview at another time if you wish, or you can decide to leave the study. You do not need to answer all questions if you feel uncomfortable discussing something in particular. I will provide you with information about sources of support if you feel you need them following the interview.

### What are the possible benefits of taking part?

The information you give will be used to develop a public health intervention which will be piloted in your area; this will hopefully mean that more people will be aware of hygienic swimming behaviours. This will hopefully benefit you as a Health Professional as hygienic swimming behaviours can help reduce the number of cases and outbreaks of communicable disease such as Cryptosporidium. The awareness intervention could also help reduce the amount of pool closures due to an outbreak of communicable disease.

### What happens when the research study stops?

Once the interview has finished, I will not contact you again unless I cannot hear something clearly on the audio tape and you have given permission for me to contact you. However, you are free to contact me at any time about the study or for any advice in relation to hygienic swimming behaviours (please see the end of this sheet for my contact details).

### What if there is a problem?

Please do not hesitate to contact me immediately if you have any concerns about this research (contact details are provided at the end of this sheet) and I will do my best to answer your questions. You can contact my academic supervisor, Dr Jaynie Rance (contact details are provided at the end of this sheet) if you do not feel it is appropriate to contact me directly. Please inform us of any issues about how we have dealt with you during this study and we will aim to address any of your concerns.

### What will happen if I do not want to carry on with the study?

If you decide at any time that you no longer want to take part in the study, or you do not want the information you provide during the interview to be used in the study, you can contact me at any time to inform me. You do not need to give reasons for withdrawing from the study. The information you provide will not be able to be withdrawn from the study once the information has been anonymised.

### Will my taking part in the study be kept confidential?

Ethical considerations will be followed during all aspects of the study to ensure that you will remain anonymous and that the information you provide will be kept confidential. The audio-recorder and written notes will be stored in a lockable cabinet and data will be stored on a password secured computer at Swansea University.

### What will happen to the results of the study?

Once the interview has finished, I will transfer the audio-recording into a written format on the computer. Any information such as names and locations, which could identify you, or anyone else that take part in the study, will be removed. The interviews from all swimmers or parents will be analysed together and key information about swimmers' awareness of hygienic swimming behaviours and ways swimmers would like to receive health information will be drawn from the interview data. Quotes from the interviews will be used in the PhD thesis, and any other publications, but will be anonymised. You will not be able to be identified in any report or publication.

### Who is organising and funding the study?

The study is being carried out by Hannah Jones who is currently a PhD student at Swansea University's College of Human and Health Sciences. The study is being funded by the College of Human and Health Sciences, Swansea University.

### Who has reviewed the study?

The College of Human and Health Sciences Ethics Committee at Swansea University have reviewed this study to protect your safety, rights, wellbeing and dignity.

Who should I contact for further information?

**Chief Investigator:**

*Hannah Jones*

Email: [REDACTED]

**Academic Supervisors:**

*Dr Jaynie Rance*

Email: [REDACTED]

Telephone: [REDACTED]

*Professor Joy Merrell*

[REDACTED]

Telephone: [REDACTED]

## Topic Guide for interviews with Swimmers / Parents of Swimmers

Arrive at the leisure centre's relevant room and test the recording equipment to make sure it is working properly. Use the following as cues during the interview:

### Opening

1. **(Establish Rapport)** [shake hands] My name is Hannah Jones and I am a PhD Student at Swansea University conducting some research on hygienic swimming behaviours.
2. **(Purpose)** I would like to ask you some questions about:  
what you know about hygienic swimming practices,  
if you've ever experienced your child or someone else's child having a toileting accident in the swimming pool,  
what you know about some bugs that can live in swimming pools,  
how you have found out information about hygienic swimming,  
how you would like to get information to know more about hygienic swimming?
3. **(Motivation)** I hope to use this information to develop a public health intervention to raise awareness of the importance of following hygienic swimming behaviours to keep swimmers safe and healthy.
4. **(Time Line)** The interview should take about 60 minutes. Is that still convenient for you?
5. **(Consent)** Do you have any questions before we begin? If you're happy to take part, please sign the informed consent form. Are you still happy for the interview to be recorded?
6. **(Transition)** Let me begin by asking you some questions about what you know about hygienic swimming behaviours.

### Body

7. **(Topic)** Hygienic Swimming Behaviours
  - a) Is there anything you would do before getting in the pool to help keep the water clean and healthy?
  - b) (Follow up question) Why do you think it's important to do these things?
  - c) What does the term hygienic swimming behaviours mean to you?
  - d) Do you think everyone who swims follows these hygienic behaviours?
  - e) (Follow up question) Why do you think they don't shower before going in or pee in the pool?
  - f) Do you swallow pool water? Why?
  - g) Have you been swimming if you've had diarrhoea or sickness?
  - h) If you had some diarrhoea in the morning, would you go swimming that same

day in the evening?

- i) (Follow up question) How much time would you give it from your last loose bowel movement to go swimming again?

8. **(Topic)** Faecal accidents

- a) Do you take young children swimming, either your own or friends/family?
- b) (Follow up question) Have they ever had a toileting accident, like a poop, while they were in the swimming pool water?
- c) (Follow up question) What did you do? or What would you do if it was to happen?
- d) What's your opinion on using swim nappies for children? Do your children use them?
- e) How do you think the pool staff should react to these types of accidents?

9. **(Topic)** Cryptosporidium

- a) Do you know of any bugs / germs that can live in the swimming pool water?
- b) Have you heard of a bug called Cryptosporidium?
- c) Can you explain what it might be?

10. **(Topic)** Health information

- a) Would you like to get information about this disease and ways you can prevent it?
- b) What's the best way, in your opinion, for swimmers or parents to get this type of information?
- c) Do you think the swimming pools should regularly give out this type of information?
- d) What type of messages do you think would be useful to give that won't put people off swimming?
- e) Whose information do you trust? Credibility of the source of information.

**Closing**

- 11. **(Summarize)** From our discussion, \_\_\_\_\_
- 12. **(Maintain Rapport)** I appreciate you taking time out of your day to take part in this interview. Is there anything else you think would be helpful for me to know or is there anything else you would like to ask me?
- 13. **(Action to be taken)** I should have all the information I need. Would it be alright to call or email you if there is anything else I need? The information you have given will help towards developing a public health intervention to raise awareness of hygienic swimming behaviours to help keep swimmers safe and healthy.

Provide information leaflet and debriefing sheet to participant and thank them again for their time and their views.

## Topic Guide for interviews with Pool Operators

Arrive at the leisure centre's relevant room and test the recording equipment to make sure it is working properly. Use the following as cues during the interview:

### Opening

14. **(Establish Rapport)** [shake hands] My name is Hannah Jones and I am a PhD Student at Swansea University conducting some research on hygienic swimming behaviours.
15. **(Purpose)** I would like to ask you some questions about:  
what you know about hygienic swimming practices,  
if you've ever experienced a toileting accident at your swimming pool,  
what you know about some bugs that can live in swimming pools,  
how you think swimmers should get information to encourage them to follow hygienic swimming behaviours?
16. **(Motivation)** I hope to use this information to develop a public health intervention to raise awareness of the importance of following hygienic swimming behaviours to keep swimmers safe and healthy and to reduce the number of outbreaks associated with swimming pool settings.
17. **(Time Line)** The interview should take about 60 minutes. Is that still convenient for you?
18. **(Consent)** Do you have any questions before we begin? If you're happy to take part, please sign the informed consent form. Are you still happy for the interview to be recorded?
19. **(Transition)** Let me begin by asking you some questions about what you know about hygienic swimming behaviours.

### Body

20. **(Topic)** Hygienic Swimming Behaviours
  - j) What does the term hygienic swimming behaviours mean to you?
  - k) Do you actively encourage swimmers to follow hygienic behaviours while at your swimming pool?
  - l) (Follow up question) What type of things do you encourage swimmers to do to help clean the pool water clean and healthy?
  - m) Do you think everyone who swims follows these hygienic behaviours?
  - n) (Follow up question) Why do you think they don't shower before going in or pee in the pool?
  - o) Are there any messages you provide to swimmers about not swimming if they have / had diarrhoea or sickness?
  - p) (Follow up question) For how long do you encourage swimmers not to come swimming for if they have had diarrhoea or vomiting?

21. **(Topic)** Faecal accidents

- f) Have you had to deal with a toileting accident, like a poop, in the swimming pool water?
- g) (Follow up question) What did you do? or What would you do if it was to happen?
- h) Do you have a written procedure for dealing with the different types of stools?
- i) Do faecal accidents often happen at your swimming pool?
- j) (Follow up question) Have you ever had to shut the pool because of one?
- k) Do you encourage parents to use swim nappies?
- l) (Follow up question) Do you sell them here?
- m) (Follow up question) What's your opinion on using swim nappies for children?

22. **(Topic)** Cryptosporidium

- d) Have you heard of a bug called Cryptosporidium?
- e) Can you explain what issues it can cause for your swimming pool?
- f) Do you think swimmers are aware of it and the implication it can have to your operation?

23. **(Topic)** Health information

- f) Do you think swimmers should get information about this disease and ways they can prevent it? Why?
- g) What's the best way, in your opinion, for swimmers or parents to get this type of information?
- h) Who do you think should be responsible for giving this type of information to swimmers?
- i) (Follow up question) Do you think you should regularly give out this type of information?
- j) What type of messages do you think would be useful to give that won't put people off swimming?

**Closing**

24. **(Summarize)** From our discussion, \_\_\_\_\_

25. **(Maintain Rapport)** I appreciate you taking time out of your day to take part in this interview. Is there anything else you think would be helpful for me to know or is there anything else you would like to ask me?

26. **(Action to be taken)** I should have all the information I need. Would it be alright to call or email you if there is anything else I need? The information you have given will help towards developing a public health intervention to raise awareness of hygienic swimming behaviours to help keep swimmers safe and healthy.

Provide information leaflet and debriefing sheet to participant and thank them again for their time and their views.

## Topic Guide for interviews with Lead Officers

Arrive at convenient location previously arranged, and test the recording equipment to make sure it is working properly. Use the following as cues during the interview:

### Opening

27. **(Establish Rapport)** [shake hands] My name is Hannah Jones and I am a PhD Student at Swansea University conducting some research on hygienic swimming behaviours.
28. **(Purpose)** I would like to ask you some questions about:  
what you know about hygienic swimming practices,  
dealing with faecal accidents in swimming pools,  
your opinion on swimmers' awareness of Cryptosporidium,  
how you think swimmers should get information to encourage them to follow hygienic swimming behaviours?
29. **(Motivation)** I hope to use this information to develop a public health intervention to raise awareness of the importance of following hygienic swimming behaviours to keep swimmers safe and healthy and to reduce the number of outbreaks associated with swimming pool settings.
30. **(Time Line)** The interview should take about 60 minutes. Is that still convenient for you?
31. **(Consent)** Do you have any questions before we begin? If you're happy to take part, please sign the informed consent form. Are you still happy for the interview to be recorded?
32. **(Transition)** Let me begin by asking you some questions about what you know about hygienic swimming behaviours.

### Body

33. **(Topic)** Hygienic Swimming Behaviours
  - q) What does the term hygienic swimming behaviours mean to you?
  - r) Do you actively encourage swimmers to follow hygienic behaviours during sporadic / outbreak investigations?
  - s) (Follow up question) What type of things do you encourage swimmers to do to help clean the pool water clean and healthy?
  - t) Do you think everyone who swims follows these hygienic behaviours?
  - u) (Follow up question) Why do you think they don't shower before going in or pee in the pool?
  - v) Are there any messages you provide to swimmers about not swimming if they have / had diarrhoea or sickness?
  - w) (Follow up question) For how long do you encourage swimmers not to go swimming for if they have had diarrhoea or vomiting?



34. **(Topic)** Faecal accidents

- n) Have you ever been contacted by a Pool Operator asking for advice on how to deal with a faecal accident?
- o) (Follow up question) What advice do / would you give to pool operators?
- p) Would you encourage parents to use swim nappies?
- q) (Follow up question) What's your opinion on using swim nappies for children?
- r) Have you ever dealt with an outbreak situation linked to a swimming pool due to a faecal incident?
- s) (Follow up question) Have you ever had to request a pool to close because of an outbreak?

35. **(Topic)** Cryptosporidium

- g) Do you think swimmers are aware of Cryptosporidium and the implication it can have in swimming pools?
- h) What's your opinion on raising awareness of Cryptosporidium amongst swimming pool users?

36. **(Topic)** Health information

- k) Do you think swimmers should get information about this disease and ways they can prevent it? Why?
- l) What's the best way, in your opinion, for swimmers or parents to get this type of information?
- m) Who do you think should be responsible to provide this type of information to swimmers?
- n) What type of messages do you think would be useful to give that won't put people off swimming?

**Closing**

37. **(Summarize)** From our discussion, \_\_\_\_\_

38. **(Maintain Rapport)** I appreciate you taking time out of your day to take part in this interview. Is there anything else you think would be helpful for me to know or is there anything else you would like to ask me?

39. **(Action to be taken)** I should have all the information I need. Would it be alright to call or email you if there is anything else I need? The information you have given will help towards developing a public health intervention to raise awareness of hygienic swimming behaviours to help keep swimmers safe and healthy.

Provide information leaflet and debriefing sheet to participant and thank them again for their time and their views.

## Topic Guide for interviews with Health Professionals

Arrive at convenient location previously arranged, and test the recording equipment to make sure it is working properly. Use the following as cues during the interview:

### Opening

40. **(Establish Rapport)** [shake hands] My name is Hannah Jones and I am a PhD Student at Swansea University conducting some research on hygienic swimming behaviours.
41. **(Purpose)** I would like to ask you some questions about:  
what you know about hygienic swimming practices,  
dealing with faecal accidents in swimming pools,  
your opinion on swimmers' awareness of Cryptosporidium,  
how you think swimmers should get information to encourage them to follow hygienic swimming behaviours?
42. **(Motivation)** I hope to use this information to develop a public health intervention to raise awareness of the importance of following hygienic swimming behaviours to keep swimmers safe and healthy and to reduce the number of outbreaks associated with swimming pool settings.
43. **(Time Line)** The interview should take about 60 minutes. Is that still convenient for you?
44. **(Consent)** Do you have any questions before we begin? If you're happy to take part, please sign the informed consent form. Are you still happy for the interview to be recorded?
45. **(Transition)** Let me begin by asking you some questions about what you know about hygienic swimming behaviours.

### Body

46. **(Topic)** Hygienic Swimming Behaviours
  - x) What does the term hygienic swimming behaviours mean to you?
  - y) What type of things should swimmers be encouraged to do to help clean the pool water clean and healthy?
  - z) Do you think everyone who swims follows these hygienic behaviours?
  - aa) (Follow up question) Why do you think they don't shower before going in or pee in the pool?
  - bb) What messages do you think swimmers should receive about exclusion from swimming following diarrhoea and vomiting?
47. **(Topic)** Faecal accidents
  - t) Have you ever been contacted by a Pool Operator/ Lead Officer asking for advice on how to deal with a faecal accident?

- u) (Follow up question) What advice do / would you give to pool operators?
- v) Would you encourage parents to use swim nappies?
- w) (Follow up question) What's your opinion on using swim nappies for children?
- x) Have you ever dealt with an outbreak situation linked to a swimming pool due to a faecal incident?
- y) (Follow up question) Do you think pools should close in an outbreak situation and why?

48. **(Topic)** Cryptosporidium

- i) Do you think swimmers are aware of Cryptosporidium and the implication it can have in swimming pools?
- j) What's your opinion on raising awareness of Cryptosporidium amongst swimming pool users?

49. **(Topic)** Health information

- o) Do you think swimmers should get information about this disease and ways they can prevent it? Why?
- p) What's the best way, in your opinion, for swimmers or parents to get this type of information?
- q) Who do you think should be responsible to provide this type of information to swimmers and why?
- r) What type of messages do you think would be useful to give that won't put people off swimming?

**Closing**

- 50. **(Summarize)** From our discussion, \_\_\_\_\_
- 51. **(Maintain Rapport)** I appreciate you taking time out of your day to take part in this interview. Is there anything else you think would be helpful for me to know or is there anything else you would like to ask me?
- 52. **(Action to be taken)** I should have all the information I need. Would it be alright to call or email you if there is anything else I need? The information you have given will help towards developing a public health intervention to raise awareness of hygienic swimming behaviours to help keep swimmers safe and healthy.

Provide information leaflet and debriefing sheet to participant and thank them again for their time and their views.

## Hygienic Swimming Behaviours Research Study Informed Consent Form

Please complete the following form if you are happy to take part in this study, please tick as appropriate.

1.	I have read and understood the information about the study as provided in the Information Sheet.	<input type="checkbox"/>
2.	I have been given the opportunity to ask questions about the study and my participation, and any questions have been answered to my satisfaction.	<input type="checkbox"/>
3.	I voluntarily agree to participate in the study.	<input type="checkbox"/>
4.	I understand I can withdraw at any time without giving reasons up until the information has been anonymised and that I will not be penalised for withdrawing nor will I be questioned on why I have withdrawn.	<input type="checkbox"/>
5.	The procedures regarding confidentiality have been clearly explained (e.g. use of names, pseudonyms, anonymisation of data, etc.) to me.	<input type="checkbox"/>
6.	I agree to the interview being audio-recorded.	<input type="checkbox"/>
7.	The use of the data in research, publications, sharing and archiving has been explained to me and I agree to the use of anonymised quotes in publications.	<input type="checkbox"/>
8.	I, along with the Researcher, agree to sign and date this informed consent form.	<input type="checkbox"/>

_____	_____	_____
Name of Participant	Date	Signature
_____	_____	_____
Name of Researcher	Date	Signature

Appendix 2g: Model of my analysis for Theme 1



The codes were generated from the data. These codes were then grouped thematically to create the categories. The categories were grouped thematically, if relevant to create sub-themes. These categories or sub-themes then formed the main themes.

Appendix 2h: Ethical approval

Dear Hannah,

**RE: Application for CHHS Research Ethics Approval**

Ref: 130517 A Public Health intervention to raise awareness of hygienic swimming behaviours, amongst swimming pool users in the South Wales area, to reduce the transmission of cryptosporidium.

The CHHS Research Ethics Committee has met to consider your proposal and have approved your application. Furthermore, I agree with your suggestions for a staged data collection and wish you well with your study.

Best Wishes

Dr S Snelgrove

Sherrill Snelgrove (Chair Research Ethics committee)

## Hygienic Swimming Behaviours Research Study Debriefing sheet for Swimmers

Thank you for taking part in the interview, your time is appreciated.

This study aims to explore the views of swimmers / swimmers' parents on hygienic swimming behaviours and the type of awareness intervention which would be feasible and acceptable. Previous work has shown that swimming pools are common settings for outbreaks of cryptosporidiosis (a stomach bug).

I hope you find the information leaflet illustrating hygienic swimming practices useful. If you want to find out more information, please visit the following websites:

- Cryptosporidium (Poo in the Pool) by Swansea University:  
<https://www.youtube.com/watch?v=T5CcFcXXn3U>
- Information about Cryptosporidium from Public Health Wales:  
<http://www.wales.nhs.uk/sitesplus/888/page/44044>
- Swimming Hygiene by The Centers for Disease Control and Prevention, USA:  
<https://www.cdc.gov/healthywater/hygiene/swimming/>

Please contact Hannah Jones at the following email address: [REDACTED]@k, if you have any questions about this study.

**Thank you again for your participation.**

# Hygienic Swimming Behaviours Research Study

## Debriefing sheet for Pool Operators

Thank you for taking part in the interview, your time is appreciated.

This study aims to explore the views of pool operators on hygienic swimming behaviours and the type of awareness intervention which would be feasible and acceptable. Previous work has shown that swimming pools are common settings for outbreaks of cryptosporidiosis (a stomach bug).

If you would like further information, I believe the following websites / documents to be very useful:

- Cryptosporidium (Poo in the Pool) by Swansea University:  
<https://www.youtube.com/watch?v=T5CcFcXXn3U>
- Information about Cryptosporidium from Public Health Wales:  
<http://www.wales.nhs.uk/sitesplus/888/page/44044>
- Swimming Hygiene by The Centers for Disease Control and Prevention, USA:  
<https://www.cdc.gov/healthywater/hygiene/swimming/>
- The Pool Water Treatment Advisory Group's website:  
<http://pwtag.org>
- The Health and Safety Executive's swimming pool management guidance:  
<http://www.hse.gov.uk/entertainment/leisure/swimming-pool.htm>

Please contact Hannah Jones at the following email address: [REDACTED], if you have any questions about this study.

**Thank you again for your participation.**



# Hygienic Swimming Behaviours Research Study

## Debriefing sheet for Health Professionals

Thank you for taking part in the interview, your time is appreciated.

This study aims to explore the views of Health Professionals, who have direct involvement in the investigation of cases and outbreaks of cryptosporidiosis, on hygienic swimming behaviours and the type of awareness intervention which would be feasible and acceptable. Previous work has shown that swimming pools are common settings for outbreaks of cryptosporidiosis.

I would like to bring your attention to the following animation which may be of interest to you:

- Cryptosporidium (Poo in the Pool) by Swansea University:  
<https://www.youtube.com/watch?v=T5CcFcXn3U>

Please contact Hannah Jones at the following email address: [REDACTED] if you have any questions about this study.

**Thank you again for your participation.**

## No to Poo in the Pool!



Germs like cryptosporidium (sometimes called crypto) can spread in the pool water when someone who has diarrhoea and vomiting goes swimming. These germs can cause a lot of people to become ill (an outbreak). Pool chemicals can usually kill most germs, but not cryptosporidium. So, keeping it out of the pool in the first place, by avoiding any [Poo in the Pool](#), is important.

Follow these simple steps to help stop the spread of any bugs in the swimming pool:

Before you get in:

- Do not go swimming if you have diarrhoea or vomiting.
- Do not take your child swimming if they have diarrhoea, a swim nappy is not likely to keep a loose stool from leaking.
- Make sure you have been free from symptoms of diarrhoea or vomiting for at least 48 hours.
- Do not go swimming for 14 days after your symptoms have stopped if you have been diagnosed with cryptosporidiosis by your doctor.
- Shower before you get in to the pool to wash away any dirt, grease or make-up.
- Wash / shower babies and young children, making sure there is no faecal (poo) matter around the bottom after they have been to the toilet.



While you're in:

- Do not pee or poo in the water.
- Try not to swallow the water.
- Take children on regular toilet breaks.
- If your child is wearing a swim nappy, ensure you check and change them regularly.
- If your child has an accident in the pool, please don't be embarrassed, tell a member of staff who can take measures to deal with the [Poo in the Pool](#) and keep swimmers safe.



Appendix 2k: Codebook and thematic grid

Theme:	Influences on Hygienic Swimming Behaviours			
Sub-theme:	Category:	Code:	Description:	Example:
<b>Internal Influences</b>	<b>Current Awareness</b>	<b>Exclusion</b>	Not going swimming if they are ill with sickness and diarrhoea.	No, definitely not. You know, again, um, your common sense will prevail if, you know, if you're ill you're not gonna be going anywhere like that...into that kind of an environment. And, obviously, there are rules and regulations with most-every swimming pool. You know, they have-normally have, you know, signage that will say, you know, you are not supposed to be coming into this pool if you had anything like that...Um, and um, so no, definitely not. Definitely not (Swimmer 13).
		<b>Showering Before Swimming</b>	Aware of the need to shower before swimming.	But, yeah, I just thought you'd shower just to rid of, obviously, any germs or bacteria or whatever you've got on your body...whatever you're carrying in from somewhere else...you know, it just prevents the spread and-- (Swimmer 5).
		<b>Hand washing</b>	Being aware of the need to wash hands after being to the toilet.	I'd probably just wash when I was in the shower...But I wouldn't specifically wash my hands and then, you know, just go to the pool...If I was using the toilet, then I'd wash my hands and then-- and then I would shower, yeah (Swimmer 5).
		<b>Swim nappy use</b>	Being aware that there are appropriate swim nappies.	It's a lot more hygienic, the pool and um, it's a lot less embarrassing for the child as well if they did have an accident obviously it's kept under control (Swimmer 18).
		<b>Using the toilet before swimming</b>	Using the toilet before swimming and not using the pool as a toilet.	Um, just make sure he's been to the toilet or whatever before we go...He doesn't need to go (Swimmer 12).
		<b>Informing staff of any 'poo in the pool'</b>	Letting staff know of any poo in the pool .	I would inform the pool supervisor...Straight away...I'd feel embarrassed but it's better than leaving people swim in poo (Swimmer 9).
		<b>Bug awareness</b>	Are participants aware of any bugs	I can understand there will be a lot of germs and bacteria there...That's why they use the chlorine but specific ones I wouldn't know (Swimmer 12).

			that can live in swimming pools.	
	<b>Habits / Routines</b>		Their own personal habits and routines of being a swimmer, including; personal hygiene or skin care.	So I suppose if you're aware of it I mean as a young age then you grow up with it then don't you? Of the understanding...like a habit forming isn't it? (Swimmer 16).
	<b>Beliefs</b>		Swimmers beliefs around chlorine effects, experiences, costs and time.	Not, I don't know names are but I know they're all bugs that live in there but I don't know the name of them...No, blissful ignorance...Don't need to know what's in there. I know there's chlorine in there and it keeps it clean (Swimmer 14).
<b>External Influences</b>	<b>Culture</b>	<b>Parental Influence</b>	Parents creating the habits / routines children will become accustomed to.	But, you know, maybe a lot of adults don't realise either, that, you know, if they've had, like, a vomiting bug or diarrhoea, that they shouldn't be using, you know, swimming pools, spas, and that sort of thing, really (Pool Operator 4).
		<b>Peer Influence</b>	The culture within the swimming pool setting, whether or not it is the norm to follow hygienic swimming behaviours.	Umm-- No I don't do anything special coz nobody else does...I think everyone should shower I before go in...but they don't do it here...Oh yeah, in other places its say shower before you go in, I do. But, if nobody else does, you know, it's morning, you're in a hurry, why bother if you don't have to? (Swimmer 2).
		<b>Staff Influence</b>	Do staff actively encourage hygienic swimming behaviours?	Oh yeah, definitely. I feel like if they weren't approachable, people might be more inclined not to say anything and just to kind of hope that the mess would go away (Swimmer 10).
	<b>Current Educational Materials</b>		Are any materials available to swimmers?	I've seen posters about having a shower...Before going into the pool but that's about it really (Swimmer 14).

Theme:	Design of Swimming Facility			
Sub-theme:	Category:	Code:	Description:	Example:
	<b>Convenience</b>		The convenient design of the facility, for example, the location of pre-swim showers.	The way it's constructed, the shower is at that end...So you'd have to go that way, you know, come back. The-the lockers are at that end...It's just inconvenient...People in a hurry, they're not gonna do it...You know what it's like, don't do anything unless they really have to (Swimmer 2).
	<b>Accessibility</b>		Are facilities present to help facilitate hygienic swimming behaviours, and are they disability friendly?	They do say to have um a shower before hydro but I will say that we don't...go in the shower before hydro...Hydro's in [location]...Um, well the shower's on the other side of the pool...so you've got to walk past the pool and because of [name]'s walking...it's a long way to walk to the shower and then back to the pool...and it's a lot of hassle (Swimmer 1).
	<b>Cleanliness</b>		Are facilities clean and useable to help facilitate hygienic swimming behaviours?	And the hygiene in the toilets here is poor...It's poor. It-- To be quite honestly, it stinks...It was stinking this morning...Now I don't know who's responsible for cleaning the pool and the same people as responsible for cleaning the toilet, but as for the gents toilet, it is akin to a pub, a pub toilet... (Swimmer 3).

<b>Theme:</b>	<b>Education for swimming pool users</b>			
<b>Sub-theme:</b>	<b>Category:</b>	<b>Code:</b>	<b>Description:</b>	<b>Example:</b>
<b>Raising Awareness</b>	<b>Content</b>		What should the message include and how it should be portrayed.	So it- you- there's no point in scaring people...Just make it as- you know, please wash, please be hygienic so you're not passing bugs onto other people and you won't receive the bugs back...And that's it (Swimmer 9).
	<b>Crypto-sporidium vs general message</b>		Should the message be specific to cryptosporidium or more general?	I think what you might want to consider is whether you have a intervention just for Crypto or whether you have a intervention for healthy swimming or hygienic swimming...Generally...the advantage of doing it for hygienic swimming generally, is as a big advantage for swimming pools...in that, um, you know, they-they might find that if their local user group has an increasing trend for better hygiene they-they might actually be able to reduce the amount of chlorine they're using...in their pool which means there's less by-products...Um, you know which has a n-nicer swim experience for...bathers and reduces their cost (Health Professional 1).
	<b>Types of intervention</b>	<b>Signage</b>	Displaying posters and other signage in centres.	And I would put logos then if-if that would be the case. Logos, like a funny logo of um how it affects the pool, before they-- uh when they have the shower...This is what's going to happen if you don't have the shower, this is when you have a shower, its right...Yes. So you-you got these, sort of, funny things, logos, "These is what will happen, if you don't if you have a shower." Yes (Swimmer 7).
		<b>Leaflets</b>	Providing leaflets to swimmers.	I think I'd be more inclined to read a leaflet than I would a poster because you tend to just focus on what you're gonna do and...Yeah. Especially if you've got children as well. The last thing you want to be doing is stopping and reading posters, really (Swimmer 18).
		<b>Video</b>	Providing a video to watch in schools are at the facility.	I think something on that. Um, our schools come in three-week blocks when they swim, so before they swim maybe there would be a DVD we could send them that they could, you know, learn with the children why we do these things (Pool Operator 6).

		<b>Verbal</b>	Providing verbal instructions to pool users.	Yeah. I do but I also think like verbal communication...is a lot better because you could read something but you don't take it in...When you're talking about something, you take it in more...No. If somebody said to me you gotta shower, and those were the guidelines in the pool, I would certainly would shower (Swimmer 1).
		<b>Online</b>	Providing information on websites / social media.	Um, social media is very strong these days and people often live their lives via social media. I'm from a different era um, I can see it has a benefit, obviously, and if you-it's like if you join a gym, you might then follow the gym on Facebook or Twitter or whatever an-and get updates of things that they're offering, or, you know, classes that they're offering. So, I can see definitely it would have a benefit, you know. Yeah (Swimmer 13).
	<b>Means of delivery</b>	<b>Changing Rooms</b>	Use the changing room area as a way of displaying information.	So yeah, yes as it says like I think stickers on the back of the changing room doors would really, like a poster like that one...Would really, when they're getting changed that'd really bring it to attention...Yeah, so then nine times out of ten and I think they'll see the showers are there as you walk through so...So you've just read that information and then I'd say you're more likely to go and shower before going in (Swimmer 12).
		<b>Reception</b>	Use the reception area as a way to inform swimmers of hygienic swimming behaviours.	Yeah. I don't know. Perhaps-Perhaps have something when you go to reception, and you-you're just joining the pool and you're new then a leaflet or something...Giving out something like that? Mm (Swimmer 15).
		<b>Staff</b>	Use trained and competent staff to educate swimmers.	Why you need a shower. "Because--" And if you say, "Well I'm not bothering with a shower today." Then, they can actually say, "Well," you know, "What have you got on your body?" You know, "Where have you been?" And...then it'd make them think, "Oh, my goodness. I'm really dirty today...let me shower." [chuckles] Yeah (Swimmer 15).
		<b>Online</b>	Website or social media as a means of	Yeah, I think that would be a good platform coz everybody's involved in social media these days (Swimmer 18).



			delivering the information.	
		<b>External</b>	Involve schools, clubs, health boards, etc. to help provide information to the general public.	Um, well I think, um, if your children go to swimming lessons um, there are obviously swimming clubs, maybe aqua aerobics...Um, you know, um, when you're going to organised events at pools and things, I think that, you know, w-whichever organisation or body is in charge of that particular lesson or, you know, event, should perhaps be take responsibility and-and push that information home, as well (Swimmer 13).
	<b>Audience</b>		Who will the information be targeted to?	I think trying to get that message over, um, for children would help, and then as the generations move through it would be the norm then...instead of just the odd person (Pool Operator 6).
	<b>Frequency</b>		How frequent should the 'intervention be conducted?	Yeah, I think so, because if I read a leaflet a year and a half ago I wouldn't, you know, think about that now...Um, so obviously if there new-- are like maybe newsletters almost like monthly about it...I think it'd be really good for everyone (Swimmer 10).
<b>Credibility and Trust</b>	<b>Source of the information</b>		Having the support of the swimming facility, including their logo would help increase credibility and trust.	Um, sometimes being like a friendly leaflet from your local pool might not be enough...It might need like the authority behind it from the government or the council...So maybe the government or council would be like a good like backing...behind it (Swimmer 10).

Appendix 2l: Main themes in relation to the Socio-Ecological Model

*Theme 1, Influences on Hygienic Swimming Behaviours*

<b>Theme 1</b>	<b>Influences on Hygienic Swimming Behaviours</b>		
<i>Sub-theme:</i>	<i>Category:</i>	<i>Socio-Ecological Model Level:</i>	
Internal Influences	Current Awareness	Intrapersonal	An individual's current awareness.
	Habits / Routines	Intrapersonal	Current habits/routine about hygienic swimming behaviours i.e. whether a swimmer takes off their make up before entering the swimming pool. but these can also be influenced from parental / peer beliefs.
	Beliefs	Intrapersonal	To shower or not is a practice / belief of an individual
External Influences	Parental / peer influence	Interpersonal	The influence of parents on their children as to whether they shower before swimming.
	Culture / Social Norms	Community	For example, whether showering is the social norm within the swimming community.
	Current Educational Materials	Organisational	Whether educational materials are available to swimming pool users to make them aware.

*Theme 2, Design of Swimming Facility*

<b>Theme 2</b>	<b>Design of Swimming Facility</b>		
<i>Sub-theme:</i>	<i>Category:</i>	<i>Socio-Ecological Model Level:</i>	
	Convenience	Organisational / Public Policy	The design can be influenced on the organisational level, i.e. where the pre-swim showers are located, while also be influenced at the policy level as the design of swimming pools, i.e. why were the pre-swim showers designed to be in that location.
	Accessibility	Organisational / Public Policy	As above.
	Cleanliness	Organisational	Swimming pool operators have a responsibility to ensure the swimming facility, including toilets and wash basins are kept clean. This code refers to cleanliness of the changing facilities rather than the cleanliness of the swimming pool water itself, therefore organisational influence.

*Theme 3, Education for Swimming Pool Users*

<b>Theme 3</b>	<b>Education for Swimming Pool Users</b>		
<i>Sub-theme:</i>	<i>Category:</i>	<i>Socio-Ecological Model Level:</i>	
Raising awareness	Content	Intrapersonal	What type of messages people think are important.
	Cryptosporidium vs general message	Intrapersonal	Whether swimmers feel like they need to know the specifics around cryptosporidium or a more general message.
	Types of intervention	Organisational	What types of interventions that can be provided by facilities to influence their behaviours?
	Means of delivery	Organisational	The ways in which interventions can be delivered to swimming pool users by facilities.
	Audience	Organisational	There is a vast population who use swimming pools and should include staff education. (Does cross over in intrapersonal factors too).
	Frequency	Organisational	The frequency at which the information will be provided to individuals will depend on the motivation of the swimming facility. (Does cross over in intrapersonal factors too).
Credibility and Trust	Source of the information	Public Policy	Providing information from recognisable sources may be more influential on behaviour. (Does cross over in interpersonal factors too).

Appendix 3a: Questionnaire

## Hygienic Swimming Behaviours Research Study



Hannah Jones  
[REDACTED]

Please read the Participant Information Sheet before completing the questionnaire. The purpose of this research is to find out how swimmers / parents of swimmers would like to receive information about how to keep the swimming pool water clean and healthy. It is not envisaged that this questionnaire will cause you any distress and it is up to you whether you want to take part or not. The survey will close on the 30<sup>th</sup> of September 2018.

The questionnaire should take you no longer than 10 minutes to complete. You must be over 18 years old to take part.

Please return your completed questionnaires to the box at reception.

## Participant Consent Form

	Participant initials
1. I (the participant) confirm that I have read and understand the information sheet for the above study (dated 1st of August 2018 to 30th of September 2018) which is attached to this form.	
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reasons.	
3. I understand what my role will be in this research, and all my questions have been answered to my satisfaction.	
4. I understand that I am free to ask any questions at any time before and during the study.	
5. I have been informed that the information I provide will be safeguarded.	
6. I am happy for the information I provide to be used (anonymously) in academic papers and other formal research outputs.	

Thank you for your participation in this study. Your help is very much appreciated. This study is being conducted by Swansea University, College of Human and Health Science.

# Hygienic Swimming Behaviours Questionnaire

## Please note:

You can withdraw from the study at any time without penalty, up until the data has been published in the PhD thesis or academic papers. To do this please enter a six-digit code in the box below and keep it safe.

You will need this code when contacting the researcher to withdraw from the study to ensure anonymity:

## About your swimming

### 1. Do you go swimming?

Yes

No

If you answered **Yes** to question 1, please go to question 2.

If you answered **No** to question 1, please skip to question 4 on page 2.

### 2. How often do you go swimming on average?

More than 3 times a week

1-2 times a week

Once every 2 weeks

Once a month

Less than once a month

### 3. Please provide the name of the swimming pool you usually go to.

About taking children swimming

**4. Do you take children swimming either yourself or through swimming lessons?**

Yes

No

*If you answered **Yes** to question 4, please go to question 5.*

*If you answered **No** to question 4, please skip to question 8 on page 3.*

**5. Are any of the children under 5 years of age?**

Yes

No

**6. On average, how often would the child(ren) go swimming?**

More than 3 times a week

1-2 times a week

Once every 2 weeks

Once a month

Less than once a month

**7. Please provide the name of the swimming pool where you usually take children swimming either yourself or for swimming lessons.**

*About keeping the pool water clean and healthy*

**8. Do you know what you can do as a swimmer or parent of a swimmer to help keep the pool water clean and healthy?**

- Yes
- No

**9. Have you noticed any information at the swimming pool you usually go to about how you can help keep the pool water clean and healthy?**

- Yes
- No

**10. How much do you agree or disagree with the following statement?**

**"It is important for swimming pools to let everyone know what they can do to help keep the pool water clean and healthy."**

- Strongly Agree
- Agree
- Neither Agree nor Disagree
- Disagree
- Strongly Disagree

*About showering*

**11. When do you shower at the swimming pool?**

- Before swimming
- After swimming
- Before and after swimming
- I don't shower

**12. Have you noticed any information at the swimming pool you usually go to about showering before going swimming?**

- Yes
- No



About getting information

13. Please rank the following options from your most (top) to least (bottom) preferred method of receiving information from the swimming pool about how you can help keep the pool water clean and healthy.

1 being your most (top) preferred choice and 6 being your least (bottom) preferred choice.

- Leaflets at reception
- Posters / Signs on changing room walls
- Posters / Signs on the back of toilet doors
- Video / Posts on the swimming pools' social media pages
- Video / Posts on the swimming pools' website
- Video on TV screens in reception


14. Is there any other way that you would like to receive information from the swimming pool about how you can help keep the pool water clean and healthy?

15. Is there anything else you think is important in relation to keeping the swimming pool water clean and healthy?

About you

16. How old are you?

- 18-24     25-34     35-44     45-54     55-64     65-74     75+

17. What is your gender?

- Male  
 Female  
 Prefer not to say

*This is the end of the questionnaire.*

Thank you for taking the time to complete this questionnaire.  
If you would like more information about hygienic swimming behaviours, visit this link <https://www.cdc.gov/healthywater/swimming/index.html> or contact Hannah Jones using the following email address, [REDACTED]

## PARTICIPANT INFORMATION SHEET

# Hygienic Swimming Behaviours Research Study

You are being invited to take part in some research. Before you decide whether or not to participate, it is important for you to understand why the research is being conducted and what it will involve. Please read the following information carefully.

### **What is the purpose of the research?**

We are conducting research on Hygienic Swimming Behaviours. You have been invited to take part in a confidential, questionnaire as part of a PhD research study to find how swimmers / parents of swimmers (and you are over 18 years old) would like to receive information about how to keep the swimming pool water clean and healthy. The purpose of the study is to develop a intervention to raise awareness of hygienic swimming behaviours to keep swimmers healthy. Your participation in this study will take approximately 10 minutes.

### **Who is carrying out the research?**

The data are being collected by Hannah Jones, Department of Public Health, Policy, and Social Sciences within the College of Human and Health Sciences at Swansea university. The research has been approved by the College of Human and Health Sciences Research Ethics Committee.

### **What happens if I agree to take part?**

You are asked to complete a short questionnaire about ways you think it's best to receive health information. It should take no longer than 10 minutes to complete. A consent form will be provided for you to initial if you are happy to take part. You will not be asked your name or address on the questionnaire, only your age and sex. The information you provide will be kept confidential and questionnaires / consent forms will be stored securely.

### **Are there any risks associated with taking part?**

The research has been approved by the College of Human and Health Sciences Research Ethics Committee. There are no significant risks associated with participation.

## **Data Protection and Confidentiality**

Your data will be processed in accordance with the Data Protection Act 2018 and the General Data Protection Regulation 2016 (GDPR). All information collected about you will be kept strictly confidential. Your data will only be viewed by the researcher/research team. All electronic data will be stored on a password-protected computer file at Swansea University. All paper records will be stored in a locked filing cabinet at Swansea University.

Please note that if data is being collected online, once the data has been submitted online you will be unable to withdraw your information unless you provide a unique code which you will need to provide at the start of the questionnaire.

### **What will happen to the information I provide?**

An analysis of the information will form part of our report at the end of the study and may be presented to interested parties and published in scientific journals and related media. *Note that all information presented in any reports or publications will be anonymous and unidentifiable.*

### **Is participation voluntary and what if I wish to later withdraw?**

Your participation is entirely voluntary – you do not have to participate if you do not want to. If you decide to participate, but later wish to withdraw from the study, then you are free to withdraw at any time, without giving a reason and without penalty.

## **Data Protection Privacy Notice**

The data controller for this project will be Swansea University. The University Data Protection Officer provides oversight of university activities involving the processing of personal data, and can be contacted at the Vice Chancellors Office.

Your personal data will be processed for the purposes outlined in this information sheet.

Standard ethical procedures will involve you providing your consent to participate in this study by completing the consent form that has been provided to you. [\[REDACTED\]](#)

The legal basis that we will rely on to process your personal data will be processing is necessary for the performance of a task carried out in the public interest. This public interest justification is approved by the College of Human and Health Sciences Research Ethics Committee, Swansea University.

The legal basis that we will rely on to process special categories of data will be processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes.

### **How long will your information be held?**

Data will be destroyed after 5 years when publications and all outputs from the study have been completed. You will not be asked to provide any personal data.

### **What are your rights?**

Please visit the University Data Protection webpages for further information in relation to your rights.

Any requests or objections should be made in writing to the University Data Protection Officer:-

University Compliance Officer (FOI/DP)

Vice-Chancellor's Office

Swansea University

Singleton Park

Swansea

SA2 8PP

Email: [dataprotection@swansea.ac.uk](mailto:dataprotection@swansea.ac.uk)

### **How to make a complaint**

If you are unhappy with the way in which your personal data has been processed you may in the first instance contact the University Data Protection Officer using the contact details above.

If you remain dissatisfied then you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at: -

Information Commissioner's Office,

Wycliffe House,

Water Lane,

Wilmslow,

Cheshire,

SK9 5AF

[www.ico.org.uk](http://www.ico.org.uk)

**What if I have other questions?**

If you have further questions about this study, please do not hesitate to contact us:

Hannah Jones

College of Human and Health Sciences

Swansea University

████████████████████ [k](#)

Professor Jaynie Rance

College of Human and Health Sciences

Swansea University

████████████████████

## Are you interested in taking part in a study looking at hygienic swimming behaviours?

### What?

If you're a swimmer or a parent of a swimmer, you're over 18 years old, and want to take part, fill in a questionnaire which is available at reception or use this link

[https://swanseachhs.eu.qualtrics.com/jfe/form/SV\\_bKRlxyOpwSBYscJ](https://swanseachhs.eu.qualtrics.com/jfe/form/SV_bKRlxyOpwSBYscJ)

or the QR code below to access the online version.



### Why?

To understand how swimmers / parents of swimmers would like to receive information about how they can help to keep the swimming pool water clean and healthy. This will then help develop a campaign to raise awareness of hygienic swimming behaviours.

### For more information:


If you want to find out more about taking part in this study, or have any questions about the research, please email Hannah Jones, PhD Student at Swansea University:



This study has been approved by the Human and Health Sciences Ethics Committee, Swansea University.

Appendix 3d: Recruitment card

***Hygienic Swimming Behaviours  
Research Study***

  
Prifysgol Abertawe  
Swansea University

**We're looking for swimmers or parents of swimmers, who are over 18 years old, to complete a short survey about keeping the swimming pool water clean and healthy.**


Use the QR code on the back of this card to take part.

Hannah Jones  
[Redacted]

---

**Use this QR code to access the survey:**

1. Open the camera or QR reader on your smartphone.
2. Line up the QR code in the camera frame.
3. Click on the link that pops up.



Appendix 3e: Ethical approval

Dear Hannah,

Ref: 210518c

Many thanks for your comprehensive answer and attachment in response to my queries. I am now able to give you ethical approval for your research. May I wish you good luck with the study.

Best wishes,

**Angela Smith**

**Lecturer in Health Care Law and Ethics | Darlithydd mewn Cyfraith Gofal Iechyd a Moeseg**

**Chair, CHHS Ethics Committee**

**[www.swansea.ac.uk/humanandhealthsciences/research/research-ethics-committee](http://www.swansea.ac.uk/humanandhealthsciences/research/research-ethics-committee)**

**College of Human and Health Sciences | Coleg y Gwyddorau Dynol ac Iechyd**

Singleton Park | Parc Singleton

Swansea | Abertawe

Wales | Cymru

SA2 8PP

Room 700 Vivian Tower | Ystafell 700, Vivian

Swansea University | Prifysgol Abertawe

**Phone | Ffôn Ext.** [REDACTED]

**Email | Epost** [REDACTED]



Appendix 4a: 'A Healthy Swimmer Is A Happy Swimmer' Poster

English Version

# A HEALTHY SWIMMER IS A HAPPY SWIMMER...

**Prifysgol Abertawe**  
Abertawe University

**GIG NHS** | Iechyd Cyhoeddus  
Wales | Cyhoeddus  
PUBLIC HEALTH  
Wales

If you've had a poorly tummy, and your poos are rather runny, please don't use our pool, wait 48 hours, that's the rule.

A proper swim nappy keeps everyone happy!

Before swimming have a shower, to give chlorine more germ-killing power!

Before swimming use the loo, and make sure to wash your hands too!

If there's any 'poo in the pool', let the staff know and stay cool!

If you need a number 1 or 2, get out and use the loo!

**FOLLOW THESE SIMPLE STEPS SO THAT EVERYONE HAS A CLEAN AND HEALTHY SWIM!**

For more information, visit this link: <https://youtu.be/iIM3-kkFjXk> or scan the QR code

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# NOFIWR HAPUS YW NOFIWR IACH...

Prifysgol Abertawe  
Swansea University

GIG  
CYMRU  
NHS  
WALES | Iechyd Cyhoeddus  
Cymru  
Public Health  
Wales



Mae cewyn nofio priodol,  
yn wir yn anghenrheidiol!

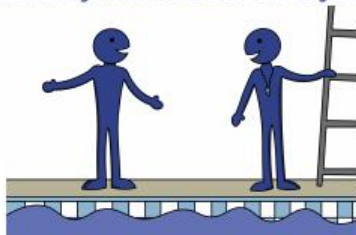


Ewch am gawod cyn nofio,  
peidiwch anghofio!



Ewch i'r tŷ bach cyn i chi nofio  
a golchwch eich dwylo,  
peidiwch anghofio!

Os gwelwch chi faw yn y dŵr,  
rhowch wybod i'r staff i fod yn siŵr!



Croesi'ch coesau?  
Rhif un neu rif dau?  
Ewch allan o'r pwll,  
i'r tŷ bach yn glou!

**DILYNWCH Y CAMAU HYN FEL BOD PAWB YN CAEL NOFIAD GLÂN AC IACH!**

Am fwy o wybodaeth, ewch i: <https://youtu.be/fBjXvK-6VIU> neu sganiwch y c6d QR

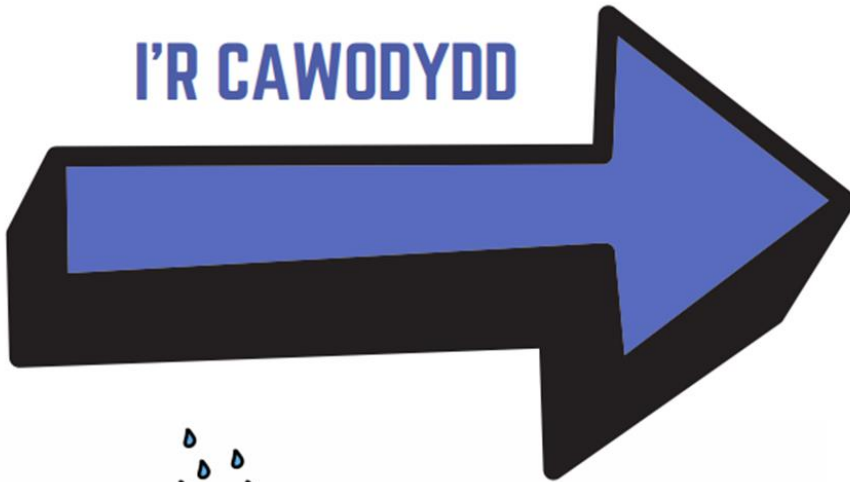


Appendix 4b: Shower signage

English Version



**I'R CAWODYDD**



**Ewch am gawod  
cyn nofio,  
peidiwch anghofio!**

## Appendix 4c: Public Health Wales Approval

Chris – can you supply Hannah with the appropriate logo and advise on usage.

I've agreed she can use the logo on her posters.

Thanks,  
Leah

### **Leah Morantz**

Pennaeth Cyfathrebu, y Tîm Cyfathrebu, Iechyd Cyhoeddus Cymru, Llawr 3, Rhif 2 Capital Quarter, Stryd Tyndall, Caerdydd CF10 4BZ  
Head of Communications, Public Health Wales, Communications Team, Floor 3, Number 2 Capital Quarter, Tyndall Street, Cardiff CF10 4BZ

Ffon/Tel: [REDACTED] WHTN: 01899 4728

Ebost/Email: [Leah.morantz@wales.nhs.uk](mailto:Leah.morantz@wales.nhs.uk)

Rhyngwrwyd/Internet: [www.iechydcyhoedduscymru.org](http://www.iechydcyhoedduscymru.org) / [www.publichealthwales.org](http://www.publichealthwales.org)

Mewnrwyd/Intranet: [www.publichealthwales.wales.nhs.uk](http://www.publichealthwales.wales.nhs.uk)

Twitter: @IechydCyhoeddus / @PublicHealthW

Facebook: Iechyd Cyhoeddus Cymru / Public Health Wales

Rydym yn croesawu gohebiaeth yn y Gymraeg neu'r Saesneg

We welcome correspondence in Welsh or English



Hi Hannah,

Thanks for these, please find attached the Public Health Wales logo as requested.

Please maintain the aspect ratio of the image so that it isn't stretched or contorted in any way, and please maintain a border around the logo that is half the height of the logo when used. i.e if the logo as used is 10mm tall, use a border of 5mm all the way around the logo.



If I might make one minor observation on the design of the posters as well... perhaps you could consider changing the font used in the descriptors on the first poster to match the font used on the headings and in the later posters to maintain a consistent design across all the posters. A consistent font will help people make the mental connection between posters which will help reinforce the messaging across all the posters.

I hope this is of some help, if I can be of any assistance, don't hesitate to get in touch.

Best wishes,  
Chris.

**Chris Jones**

Cyflwynydd Cyfathrebiadau, Iechyd Cyhoeddus Cymru, Llawr 3, Rhif 2 Capital Quarter, Stryd Tyndall, Caerdydd CF10 4BZ.

# Hygienic Swimming Behaviours Research Study Questionnaire



Prifysgol Abertawe  
Swansea University

Hannah Jones  
[REDACTED]

Please read the Participant Information Sheet before completing the questionnaire. The purpose of this research is to get feedback on the poster 'A Healthy Swimmer Is A Happy Swimmer'. The poster aims to raise awareness of hygienic swimming behaviours.

The questionnaire should take you no longer than 5 minutes to complete.

You must be over 18 years old to take part.

It is not envisaged that this questionnaire will cause you any distress and it is up to you whether you want to take part or not.

The survey will close on the 31<sup>st</sup> of July 2019. Please return your completed questionnaires to reception.

## Participant Consent Form

	Participant initials
11 (the participant) confirm that I have read and understand the information sheet for the above study (dated 1 <sup>st</sup> of June to the 31 <sup>st</sup> of July 2019) which is attached to this form.	
7. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reasons.	
8. I understand what my role will be in this research, and all my questions have been answered to my satisfaction.	
9. I understand that I am free to ask any questions at any time before and during the study.	
10. I have been informed that the information I provide will be safeguarded.	
11. I am happy for the information I provide to be used (anonymously) in academic papers and other formal research outputs.	

Please note:

*If you decide to participate, but later wish to withdraw from the study, then you are free to withdraw at any time, without giving a reason and without penalty, up until the 31st of October 2019.*

*To do this please enter a six-digit code in the box, you will need this code when contacting the researcher to withdraw from the study to ensure anonymity:*

**Thank you for your participation in this study. Your help is very much appreciated. This study is being conducted by Hannah Jones, PhD student at the College of Human and Health Science, Swansea University.**

## Feedback on the poster 'A Healthy Swimmer Is A Happy Swimmer'

**1. Have you seen a poster called 'A Healthy Swimmer Is A Happy Swimmer', showing you how to have a clean and healthy swim?**

Yes       No

*If you answered **Yes** go to question 2.*

*If you answered **No** go to question 9 on page 3.*

**2. Where did you see the poster? Please tick all that apply.**

Reception       Changing Room       Website  
 Social Media       Other (Please specify) \_\_\_\_\_

**3. Is the poster easy to read?**

Yes       No

**4. Did you know the information about hygienic swimming behaviours before reading the poster?**

Yes       No

**5. Has the poster encouraged you to think about your own hygienic swimming behaviours?**

Yes       No

**6. After seeing the poster, how likely are you to do any of the following?**

	Very Likely	Likely	Unlikely	Very Unlikely
Shower <b>BEFORE</b> swimming.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Avoid swimming if ill with sickness or diarrhoea.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Avoid coming back swimming for 48 hours after symptoms have stopped.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tell a member of staff if there is any 'Poo in the Pool'.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



7. Please share with us any comments which you might have about the poster:

8. Do you have any other comments?

About you

9. How old are you?

- 18-24     25-34     35-44     45-54     55-64     65-74     75+

10. What is your gender?

- Male     Female     Trans\* male     Trans\* female
- Gender non-binary     Self-Defined (please state)\_\_\_\_\_

11. Are you a Swimmer, Parent of a Swimmer, or both a Swimmer and a Parent of a Swimmer?

*Please circle the one that applies to you.*

12. Please provide the name of the swimming pool you (or your child) usually go to.

*This is the end of the questionnaire.*

Thank you for taking the time to complete this questionnaire.  
If you would like more information about hygienic swimming behaviours, visit this link  
<https://www.cdc.gov/healthywater/swimming/index.html>  
or contact Hannah Jones using the following email address, [REDACTED]



## **PARTICIPANT INFORMATION SHEET**

### *Hygienic Swimming Behaviours Research Study*

You are being invited to take part in some research. Before you decide whether or not to participate, it is important for you to understand why the research is being conducted and what it will involve. Please read the following information carefully.

#### **What is the purpose of the research?**

We are conducting research on Hygienic Swimming Behaviours. You have been invited to take part in a confidential questionnaire, as part of a PhD research study, to get feedback on a poster designed to raise awareness on how to help keep the swimming pool water clean and healthy. The purpose of the study is to evaluate the intervention to raise awareness of hygienic swimming behaviours to keep swimmers healthy. Your participation in this study will take approximately 5 minutes. You must be over 18 years old to take part.

#### **Who is carrying out the research?**

The data are being collected by Hannah Jones, Department of Public Health, Policy, and Social Sciences within the College of Human and Health Sciences at Swansea University. The research has been approved by the College of Human and Health Sciences Research Ethics Committee.

#### **What happens if I agree to take part?**

You are asked to complete a short questionnaire about a poster you might have seen in the swimming pool. It should take no longer than 5 minutes to complete. A consent form is provided at the start of the questionnaire for you to initial, if you are happy to take part. You will not be asked your name or address on the questionnaire, only your age and gender. The information you provide will be kept confidential and questionnaires / consent forms will be stored securely.

#### **Are there any risks associated with taking part?**

The research has been approved by the College of Human and Health Sciences Research Ethics Committee. There are no significant risks associated with participation.

#### **Data Protection and Confidentiality**

Your data will be processed in accordance with the Data Protection Act 2018 and the General Data Protection Regulation 2016 (GDPR). All information collected about you will be kept strictly confidential. Your data will only be viewed by the researcher/research team. All electronic data will be stored on a password-protected computer file at Swansea University. All paper records will be stored in a locked filing cabinet at Swansea University.

Please note that if data is being collected online, once the data has been submitted online you will be unable to withdraw your information unless you provide a unique code which you will need to provide at the start of the questionnaire.

#### **What will happen to the information I provide?**

An analysis of the information will form part of our report at the end of the study and may be presented to interested parties and published in scientific journals and related media. *Note that all information presented in any reports or publications will be anonymous and unidentifiable.*

#### **Is participation voluntary and what if I wish to later withdraw?**

Your participation is entirely voluntary – you do not have to participate if you do not want to. If you decide to participate, but later wish to withdraw from the study, then you are free to withdraw at any time, without giving a reason and without penalty up until the 31st of October 2019. To be able to withdraw, you will need to enter a six-digit code in the box at the beginning of the questionnaire. You will need this code when contacting the researcher to withdraw from the study to ensure anonymity.

#### **Data Protection Privacy Notice**

The data controller for this project will be Swansea University. The University Data Protection Officer provides oversight of university activities involving the processing of personal data, and can be contacted at the Vice Chancellors Office.

Your personal data will be processed for the purposes outlined in this information sheet.

Standard ethical procedures will involve you providing your consent to participate in this study by completing the consent form that has been provided to you. □□□□□□

The legal basis that we will rely on to process your personal data will be processing is necessary for the performance of a task carried out in the public interest. This public interest justification is approved by the College of Human and Health Sciences Research Ethics Committee, Swansea University.

The legal basis that we will rely on to process special categories of data will be processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes.

#### **How long will your information be held?**

Data will be preserved and accessible **for a minimum of 10 years after completion of the research**. Records from studies with major health, clinical, social, environmental or heritage importance, novel intervention, or studies which are on-going or controversial should be retained for at least 20 years after completion of the study. It may be appropriate to keep such study data permanently within the university, a national collection, or as required by the funder's data policy.

### **What are your rights?**

Please visit the University Data Protection webpages for further information in relation to your rights.

Any requests or objections should be made in writing to the University Data Protection Officer:-

University Compliance Officer (FOI/DP)  
Vice-Chancellor's Office  
Swansea University  
Singleton Park  
Swansea  
SA2 8PP  
Email: [dataprotection@swansea.ac.uk](mailto:dataprotection@swansea.ac.uk)

### **How to make a complaint**

If you are unhappy with the way in which your personal data has been processed you may in the first instance contact the University Data Protection Officer using the contact details above.

If you remain dissatisfied then you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at: -

Information Commissioner's Office,  
Wycliffe House,  
Water Lane,  
Wilmslow,  
Cheshire,  
SK9 5AF  
[www.ico.org.uk](http://www.ico.org.uk)

### **What if I have other questions?**

If you have further questions about this study, please do not hesitate to contact us:

Hannah Jones  
College of Human and Health Sciences  
Swansea University  
[REDACTED]

Professor Jaynie Rance  
College of Human and Health Sciences  
Swansea University  
[REDACTED]

## Are you interested in taking part in a study looking at hygienic swimming behaviours?

### What?

If you're a swimmer or a parent of a swimmer, you're over 18 years old, and want to take part, fill in a questionnaire using this link [https://swanseachhs.eu.qualtrics.com/jfe/form/SV\\_bKRIxyOpwSBYscJ](https://swanseachhs.eu.qualtrics.com/jfe/form/SV_bKRIxyOpwSBYscJ) or the QR code below to access the online version.



### Why?

The purpose of this research is to get feedback on the poster 'A Healthy Swimmer, Is A Happy Swimmer'. The poster aims to raise awareness of hygienic swimming behaviours.

### For more information:

If you want to find out more about taking part in this study, or have any questions about the research, please email Hannah Jones, PhD Student at Swansea University:


[REDACTED]



This study has been approved by the Human and Health Sciences Ethics Committee, Swansea University.

Appendix 4g: Recruitment card

*Hygienic Swimming Behaviours  
Research Study*

  
Prifysgol Abertawe  
Swansea University


**We're looking for swimmers or parents of swimmers, who are over 18 years old, to complete a short questionnaire about keeping the swimming pool water clean and healthy.**

Use the QR code on the back of this card to take part.

Hannah Jones  
[REDACTED]

**Use this QR code to access the questionnaire:**

1. Open the camera or QR code reader.
2. Line up the QR code in the camera frame.
3. Click on the link that pops up.



Appendix 4h: Ethical approval

Dear Hannah,

Ethics application: 290419c

Many thanks for your comprehensive answer and attachment in response to my queries. I am now able to give you ethical approval for your research. May I wish you good luck with the study.

Best wishes,

**Angela Smith**

**Senior Lecturer in Health Care Law and Ethics | Uwch Ddarlithydd mewn Cyfraith Gofal Iechyd a Moeseg**

**Chair, CHHS Ethics Committee**

<https://www.swansea.ac.uk/humanandhealthsciences/research-at-the-college-of-human-and-health/research-ethics-committee/>

**College of Human and Health Sciences** | Coleg y Gwyddorau Dynol ac Iechyd

Singleton Park | Parc Singleton

Swansea | Abertawe

Wales | Cymru

SA2 8PP

Room 700 Vivian Tower | Ystafell 702, Vivian

Swansea University | Prifysgol Abertawe

**Phone | Ffôn Ext.** [REDACTED]

**Email | Ebst** [REDACTED]

## Appendix 5: Conference communications

Cryptosporidiosis 2018: an essential update on the risk from recreational waters, drinking water and food, London

March, 2018

Oral presentation of findings from the first phase of the study

Three Minute Thesis, Swansea

March, 2018

Oral presentation of findings from the first phase of the study

College of Human and Health Sciences Conference, Swansea

June, 2018

Oral presentation of findings from the first phase of the study

What is the future of water and public health, Sheffield

December, 2018

Poster presentation of findings from the first and second phase of the study, in addition to an oral presentation

Pint Of Science Event, Swansea

May, 2019

Oral presentation of findings from all three phases of the study, including the display of the poster intervention and video developed

Soapbox Science Event, Swansea

June, 2019

Oral presentation of findings from all three phases of the study, including the display of the poster intervention, in addition to interaction with members of the public