



Toh, Li Shean and Lai, P.S.M. and Othman, S. and Wong, K.T. and Low, B.Y. and Anderson, CLaire (2017) An analysis of inter-professional collaboration in osteoporosis screening at a primary care level using the D'Amour model. *Research in Social and Administrative Pharmacy*, 13 (6). pp. 1142-1150. ISSN 1934-8150

Access from the University of Nottingham repository:

<http://eprints.nottingham.ac.uk/46767/1/Li%20Shean%20RSAP%20BCW%20v2.pdf>

Copyright and reuse:

The Nottingham ePrints service makes this work by researchers of the University of Nottingham available open access under the following conditions.

This article is made available under the Creative Commons Attribution Non-commercial No Derivatives licence and may be reused according to the conditions of the licence. For more details see: <http://creativecommons.org/licenses/by-nc-nd/2.5/>

A note on versions:

The version presented here may differ from the published version or from the version of record. If you wish to cite this item you are advised to consult the publisher's version. Please see the repository url above for details on accessing the published version and note that access may require a subscription.

For more information, please contact eprints@nottingham.ac.uk

The development of a pharmacist-led osteoporosis screening program using the behavioural change wheel

Toh L.S^{a,b}, Lai P.S.M^c, Othman S^c, Shah A^a, Dang C.P.L.^a, Low B.Y^b, Wong K.T^b, Anderson C^{d*}

^aDivision of Pharmacy, School of Medicine, University of Tasmania, Sandy Bay campus, Pharmacy Building, Churchill Avenue 7005, Australia

^bSchool of Pharmacy, University of Nottingham, Jalan Broga, 43500 Semenyih, Selangor, Malaysia

^cDepartment of Primary Care Medicine, University of Malaya Primary Care Research Group (UMPCRG), Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia

^dDivision of Pharmacy practice and Policy, School of Pharmacy, University of Nottingham, NG7 2RD, UK

*Corresponding author: Claire.Anderson@nottingham.ac.uk

Acknowledgement: Ministry of Science, Technology and Innovation (MOSTI) fund (06-02-12-SF0183)

Conflict of interest: None

Abstract

Objective: To develop a pharmacist-led osteoporosis screening intervention based on interviews with stakeholders.

Methods: Nurses(n=10), pharmacists(n=11), doctors(n=10), patients(n=20) and policy makers(n=5) from a primary care clinic in Malaysia, were individually interviewed using a semi-structured topic guide. Purposive sampling was used to ensure a maximum variation sample. Interviews were transcribed verbatim and analysed using thematic analysis. The themes which emerged within each group were similar and the analysis of all the stakeholders were combined. The behavioural change wheel (BCW) was used as it draws on relevant theories to guide the selection of interventions that are most likely to be effective.

Results: Several barriers were identified: governmental, organisational, work environment, team, individual, tasks and patient factors. We decided to develop our intervention based on

patient factors as these directly influence practice and outcomes. The main patient factor was their nonchalant attitude towards osteoporosis, it was perceived to be a non-life threatening disease. Hence, our intervention consisted of: an assessment of patients' osteoporosis risk by the pharmacist whilst the patients are waiting for the doctor's appointment, an education session, and restructuring of the current practice which incorporates this intervention into daily clinic practice. Subsequently, a recommendation to the doctor was made for a bone mineral density scan when necessary.

Conclusions: This is the first study to use the Behaviour Change Wheel study to develop an osteoporosis screening intervention. The BCW assisted the development of a pharmacist-led osteoporosis screening intervention. This intervention will be evaluated for its feasibility in a future study

Keywords: osteoporosis, screening, pharmacist, behavioural change wheel, primary care, qualitative

Introduction

Osteoporosis is known as the 'silent disease' due to its asymptomatic nature. The end result of osteoporosis is a fragility fracture (1). A fragility fracture is a low trauma fracture or a fracture that would not have normally occurred at a standing height. Due to the disease's asymptomatic nature, patients who have osteoporosis may not know they have osteoporosis until a fracture has occurred. These fragility fractures are debilitating to both the patient and the economy (1, 2).

Consequences, to the patient includes increase morbidity and mortality (1). A common site for fragility fracture is at the hip and is considered the most serious osteoporosis fracture, most probably necessitates hospitalization (1). Studies have shown that up to 20% of patients die in the first year following a hip fracture and less than half of survivors regain the level of function that they had prior to the hip fracture (3, 4). It has been found that the mortality, morbidity and social burden of hip fractures in Asian countries are similar to those in the West. A Singaporean study has found that after a hip fracture, 20% of patients will die within two years, 33% remain ambulant without aids, 40% are ambulant with aids, and 10% are wheel chair or bed bound (1, 5).

Economically, the disability caused by osteoporosis is comparable or greater than that lost to a variety of chronic non-communicable diseases, such as rheumatoid arthritis, asthma and high blood pressure related heart disease (6). For example, the cost of osteoporosis, including pharmacological intervention in the EU in 2010 was estimated at €37 billion. This includes the costs of treating incident fractures represented 66%, pharmacological prevention 5% and long-term fracture care 29% (7, 8) . The direct hospitalisation cost for hip fractures in Malaysia from year 1997 was estimated at RM22 million (~\$6000 000). This is an underestimate as it does not include the cost incurred in rehabilitation and long term nursing care Therefore, without proper intervention the cost will escalate as the population ages (9).

Although treatment for osteoporosis are available, cost effective, well-tolerated and effective to reduce fracture risk, only approximately 20 percent of women who have an osteoporosis-related fracture receive either a bone mineral density test or a prescription for a drug to treat osteoporosis in the six months after the fracture (10-12). Studies have found that early detection of osteoporosis (screening and prevention) is the most cost-effective ways to reduce the number of hospital admittance due to osteoporotic fractures. (13, 14, 11, 15). Screening and prevention of osteoporosis can be divided to primary and secondary. Primary prevention of osteoporosis is directed at identifying high risk non-osteoporotic individuals, while secondary prevention of osteoporosis refers to the early detection of the disease and prevention of subsequent fragility fracture.

There has been much focus on secondary prevention due to the clarity of its cost effectiveness as compared to primary prevention. In year 2012, the International Osteoporosis Foundation (IOF) launched a campaign called 'Capture the Fracture' (16, 17). The aim of this campaign was to reduce the incidence of secondary fractures throughout the world by the establishment of a new standard of care for fragility fracture sufferers. Healthcare providers were urged to respond to the first fracture to prevent the second and subsequent fractures. It has been found that the most effective way to achieve this is through the implementation of coordinator-based, post fracture models of care. To date various model known as 'Fracture Liaison Services' have been conducted in the United Kingdom (18-22), Europe (23, 24) and Australia (25-27). In Canada these services are called 'Osteoporosis Coordinator Programmes' (28) and in the US it is called the 'Care Manager Programmes' (29). Despite, the considerable progress made in terms of establishment of exemplar services in many countries (16, 17), these services are currently only available in a very small proportion of facilities that receive fracture patient worldwide. These services are also the beginning of inclusion of secondary fracture prevention in national health policy (30-32). However, many governments are yet to create the political framework to support

funding of these new services. Additionally these services only target the population who have had a previous history of fractures. Currently, there is no osteoporosis screening programme or fracture liaison services available in Malaysia.

There is a growing body of literature supporting the roles of pharmacists in osteoporosis (33). Studies conducted in various settings around the globe have shown those pharmacists' interventions improved adherence to osteoporosis medication. Some studies have also reported improvements in both clinical and economic outcome (34-37). Although, most pharmaceutical care services are mainly targeted at treatment of osteoporosis. A further literature search revealed that there are three randomized control trials (RCTs) conducted by community pharmacies in Canada, Australia and US to evaluate the impact of pharmacist's interventions on osteoporosis management (38-40). However, two of these studies were considered biased (41). Nonetheless, all three studies provided attestation that the intervention of pharmacists increased the number of patients that had their BMD tested and calcium intake initiated, indicating that pharmacists may have a role to play in reducing the gap in osteoporosis management (38-40). To date, there is no osteoporosis screening program in Malaysia. Therefore, this study aims to develop a pharmacist-led osteoporosis screening program in Malaysia using the behavioural change wheel. This is also a follow up study of the previously published paper on interprofessional-collaboration in osteoporosis screening (33).

Methods

Design

This was a qualitative study using semi-structured in-depth interviews as it allowed us to explore the barriers and suitable interventions for developing a pharmacist-led osteoporosis screening program. The United Kingdom Medical Research Council (UKMRC) framework for complex intervention was used to guide the process of developing the intervention (42). The behavioural change wheel was the theory used to guide the development of the intervention within the screening program. Ethics approval was obtained from, the University Malaya Medical Centre Ethics Committee (approval number 914.14)

Setting

This study was conducted at the primary care clinics of University Malaya Medical Centre (UMMC), Kuala Lumpur, Malaysia.

Participants and sampling

Patients

Non-osteoporosis postmenopausal women ≥ 50 years of age from the three main ethnic groups (the Malays, Chinese and Indian) in Malaysia was selected using purposive sampling. Exclusion were those not healthy to participate in the study.

Nurses

Purposive sampling was used to select nurses from the primary care with more than one year of working experience in the primary care clinic. Nurses with at least one year of working experience at the primary care was selected to ensure that they had sufficient working experience and understanding of the primary care clinic's processes. Nurses were included in the study as they were involved in patient registration, screening and their medical records. They provided information on the clinic's general workflow. Excluded were nurses from other departments.

Doctors

Similarly, doctors with more than one year of working experience from the primary care clinic were selected via purposive sampling. The doctors were included in the study as they were involved with examining the patients.

Pharmacists

Purposive sampling was also used to select pharmacists. The pharmacists recruited had at least one year of working experience in the outpatient pharmacy. Intern pharmacists were excluded as they were not in a position to make any decisions regarding pharmacy practice. We included pharmacists in our study as we wanted to explore the expansion of the pharmacists' role to include osteoporosis screening.

Policy makers

The definition used for policy makers in this study was individuals who had the authority to influence practice. The Head of Primary Care Department was included as her view represented the management of primary care doctors. The Heads of outpatient pharmacy, pharmacy store, in-patient pharmacy, as well as the chief pharmacists were also included due to their involvement in the development and administration of pharmacy services.

However, there were three policy makers who did not respond to the invitation to participate in this study: the head of nursing, the Chief Executive Officer (CEO) and the deputy CEO.

Instrument used

Baseline demographic form

We collected the patients' medical history, lifestyle and medication history using the baseline demographic form. A different form was used to collect information from the healthcare professionals (nurses, doctors, pharmacists and policy makers) regarding their work experience and level of education.

Topic guide

Three separate topic guides were developed: one for patients, one for healthcare professionals (nurses, pharmacists, doctors) and one for policy makers. These topic guides explored the stakeholder's knowledge, feelings and attitudes towards developing a pharmacist-led osteoporosis-screening program. Literature review and expert panel (consisting of a consultant endocrinologist and four pharmacists with many years of research and clinical experience) discussion were used to develop the topic guide. The topic guide was finalised via a pilot with three individuals (one for each topic guide).

As some interviews were anticipated to be conducted in Malay, the topic guide for patients and healthcare professionals (nurses, pharmacists, doctor) was translated to Malay. A pharmacist who was a native Malay speaker performed the forward translation of the topic guide from English to Malay. Back translation (from Malay to English) was then performed by another pharmacist who was bilingual in both English and Malay. The pharmacists involved in the translation were not participants of this study. An expert panel was used to discuss the differences to finalize the Malay version of the topic guide.

Procedure

Patients were purposively selected to ensure maximum variation. The patients were recruited by the researcher who approached them personally while there were waiting for their doctor's appointment. The researcher screened the medical records to confirm that the patients recruited did not have osteoporosis/osteopenia. A printed participant information

sheet was used to explain the purpose of the study to the participants. Written consent was obtained upon agreement and the baseline demographics data form was filled.

The interviews with the patients commenced from October 2012 to January 2013. The interviews were conducted in quiet location (e.g. conference room, seminar room or an unused doctor's room) that was suitable for an interview within the clinic setting or at their homes. Although there were various locations used for the interview, they were all conducted in an environment that was quiet and private. As such, it is believed that the change in the settings would not have an impact on the quality of the interview itself (and the results).

All interviews were conducted in either English or Malay by a trained researcher. The average interview length was 60 minutes. Interviews were transcribed verbatim. The researcher transcribed the first ten interviews. Undergraduate science students or pharmacist transcribed subsequent interviews. The rigour and trustworthiness of the transcriptions conducted by the research was ensured by allowing another pharmacist who was fluent in both languages to check it. The transcripts performed by the other transcribers were checked by the researcher for accuracy and completeness. All transcripts were offered to all interviewees to check for accuracy but all declined.

Data analysis

Nvivo version 10 for Windows, 2012, QSR International Pty Ltd was used to manage the data. Memos were written at the end of each interview to capture interesting topics raised in the interview.

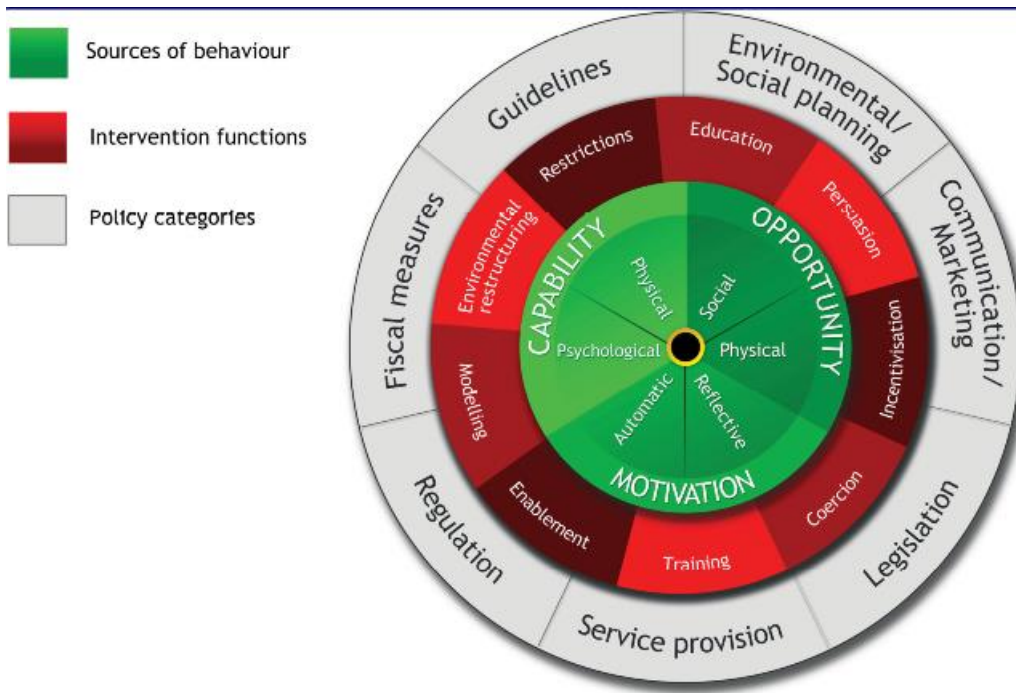
In our study, each stakeholder was analysed separately: patients, pharmacists, nurses, doctors and policy makers were conducted separately. However, the themes which emerged within each group were similar and the analysis of all the stakeholders were combined. A subset of transcripts were reviewed by two other members of the research team for agreement of the codes and themes (LPSM and CA). Data analysis was divided into two phases (data driven and theory driven) to ensure analytical rigor.

Firstly, the data driven analysis was conducted where codes were generated inductively (43, 44). The data driven approach was used to minimize bias when the codes and themes were identified. The coding framework was developed using the identified codes to code subsequent data. This was conducted by analysing each line of the transcript. The whole process was iterative and involved rereading, linking and connecting text to the nodes. A second researcher reviewed the codes and discrepancies were resolved. Next, the codes

were then refocused at a wider level of themes. The 'one sheet of paper' (OSOP) analysis as described by Ziebland and McPherson (2006) was used. The OSOP involved reading through each code and then noting all the themes on a piece of paper and making connections between them (45). The method allowed for the identification of deviant cases that did not fit into the emerging story. The deviant cases were then reanalysed and accounted for in the analysis. Data saturation was reached when no new codes emerged when new participants were recruited into the study.

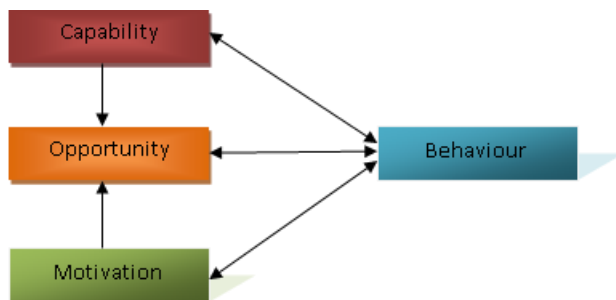
Theory driven approach was employed after the data driven analysis. The analysis was enriched by going back to the literature noting how other research and theories fitted and how it could further enhance the information from the analysis. Additional codes were added if necessary (43, 44). The reason for using this approach is to confirm the themes identified by the data driven approach. The theory applied to our analysis was the behavioural change wheel. The behaviour change wheel (BCW) theory was utilized, as we wanted to develop an intervention to improve implementation of evidence-based health care. The changing of behaviour of the healthcare professionals, policy makers and others working within and with the healthcare system can improve the implementation of a complex intervention such as the osteoporosis screening programme. The BCW is a framework for analyzing target behaviours in the context of the setting and considering the full range of intervention functions and policy categories that may be relevant to the intervention problems [Figure 1] (46)

Figure 1: The behaviour change wheel (46)



The BCW was developed to provide a basis for identifying what it would take to achieve the desired behaviour change in terms of changes to capability, opportunity and motivation. This was called the COM-B system, which made up the core of the BCW [Figure 2]

Figure 2: The COM-B system- a framework for understanding behaviour (46)



The definition of capabilities is an individual's psychological and physical capacity to engage in the activity concerned. It includes having the necessary knowledge and skills. As for opportunity, it is defined as all factors that lie outside the individual that make the behaviour possible or prompt it. There were two types, physical opportunity and social opportunity. Motivation is further distinguished from the reflective processes (involving evaluations and plans) and automatic processes (involving emotions and impulses that arise from associative learning and/or innate disposition). In Figure 2, the double arrows represent potential influence between the components of the system.

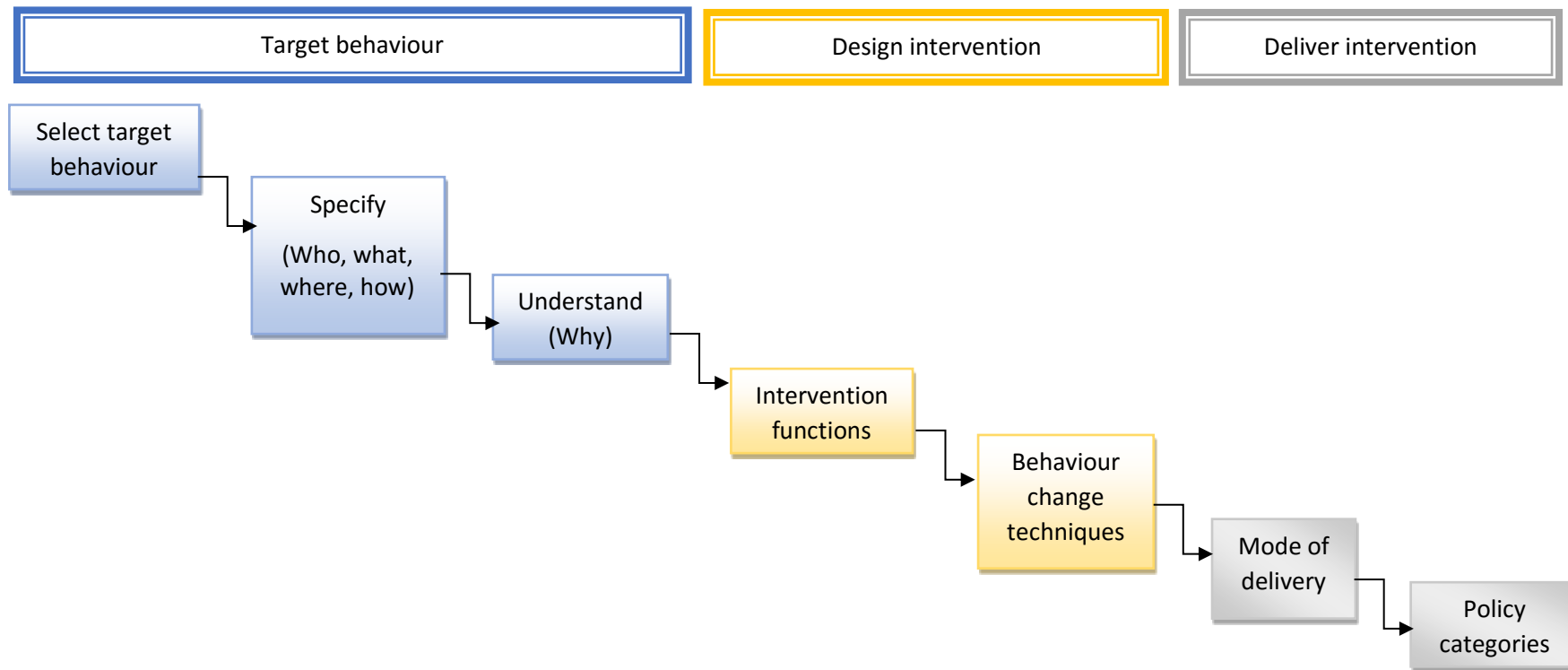
The COM-B model then links this to nine intervention functions in the BCW (education, persuasion, incentivisation, coercion, training, restriction, environmental restructuring, modelling and enablement) and seven types of policy that could be used to implement these intervention functions (mass-media/marketing legislation, fiscal policy, service provision, guideline development, regulation and environmental/social planning). It forms the basis of a systematic analysis of how to make the selection of intervention and policies. Therefore, this assists in selecting the intervention function or functions most likely to be effective in changing the target behaviour.

The intervention strategy can then be provisionally established and specific types of behaviour change technique can be selected, guided by evidence, theory and practicalities to deliver the intervention. We then need to select the type of behaviour change technique (BCT) with the guidance of the intervention function. Michie et al (2013) developed a taxonomy of 93 behaviours changed techniques on 16 clusters. We then selected the appropriate BCT based on the intervention function (47).

The authors recommend to start by understanding the problem, identifying key specific behaviours (often several) by asking questions of who needs to do what differently, when, where and how. Behavioural change can occur at different levels in healthcare such as with patients, with healthcare professional and at an organisational level. Next they recommended understanding the behaviours in the context whereby the COM-B model can be used to answer questions such as why the behaviours are as they are and what needs to change for the desired behaviour to occur (46). Subsequently the developers need to consider the full range of possible intervention using the behaviour change wheel to select broad categories of intervention type. Then identify specific behaviour change techniques that can be selected to achieve the behaviour change (46).

The developers then need to decide on the mode of delivery which could be face-to-face (individually/group) or distance (population level using media or individually tailored such as phone calls). Additionally, when selecting an intervention, mode of delivery and policy categories, issues such as evidence of effectiveness, local relevance, practicability, affordability and acceptability (public, professional and political) should be considered. Figure 2.7 summarizes this process. This model is well tested and has been shown to be useful in evaluating the 2010 English government tobacco control strategy and the National Institute for Health and Care Excellence (NICE) obesity guideline. Therefore, we decided that this is the most suitable theory to use to develop the pharmacists-led osteoporosis screening programme (46).

Figure 3: Summary of approach to developing behaviour change intervention



Results

Fifty-six participants were interviewed patients=20, nurses=10, pharmacists=11, doctors=10 and policymakers=5. The age of the patients interviewed were between 52-72 years, out of which six were Malay, six were Indians, and eight were Chinese. Healthcare professionals interviewed had two to four years of working experience.

For our study, the intervention efforts were targeted at the patients. Based on the framework of factors influencing clinical practice, patient factors most directly influence the practice and outcome and the probability of an incident (48). The overall target behaviour was to increase the number of patients undergoing a bone mineral density scan.

Table 1 displays the barriers from the patient factors, the target behaviours derived from the barriers followed by identification of the cause using the COM-B model. The BCW was then used to pick the intervention functions, specific behaviour change techniques and policy category. The barriers from the patient factors were obtained from previous qualitative data which in the time of writing this paper is not yet published.

Table 1: Intervention functions, behaviour change techniques and policy categories used to address the patient factors

Patient factors	Target behaviour	Understanding of the behaviours based on the COM-B model	Intervention function	Behaviour change technique	Policies category
Condition (complexity and seriousness)					Environmental/ social planning <ul style="list-style-type: none"> Developing a practical and sustainable osteoporosis screening programme
<ul style="list-style-type: none"> Osteoporosis is perceived to be not serious 	<ul style="list-style-type: none"> Patients to understand that untreated osteoporosis can be life threatening 	<ul style="list-style-type: none"> Psychological capability Reflective motivation 	<ul style="list-style-type: none"> Education Environmental restructuring 	Shaping knowledge <ul style="list-style-type: none"> Provide information on consequences of untreated osteoporosis Antecedents <ul style="list-style-type: none"> Restructuring the physical and social environment by implementing an osteoporosis screening 	
Personality					
<ul style="list-style-type: none"> Nonchalant attitude towards osteoporosis 	<ul style="list-style-type: none"> Patients willing to conduct osteoporosis screening and prevention measures 	<ul style="list-style-type: none"> Psychological capability Automatic motivation 	<ul style="list-style-type: none"> Education Persuasion Environmental restructuring 	Shaping knowledge <ul style="list-style-type: none"> Provide information about osteoporosis Comparison of outcomes <ul style="list-style-type: none"> Persuasive arguments on benefits of 	

				<p>screening and prevention</p> <p>Antecedents</p> <ul style="list-style-type: none"> Restructuring the physical and social environment by implementing an osteoporosis screening 	
<ul style="list-style-type: none"> Unwilling to listen to the healthcare professionals advice 	<ul style="list-style-type: none"> Patients to trust healthcare professionals 	<ul style="list-style-type: none"> Social opportunity 	<ul style="list-style-type: none"> Environmental restructuring 	<p>Antecedents</p> <ul style="list-style-type: none"> Restructuring the physical and social environment by implementing an osteoporosis screening programme 	
Knowledge					
<ul style="list-style-type: none"> Lack of knowledge 	<ul style="list-style-type: none"> Improve all aspects patients knowledge towards osteoporosis 	<ul style="list-style-type: none"> Psychological capability 	<ul style="list-style-type: none"> Education Environmental restructuring 	<p>Shaping knowledge</p> <ul style="list-style-type: none"> Provide information about osteoporosis <p>Antecedents</p> <ul style="list-style-type: none"> Restructuring the physical and social environment by implementing an 	

				osteoporosis screening	
Communication					
<ul style="list-style-type: none"> Language barrier 	<ul style="list-style-type: none"> Create opportunities to communicate information regarding osteoporosis 	<ul style="list-style-type: none"> Social opportunity Physical opportunity 	<ul style="list-style-type: none"> Environmental restructuring 	<p>Antecedents</p> <ul style="list-style-type: none"> Restructuring the physical and social environment by implementing an osteoporosis screening 	
Social factors					
<ul style="list-style-type: none"> Financial constraints 	<ul style="list-style-type: none"> Affordable osteoporosis screening and medications 	<ul style="list-style-type: none"> Reflective motivation Physical opportunity 	<ul style="list-style-type: none"> Environmental restructuring Enablement 	<p>Antecedents</p> <ul style="list-style-type: none"> Restructuring the physical and social environment by implementing an osteoporosis screening <p>Social support</p> <ul style="list-style-type: none"> Social support (financial) 	
<ul style="list-style-type: none"> Time constraints 	<ul style="list-style-type: none"> Ensure the osteoporosis screening programme is 	<ul style="list-style-type: none"> Reflective motivation 	<ul style="list-style-type: none"> Environmental restructuring Enablement 	<p>Social support</p> <ul style="list-style-type: none"> The osteoporosis screening 	

	<p>conducted at a time convenient for the patients</p>	<ul style="list-style-type: none"> Physical opportunity 		<p>programme to be conducted at a practical time for the patients</p> <p>Antecedents</p> <ul style="list-style-type: none"> Restructuring the physical and social environment by implementing an osteoporosis screening 	
<ul style="list-style-type: none"> Short consultation time 	<ul style="list-style-type: none"> Ensure sufficient time for consultation regarding osteoporosis 	<ul style="list-style-type: none"> Social opportunity Physical opportunity 	<ul style="list-style-type: none"> Environmental restructuring Enablement 	<p>Social support</p> <ul style="list-style-type: none"> Sufficient consultation time <p>Antecedents</p> <ul style="list-style-type: none"> Restructuring the physical and social environment by implementing an osteoporosis screening 	
<ul style="list-style-type: none"> Family circumstances 	<p>Ensure that the osteoporosis screening programme</p>	<ul style="list-style-type: none"> Physical opportunity 	<ul style="list-style-type: none"> Environmental restructuring 	<p>Social support</p> <ul style="list-style-type: none"> The osteoporosis 	

	is accessible to the patients		<ul style="list-style-type: none"> • Enablement 	<p>screening programme to be conducted at a practical time for the patients</p> <p>Antecedents</p> <ul style="list-style-type: none"> • Restructuring the physical and social environment by implementing an osteoporosis screening 	
Difficulty to adhere to osteoporosis prevention measure					
Difficulty to adhere to osteoporosis prevention measure	<ul style="list-style-type: none"> • Ensure patients difficulty to adhere to osteoporosis prevention measure is addressed 	<ul style="list-style-type: none"> • Physical capability • Reflective motivation • Automatic motivation 	<ul style="list-style-type: none"> • Education • Enablement • Environmental restructuring 	<p>Shaping knowledge</p> <ul style="list-style-type: none"> • Provide instruction on how to perform preventive measures <p>Goals and planning</p>	

				<ul style="list-style-type: none">• Prompt barrier identification <p>Antecedents</p> <ul style="list-style-type: none">• Restructuring the physical and social environment by implementing an osteoporosis screening	
--	--	--	--	--	--

Intervention function 1: Environment restructuring

We addressed all the patient factors using the intervention function environmental restructuring via the BCT antecedents. Antecedents involved restructuring the physical and social environment of the primary care clinic by implementing a pharmacists-led osteoporosis screening programme. Restructuring of the physical environment of the primary care clinic refers to incorporating the programme as one of the clinic services. This restructures the social environment by allowing both patient and healthcare professionals to communicate regarding osteoporosis screening. The osteoporosis screening programme was tailored to execute various BCT directed at the patients' factors which will be elaborated in sections below.

Additionally, the BCT antecedent allows the healthcare professionals to address the issue of language barriers which are caused by the lack of physical and social opportunity (COM-B model). Physical opportunity refers to the lack of a physical opportunity for the patients to undergo osteoporosis screening. Social opportunity refers to the lack of opportunity for the patients to communicate with the healthcare professionals. By conducting an osteoporosis screening programme, the health care professionals will be able to prepare the osteoporosis information in various languages and communicate with a larger population. The patients will have an opportunity to conduct osteoporosis screening.

"... So (we) have to address (this)... larger ethnic groups, that are maybe Mandarin, or... English, then BM (Malay), Tamil (speaking)... So that... they can read and maybe they would understand, after that they can do something about it."

(DR-2/M/30y)

Another barrier which was addressed by this BCT was the patients' unwillingness to listen to the healthcare professionals' advice. By conducting the osteoporosis screening programme, the healthcare professionals will be able to communicate with the patients more addressing the lack of social opportunity. Therefore, they can gain the patients' trust by proving their capabilities and creating rapport with the patients, increasing their willingness to listen to advice.

"... A bonding... So they will tell us all these things. So they will come."

(DR-6/F/48y)

Intervention function 2: Education

We found that other aspects of the patient factors: condition, knowledge, personality and difficulty to adhere to osteoporosis preventive measure can be addressed in more detail using an educational intervention via the BCT of shaping knowledge. Based on the COM-B model we evaluated that the patients' lack of osteoporosis knowledge factor was affected by the lack in psychological capability. A lack of psychological capability in this case refers to the lack of osteoporosis knowledge. We aimed to improve all aspects of the patients' osteoporosis knowledge.

As for the patient factor condition, patients perceived osteoporosis as not to be serious condition. We evaluated it to be caused by the patients' lack of psychological capability and reflective motivation from the COMB-B model. Due to the lack of knowledge on the consequences of untreated osteoporosis, patients evaluated osteoporosis to be a not serious condition. This in turn affected the patients' personality whereby they took a nonchalant attitude towards osteoporosis. We evaluated this issue to be due to the lack of psychological capability and automatic motivation from the COM-B model. As a lack of osteoporosis knowledge led to patients acting nonchalantly due to an innate dispositions such as perceiving osteoporosis to be not life threatening.

Correspondingly, patients' difficulties in adhering to osteoporosis preventive measures may be caused by a lack of psychological capability, physical capability, reflective motivation and automatic motivation. To elaborate on this, patients may have had difficulty to conduct weight-bearing exercises. Hence, it became an unpleasant activity as patients may feel pain leading to a reduction in motivation. Patients will then evaluate the preventive measures to be too difficult to adhere too. Educating patients will equip them with the knowledge on osteoporosis preventive measures suitable for their physical condition overcoming its difficulties.

Therefore, based on stakeholders' suggestions we developed a counselling session that was delivered by the pharmacist. Patients would receive 30 minutes of verbal counselling. Topics covered during the counselling session were the definition of osteoporosis, consequences of untreated osteoporosis, risk factors for osteoporosis, the role of the BMD scan (its function, what the results mean, accessibility and the frequency a patient has to go for a BMD scan), other tests used in osteoporosis screening [quantitative ultrasound scanning, x-ray, blood test and the Osteoporosis Self-assessment Tool for Asians (OSTA)], lifestyle changes (calcium intake, vitamin D intake, weight bearing exercise and fall prevention), and treatment

of osteoporosis. Additionally particular emphasis was given to the consequences of untreated osteoporosis and how to conduct osteoporosis preventive measures.

“I think you should counsel, counsel people because sometimes people are not aware of the importance of osteoporosis.”

(PT-10/F/62y)

Strategies to conduct the counselling session include using lay terms, pictorial descriptions and providing the patients with an osteoporosis booklet. Therefore during the counselling session an osteoporosis booklet was provided to the patients. This information booklet also allowed the pharmacists to engage the patients and assist the patients to visualize the information. Additionally, the patients were able to take the leaflet home with them and reread the information. Please refer to Appendix 24 for the osteoporosis booklet.

“(I need osteoporosis information) pamphlets, simple thing that we can understand. Not too scientific.” (PT-15/F/55y)

Intervention function 3: Persuasion

We used the intervention function persuasion to address the additional aspect of the patients' nonchalant attitude caused by the automatic motivation. This was achieved using the BCT whereby we compared the outcomes and use persuasive arguments on the benefits of osteoporosis screening and prevention specific to a patient. Stakeholders believed that an individualize counselling session would increase the effectiveness of the counselling session as it is easier for the patients to communicate as compared to a group counselling session. By individualizing the counselling sessions we can tailor the session based on the patients' education background and address personal issues regarding osteoporosis screening and prevention.

“If one to one session, I think they will... want to do it (osteoporosis preventive measure)... (it is) different... when we (compare with) dispens(ing) at the counter and (when) we talk to them personally. They will easily open up. They will tell us the problem.”

(PHARM-3/F/25y)

Intervention function 4: Enablement

Goals and planning: Prompt barrier identification

Additionally, in order to address the aspect of reflective and automatic motivation from the factor 'difficulty to adhere to preventive measures'. We used another intervention function called enablement where we used the BCT 'prompt barrier identification when conducting an osteoporosis preventive measure.' The pharmacist would discuss potential barriers (pain while exercising, funding, lactose intolerant etc) of conducting the osteoporosis preventive measure with the patients. This enables the pharmacists to tailor an osteoporosis preventive regimen suitable to the patient.

"When patients... asks 'Should I take calcium?' 'Should I take vitamin D?'... If you are wealthy enough, you want to take tablets, go ahead... If you are not so wealthy, you have... ten tablets to take... I would say enough. But if you can actually cope with your amount of medication... why not?" (PHARM-9/F/27y)

Social support: Osteoporosis risk assessment tools

We evaluated the financial constraints that were influenced by physical opportunity and reflective motivation. We addressed the lack of physical opportunity by using the intervention function enablement. The issue with the financial constraints is the cost of the BMD scan and medication. Therefore, we provided an osteoporosis risk assessment tool which screens for patients who are at high risk for osteoporosis. The risk assessment tool is a simple and quick calculation using the patients' weight and age. This allows the hospitals resources such as the BMD scan and funding for the scans and medications to be used more effectively leading to more accessible osteoporosis screening for these patients. By giving the patients the opportunity to go for a free screening they will then evaluate that their finances can afford an osteoporosis scan thereby addressing the aspect of reflective motivation.

*"If it's free... if you give me (a chance to go for osteoporosis screening). I don't mind going."
(PT-20/F/62y)*

Social support: The osteoporosis screening programme to be conducted at a practical time for the patients

Similarly, the barrier of patients' time constraints and family circumstances to attend the screening programme was affected by physical opportunity and reflective motivation. We addressed the lack of physical opportunity by using the intervention function enablement. Therefore, we decided to conduct the osteoporosis screening programme during the waiting time for the doctor's appointment. The waiting can be one to three hours. By using this time frame we did not extend the patients' time at the hospital nor did we need the patient to come to the hospital multiple times. This will hopefully lead to the patients positively evaluating the feasibility of going for the osteoporosis screening addressing the aspect of reflective motivation.

"There should be (information and osteoporosis screening), maybe at the clinic while we (are) wait for the doctor ('s) (appointment)." (PT-15/F/55y)

Social support: Sufficient consultation time

One of the patient factors was the lack of consultation time. We evaluated this to be caused by the lack of social opportunity and physical opportunity. Therefore by conducting a pharmacist-led osteoporosis screening programme during the waiting time for the doctor's appointment we would have created an opportunity for the patients to discuss issue pertaining to osteoporosis. The pharmacists will be able to spend the time to communicate and address any issues that the patients may have. We allocated about 15-30 minutes per patients.

"... The patient comes in, first (they) see the pharmacist, catch them, do the risk assessment... Just write in there (case notes) high risk, so the doctor is aware. Because we usually as doctors we don't so much... time with the patient, with the work load especially. So it will be a good thing." (DR-6/F/48y)

Policy category 1: Environmental/social planning- Developing a practical and sustainable osteoporosis screening programme

For our study the type of policies that can be used to implement the pharmacist osteoporosis screening programme is the policy category environmental/social planning. This involves designing and/or controlling the physical and social environment. Stakeholders emphasized that the planning of the programme was crucial. We needed to develop a practical, acceptable and sustainable osteoporosis programme. They suggested that in order for the programme to be a success upper management approval and support was essential.

“That’s why must speak to the specialist, we must, make an appointment to go and see this osteoporosis specialist, talk to them, encourage them to have this type of campaign... Only these people who can start these campaigns.” (NUR-6/F/55y)

The finalized intervention package

Based on the BCW, our final intervention consisted of: an assessment of patients’ osteoporosis risk by the pharmacist whilst the patients are waiting for the doctor’s appointment (enablement), an education session (education), and restructuring of the current practice which incorporates this intervention into daily clinic practice (environmental restructuring). Subsequently, a recommendation to the doctor was made for a bone mineral density scan when necessary. The interventions were tailored to the individual patients as a face-to-face consultation (mode of delivery) as each patient has a different osteoporosis risk factors and osteoporosis knowledge level.

Discussion

Using the behavioural change wheel to address barriers from the patients’ factors we identified four key intervention components: environment restructuring, education, persuasion and enablement. This referred to the restructuring of the environment that was the need to develop and implement an osteoporosis screening programme by empowering the patient with osteoporosis knowledge. The programme should also be conducted one-on-one with the patient to incorporate the persuasion aspect of the intervention and conducted a time convenient to patients without burdening the patients financially. All these key intervention components were used to develop an acceptable, practical and sustainable osteoporosis screening programme in a primary care clinic.

We compared the BCW to other approaches such as the Theory of Planned Behaviour and Health Belief Model (49, 50). We agreed with the BCW authors that both these theories do not address the important role of impulsivity, habit, self-control, associative learning and emotional processing. The BCW model includes automatic processing which broadens the understanding of behaviour beyond the reflective, systematic cognitive process that is normally focused of most behavioural research in implementation science and health psychology (46). These aspects have been considered in the BCW making it a comprehensive theory used for intervention design.

Additionally, the behavioural change wheel may be incorporated into the context very naturally. By context we mean the 'opportunity' component of the model. This means that the behavioural can only be understood in relation to context making it a good starting point (46).

The BCW was then compared to other frameworks such as MINDSPACE. MINDSPACE is a checklist for policymakers of the most important influences on behaviour from the UK's Institute of Government (51). However this framework recognises two systems by which human behaviour can be influenced, the reflective and automatic. But it focused on the automatic part of the human behaviour and does not attempt to link influences on behaviour with these two systems making it incoherent. The BCW manages to link these two systems using the COM-B model (46).

As for intervention mapping, a key difference between this and the BCW approach is that the intervention mapping aims to map behaviour on to its 'theoretical determinants' in order to identify potential levers for change (52). However the BCW approach recognises that the target behaviour system can in principle arise from combinations of any of the components of the behaviour system (46).

A search of published literature found several randomized controlled trials (RCTs) for osteoporosis screening services. These RCTs were conducted by various healthcare professionals such as primary care physicians,(53, 54) orthopaedic surgeons, (55, 54) pharmacists (38-40) and nurses.(56). All of these interventions had similar components to our interventions in the sense that they all had an education component, osteoporosis risk assessment; the services were provided for free at a time convenient to the patients. However, the rationale for the intervention used was often unclear. Only four studies reported that the intervention was tailored to identified barriers (13, 53, 56, 57). Nonetheless, all interventions demonstrated a positive effect towards bone mineral density (BMD) scanning and osteoporosis treatment post fracture. (38, 53, 56, 39, 55, 54, 40).

Strengths of this study were that our intervention was informed by a theory. It has been hypothesised that interventions informed by psychological theory show greater efficacy than non-theory based studies. This is because theory driven interventions are more likely to target theoretically consistent or empirically supported mechanisms of behaviour change (58). However, interventions described as theory-based often have an unclear foundation (59). Although guidelines from the UK MRC framework for complex intervention advocates drawing on theory in intervention design, it does not specify how to select and apply theory(58). There is often no analysis undertaken to guide the choice of theories. Therefore, we found the BCW to be a systematic and comprehensive theory enabling us to clearly outline which intervention affects a specific behaviour.

Limitations of this study include that we have tailored it specifically to the local setting and it may not be generalizable to other setting. Another criticism is that the area of intervention is complex and the constructs may still be too ill-defined to be able to establish useful, scientifically based evidence. The authors of the BCW also note that no framework can address the level of detail required to determine what will or will not be an effective intervention. However, they suggest that these are empirical questions and there is already evidence that character intervention by BCT can aid in the understanding and identifying which intervention are more or less effective (59, 46, 60).

Conclusion

In conclusion, based on the BCW we have systematically identified four intervention (environment restructuring, education, persuasion, enablement) components to develop an acceptable, practical and sustainable osteoporosis programme.

References:

1. Kanis JA. WHO Scientific Group Technical Report. 2007:66.
2. World Health Organization. WHO Scientific group on the assessment of osteoporosis at primary health care level. Brussels, Belgium: WHO Press; 2004.
3. Chapuy MC, Arlot ME, Delmas PD, Meunier PJ. Effect of calcium and cholecalciferol treatment for three years on hip fractures in elderly women. *British Medical Journal*. 1994;308:1081-2.

4. Trivedi DP, Doll R, Khaw KT. Effect of four monthly oral vitamin D3 (cholecalciferol) supplementation on fractures and mortality in men and women living in the community: randomised double blind controlled trial. *British Medical Journal*. 2003;326:469-72.
5. Mitra AK, Low CK, Chao AK, Tan SK. Social aspects in patients following proximal femoral fractures. *Ann Acad Med Singapore*. 1994;23:876-8.
6. Johnell O, Kanis JA. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. *Osteoporosis International*. 2006;17(12):1726-33.
7. Hernlund E, Svedbom A, Ivergård M, Compston J, Cooper C, Stenmark J, et al. Osteoporosis in the European Union: medical management, epidemiology and economic burden. *Archives of Osteoporosis*. 2013;8(1-2):136.
8. Svedbom A, Hernlund E, Ivergård M, Compston J, Cooper C, Stenmark J, et al. Osteoporosis in the European Union: a compendium of country-specific reports. *Archives of Osteoporosis*. 2013;8(1-2):137.
9. Ministry of Health Malaysia. Clinical Guideline on Management of Osteoporosis 2012. In: Health Mo, editor. Putrajaya: Malaysian Osteoporosis Society; 2012.
10. Cosman F, Lindsay R, LeBoff MS, Jan de Beur S, Tanner B. National Osteoporosis Foundation. Clinician's Guide to Prevention and Treatment of Osteoporosis. Washington, DC: National Osteoporosis Foundation; 2014.
11. Hajcsar EE, Hawker G, Bogoch ER. Investigation and treatment of osteoporosis in patients with fragility fractures. *CMAJ*. 2000;16(7):819-22.
12. National Committee for Quality Assurance. HEDIS & Performance Measurement. Proposed Changes to Existing Measure for HEDIS®1 2015: Osteoporosis Management in Women Who Had a Fracture (OMW) Washington, USA2014 [cited 2015 25 February]. Available from: www.ncqa.org/HEDISQualityMeasurement.aspx.
13. Cranney A, Lam M, Ruhland L, Brisson R, Godwin M, Harrison MM, et al. A multifaceted intervention to improve treatment of osteoporosis in postmenopausal women with wrist fractures: a cluster randomized trial. *Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA*. 2008;19(12):1733-40.
14. Davis JC, Guy P, Ashe MC, Liu-Ambrose T, Khan K. Hip watch: Osteoporosis investigation and treatment after a hip fracture: A 6-month randomized controlled trial. *Journal of Gerontology*. 2007;62A(8):888-91.
15. Richy F, Ethgen O, Bruyere O, Mawet A, Reginster J-Y. Primary Prevention of Osteoporosis: Mass Screening Scenario or Prescreening With Questionnaires? An Economic Perspective. *Journal of Bone and Mineral Research*. 2004;19(12):1955-60.
16. International Osteoporosis Foundation. Capture the Fracture: A global campaign to break the fragility fracture cycle 2012 [cited 2015 26 February]. Available from: <http://www.worldosteoporosisday.org/>
17. International Osteoporosis Foundation. Capture the Fracture: break the worldwide fragility fracture cycle 2012 [cited 2015 27 December]. Available from: <http://www.osteofound.org/capture-fracture>
18. Clunie G, Stephenson S. Implementing and running a fracture liaison service: An integrated clinical service providing a comprehensive bone health assessment at the point of fracture management. *Journal of Orthopaedic Nursing*. 2008;12(3-4):159-65.
19. McLellan AR, Gallacher SJ, Fraser M, McQuillan C. The fracture liaison service: success of a program for the evaluation and management of patients with osteoporotic fracture. *Osteoporosis International*. 2003;14(12):1028-34.
20. Premaor MO, Pilbrow L, Tonkin C, Adams M, Parker RA, Compston J. Low rates of treatment in postmenopausal women with a history of low trauma fractures: results of audit in a Fracture Liaison Service. *Qjm*. 2009;103(1):33-40.

21. Wallace I, Callachand F, Elliott J, Gardiner P. An evaluation of an enhanced fracture liaison service as the optimal model for secondary prevention of osteoporosis. *JRSM Short Reports*. 2011;2(2):8-.
22. Wright SA, McNally C, Beringer T, Marsh D, Finch MB. Osteoporosis fracture liaison experience: the Belfast experience. *Rheumatology International*. 2005;25(6):489-90.
23. Boudou L, Gerbay B, Chopin F, Ollagnier E, Collet P, Thomas T. Management of osteoporosis in fracture liaison service associated with long-term adherence to treatment. *Osteoporosis International*. 2011;22(7):2099-106.
24. Huntjens KMB, van Geel TACM, Blonk MC, Hegeman JH, van der Elst M, Willems P, et al. Implementation of osteoporosis guidelines: a survey of five large fracture liaison services in the Netherlands. *Osteoporosis International*. 2010;22(7):2129-35.
25. Cooper MS, Palmer AJ, Seibel MJ. Cost-effectiveness of the Concord Minimal Trauma Fracture Liaison service, a prospective, controlled fracture prevention study. *Osteoporosis International*. 2011;23(1):97-107.
26. Inderjeeth CA, Glennan DA, Poland KE, Ingram KV, Prince RL, Van VR, et al. A multimodal intervention to improve fragility fracture management in patients presenting to emergency departments. *Med J Aust*. 2010;193(3):149-53.
27. Lih A, Nandapalan H, Kim M, Yap C, Lee P, Ganda K, et al. Targeted intervention reduces refracture rates in patients with incident non-vertebral osteoporotic fractures: a 4-year prospective controlled study. *Osteoporosis International*. 2011;22(3):849-58.
28. Bogoch ER, Elliot-Gibson V, Beaton D, Jamal SA, Josse RG, Murray TM. Effective initiation of osteoporosis diagnosis and treatment for patients with fragility fracture in orthopaedic environment. *The Journal of bone and joint surgery American volume*. 2006;88:25-34.
29. Dell R, Greene D, Schelkun SR, Williams K. Osteoporosis Disease Management: The Role of the Orthopaedic Surgeon. *The Journal of Bone and Joint Surgery (American)*. 2008;90:188-94.
30. Australian government. PBS extended listing of alendronate for treating osteoporosis and Medicare extended listing for bone mineral density testing. . In: ageing DoHa, editor. Canberra, Australia: Australian government,; 2006.
31. National Institute for Health and Clinical Excellence. Osteoporosis: assessing the risk of fragility fracture. . In: 146 NCG, editor. London, UK: NICE; 2012.
32. Ström O, Borgström F, Kanis JA, Compston J, Cooper C, McCloskey EV, et al. Osteoporosis: burden, health care provision and opportunities in the EU. *Archives of Osteoporosis*. 2011;6(1-2):59-155.
33. Toh LS, Lai PSM, Othman S, Wong KT, Low BY, Anderson C. An analysis of inter-professional collaboration in osteoporosis screening at a primary care level using the D'Amour model. *Research in Social and Administrative Pharmacy*. 2016.
34. George PP, Molina JAD, Cheah J, Chan SC, Lim BP. The evolving role of the community pharmacist in chronic disease management- A literature review. *Ann Acad Med Singapore*. 2010;39:861-7.
35. Lai PSM, Chua SS, Chan SP. Impact of pharmaceutical care on knowledge, quality of life and satisfaction of postmenopausal women with osteoporosis. *International Journal of Clinical Pharmacy*. 2013;35(4):629-37.
36. Stuurman-Bieze AGG, Hiddink EG, van Boven JFM, Vegter S. Proactive pharmaceutical care interventions decrease patients' nonadherence to osteoporosis medication. *Osteoporosis International*. 2014;25:1807-12.
37. Van Boven JFM, Stuurman-Bieze AGG, Hiddink EG, Postma MJ, Vegter S. Medication monitoring and optimization: A targeted pharmacist program for effective and cost-effective improvement of chronic therapy adherence. *Journal of Managed Care & Specialty Pharmacy* 2014;20(8):786-92.

38. Crockett JA, Taylor SJ, McLeod LJ. Patient responses to an integrated service, initiated by community pharmacists, for the prevention of osteoporosis. *International Journal of Pharmacy Practice*. 2008;16(2):65-72.
39. McDonough RP, Doucette WR, Kumbera P, Klepser DG. An evaluation of managing and educating patients on the risk of glucocorticoid-induced osteoporosis. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research*. 2005;8(1):24-31.
40. Yuksel N, Majumdar SR, Biggs C, Tsuyuki RT. Community pharmacist-initiated screening program for osteoporosis: randomized controlled trial. *Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA*. 2010;21(3):391-8.
41. Elias MN, Burden AM, Cadarette SM. The impact of pharmacist interventions on osteoporosis management: a systematic review. *Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA*. 2011;22(10):2587-96.
42. Medical Research Council. *Developing and evaluating complex interventions- New guidance*. 2008.
43. Boyatzis RE. *Transforming qualitative information: Thematic analysis and code development*. Thousand Oaks, California: Sage publications; 1998.
44. Miles MB, Huberman AM, Saldaña J. *Qualitative data analysis: a methods sourcebook*. Third ed. Thousand Oaks, CA: Sage Publications; 2013.
45. Ziebland S, McPherson A. Making sense of qualitative data analysis: An introduction with illustrations from DIPEx (personal experiences of health and illness). *Medical Education*. 2006;40:405-14.
46. Michie S, van Stralen MM, West R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*. 2011;6(1):42.
47. Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W, et al. The Behavior Change Technique Taxonomy (v1) of 93 Hierarchically Clustered Techniques: Building an International Consensus for the Reporting of Behavior Change Interventions. *Annals of Behavioral Medicine*. 2013;46(1):81-95.
48. Vincent C, Taylor-Adams S, Chapman EJ, Hewett D, Prior S, Strange P, et al. *A protocol for investigation and analysis of clinical incidents*. London: University College London/Association of Litigation and Risk Management; 1999.
49. Ajzen I. The theory of planned behavior. *Organizational behaviour and human decision processes*. 1991;50:179-211.
50. Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the health belief model. *Health Education Quarterly*. 1988;15(2):175-83.
51. Institute for Government. *MINDSPACE: Influencing behaviour through public policy*. In: office Tc, editor. 2010.
52. Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. *Planning health promotion programs: Intervention mapping*. San Francisco, USA: Jossey-Bass; 2011.
53. Gardner MJ, Brophy RH, Demetrakopoulos D, Koob J, Hong R, Rana A, et al. Interventions to improve osteoporosis treatment following hip fracture. A prospective, randomized trial. *The Journal of bone and joint surgery American volume*. 2005;87(1):3-7.
54. Rozental TD, Makhni EC, Day CS, Bouxsein ML. Improving evaluation and treatment for osteoporosis following distal radial fractures. A prospective randomized intervention. *The Journal of bone and joint surgery American volume*. 2008;90(5):953-61.
55. Miki RA, Oetgen ME, Kirk J, Insogna KL, Lindskog DM. Orthopaedic management improves the rate of early osteoporosis treatment after hip fracture. A randomized clinical trial. *The Journal of bone and joint surgery American volume*. 2008;90(11):2346-53.

56. Majumdar SR, Beupre LA, Harley CH, Hanley DA, Lier DA, Juby AG, et al. Use of a case manager to improve osteoporosis treatment after hip fracture. *Arch Intern Med.* 2007;167(19):2110-5.
57. Majumdar SR, Johnson JA, McAlister FA, Bellerose D, Russell AS, Hanley DA, et al. Multifaceted intervention to improve diagnosis and treatment of osteoporosis in patients with recent wrist fracture: a randomized controlled trial. *CMAJ.* 2008;178(5):569-75.
58. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ.* 2008;337:a1655.
59. Michie S, Fixsen D, Grimshaw JM, Eccles MP. Specifying and reporting complex behaviour change interventions: the need for a scientific method. *Implementation Science.* 2009;4(1):40.
60. West R, Walia A, Hyder N, Shahab L, Michie S. Behavior change techniques used by the English Stop Smoking Services and their associations with short-term quit outcomes. *Nicotine & Tobacco Research.* 2010;12(7):742-7.