# Simulated Learning: Integrating Clinical Knowledge into the Dispensing Process


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## ABSTRACT

Pharmacy education has experienced a continual shift in the emphasis of the practice of pharmacy, requiring pharmacists to practice high levels of competence in performing the dispensing process while incorporating clinical knowledge using complex levels of cognitive skill. This highlights the need for opportunities within the learning environment which both require and facilitate the integration of clinical knowledge-based cognitive skills into the dispensing process. Simulation-based education has been demonstrated to assist in gradually increasing the level of complexity of tasks requiring performance by students in clinical settings.

This study explored ways in which a computer-based dispensing program, MyDispense, could be used to facilitate the integration of clinical knowledge-based cognitive skills into the dispensing process. In the study, simulated patient scenarios for MyDispense were developed, which required the integration of a hierarchy of cognitive skills into the dispensing process. These were evaluated in order to assess the level of cognitive skills required to complete the clinical scenarios created. The developed MyDispense-based clinical scenarios were then piloted with a group of pharmacy students, after which a focus group was used to explore the students' experience of the ability of MyDispense to integrate clinical knowledge into the dispensing process. This qualitative study adopted an exploratory approach in order to understand the potential benefit of computer-based simulated learning as a means of integrating clinical knowledge-based cognitive skills into the dispensing process. Purposive and convenience sampling was used in this study and data collection was through the completion of purpose-designed assessment forms by pharmacy lecturers and focus groups with student participants. Data from the assessment forms was used as feedback to further refine the clinical scenarios, and the focus group recording was transcribed and analysed using a thematic analysis approach.

The scenarios assessed by the pharmacy lecturers were shown to require high levels of cognitive skills as described by Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001) and necessitated that the students plan, construct, design, and generate information to complete the scenarios. The pharmacy students successfully practiced the MyDispense scenarios as an adjunct to a clinical module and reported that the scenarios had assisted them in learning for the clinical module. The students acknowledged that they were required to apply their clinical knowledge and make clinical decisions while completing the scenarios. This study demonstrates that simulation-based education can be used as a beneficial educational

tool for teaching the application of complex clinical knowledge-based cognitive skills to the dispensing process. It provides a valuable means of preparing students for professional work-based pharmacy practice.

**KEY WORDS**

Simulation-based education, Clinical knowledge, MyDispense, Dispensing process

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# ABBREVIATIONS

| | |
|---|---|
| AACP | American Association of Colleges of Pharmacy |
| AEE | Association for Experiential Education |
| BPharm | Baccalaureus Pharmaciae |
| GIMMICS | Groningen Institute Model for Management in Care Services |
| GPP | Good Pharmacy Practice |
| HIV | Human Immunodeficiency Virus |
| OSCE | Objective Structured Clinical Examination |
| OTC | Over-the-Counter |
| SAPC | South African Pharmacy Council |
| SBE | Simulation Based Education |
| SBME | Simulation Based Medical Education |
| STLCOP | St Louis College of Pharmacy |
| TB | Tuberculosis |
| UCSF | University of California San Francisco |
| UConn | University of Connecticut |
| UK | United Kingdom |
| UMich | University of Michigan |
| US | United States |
| WBL | Work-Based Learning |
| WIL | Work-Integrated Learning |

# DEFINITION OF TERMS

***Avatar –*** An electronic image that represents a person or character in a computer program (Merriam-Webster, 2019a).

***Clinical knowledge-based cognitive skills –*** Reasoning skills used to solve clinical problems or make clinical decisions based on acquired clinical knowledge.

***Curriculum –*** The course or study offered by an educational institution (Merriam-Webster, 2019b)

***Dispensing process –*** A process involving three phases which need to be performed to competently and responsibly dispense medicine to patients, while interpreting the communication or instructions documented on a prescription.

***Exercise –*** A given event or situation described for hypothetical reason (used interchangeably with “scenario”).

***Freeware –*** The use of a computer program for which it is not necessary to pay a fee.

***Module –*** An educational unit of learning that is credit-bearing (Merriam-Webster, 2019c).

***Objective Structured Clinical Examination (OSCE)*** – A type of assessment tool based on objective testing used to examine healthcare professionals by direct observation in a clinical setting (Zayyan, 2011).

***Over-the-Counter (OTC)*** – A category of medicines which pharmacists may recommend and dispense to patients, without the patient first acquiring a prescription.

***Scenario –*** A given event or situation described for hypothetical reasons (used interchangeably with “exercise”).

***Simulation-Based Education (SBE)*** – A form of education used to expose students to experiential practice by introducing them into environments or situations which are similar to real-life practice.

***Simulation-Based Medical Education (SBME)*** – Simulation-based education focused only on the education medicinal students. (See Simulation-based education)

***Virtual –*** Created by computer software to appear similar to real-life objects or environments

***Work-Based Learning (WBL)*** – A form of work-integrated learning which involves students being exposed to the working environment relevant to professional qualification.

***Work-Integrated Learning (WIL)*** - An approach to education that includes classroom-based and workplace-based forms of learning that are appropriate for the professional qualification (Council on Higher Education, 2011).

# CHAPTER 1: INTRODUCTION

## 1.1. Background to the study

Pharmacy practice in community or hospital environments requires pharmacy staff to dispense prescribed medicine to patients by performing a dispensing process. The dispensing process is an integral part of pharmacy practice and involves the use of multiple cognitive and technical skills to ensure the patient receives optimal treatment and care. The pharmacist manages the dispensing process and either performs the entire dispensing process themselves, or delegates certain tasks to other trained pharmacy staff members in a pharmacy.

A collective shift in the international pharmacy environment is occurring, where pharmacy technicians are increasingly being trained to perform technical aspects of the dispensing process; with new distribution technologies being developed to do the same, allowing the pharmacist to focus more on applying their specialised clinical knowledge with the use of cognitive skills during the dispensing process (Hall, Musing, Miller, & Tisdale, 2012). The pharmacist is the only professional in the pharmacy tasked with the responsibility of interpreting and evaluating the prescription for appropriateness, patient counselling, and ensuring correct and accurate dispensing. These aspects of dispensing rely heavily on the practice of high-level cognition, requiring pharmacists to access clinical knowledge and apply complex cognitive skills. Hence, there is a need for pharmacists to be well trained in these cognitive aspects of the dispensing process and not only the technical aspects as reported (Hall et al., 2012). Hall et al. (2012) elaborate on this and further suggest that pharmacy training needs to shift to a more patient-care centred model including “clinical practice skills, clinical thinking skills, decision-making skills under conditions of uncertainty, collaborative interpersonal practice skills”, all of which point towards training pharmacists to adequately integrate their clinical, knowledge-based, cognitive skills into the dispensing process.

At Nelson Mandela University, pharmacy technical support students are currently trained in conjunction with second year pharmacy students, where they are taught the same level of competence in technical skills pertaining to the dispensing process. The undergraduate pharmacy students’ exposure thereafter to situations that assist in developing the cognitive skills necessary for the dispensing process is minimal.

In addition, there has been a transformation in the curriculum for the undergraduate degree of Baccalaureus Pharmaciae (BPharm) at the Nelson Mandela University over the past five years. The educational focus has shifted from the individualised presentation of the four traditional pharmacy disciplines; pharmacology, pharmaceutics, pharmaceutical chemistry and pharmacy practice; to a presentation of all four disciplines integrated into six clinical modules. The clinical modules are themed according to the biological systems and each discipline presents topics relevant to their discipline and to the biological systems (Nelson Mandela Metropolitan University, 2017). As a result of the integration, the teaching and learning of various foundational pharmaceutical skills, such as the dispensing process, does not have a specific niche within any of the clinical modules and is taught as a separate subject under pharmacy practice.

I have been a pharmacy practice lecturer at Nelson Mandela University for 4 years and have taught in four of the integrated clinical modules. I have also taught the pharmacy practice module (ZPS201) which focuses on the dispensing process and provides extensive practice of the technical aspects and skills involved in the dispensing process to second year BPharm students. Because of these varied teaching experiences, I began to notice how the students are never taught how to integrate the clinical knowledge and skills acquired during the clinical modules, with the technical skills taught as part of the second year ZPS201 module.

My teaching experience, together with my personal undergraduate experience, highlighted the problematic educational gap which continues to exist in the new “integrated” curriculum, where the dispensing process is taught to the pharmacy students in a separate module. It was thus that I identified that there was no platform for the students to practice integrating their clinical knowledge-based cognitive skills into the dispensing process. This places the undergraduate pharmacy students in a difficult position, when they are expected to complete externship hours in the pharmacy environment during their undergraduate training, when they have not had adequate time to practice vital cognitive skills necessary for the dispensing process.

Ideally, these cognitive skills should be practiced within the clinical modules where students should be taught and encouraged to integrate the clinical knowledge learned in the integrated modules with the dispensing skills learned in pharmacy practice. However, due to time and space constraints, it is difficult for this to be incorporated. From my personal experience of teaching large classes of roughly 150 students and having limited resources, I noticed the negative impact of only providing students with limited opportunities for learning integration.

It was while puzzling this dilemma that I became aware of the availability of a simulated dispensing program developed by Monash University called MyDispense. The program focuses on the dispensing process within a simulated pharmacy environment and seemingly provides opportunities for large numbers of students to practice their dispensing skills. However, the program also provides opportunities for interaction with virtual patients, including history taking and counselling, and for interaction and interventions with virtual prescribers, apparently providing a platform for the integration of clinical knowledge-based cognitive skills into dispensing skills.

Thus, I began to envisage how the use of MyDispense could assist in bridging the educational gap which I had become aware of. I attended two MyDispense symposiums hosted by Monash University, and I was inspired to introduce the MyDispense program to pharmacy students at Nelson Mandela University. This became the focal point of my work as a lecturer, as I sought to investigate if MyDispense would provide the opportunity for pharmacy students to practice their dispensing skills while integrating their clinical knowledge-based cognitive skills. In addition, the free availability of MyDispense to pharmacy schools around the world and the supportive staff of Monash University made using the program very appealing and reinforced my decision to choose MyDispense as a solid base for integration and also provide the foundation for research of its implementation.

In order to conduct research around the use of MyDispense, as the computer-generated simulation had only been used briefly in the BPharm programme at Nelson Mandela University, I decided to use an exploratory study design. I realized that I would need to find a clinical module that provided clinical knowledge and required complex clinical reasoning which would allow for the practice of integrating cognitive skills into the dispensing process. I therefore selected the third-year clinical BPharm module, Clinical Pharmacy 311 (ZCP311) for a number of reasons. Firstly, I selected a third-year module because the students would have accumulated some clinical knowledge, and they would have a few hours of exposure to the dispensing environment after being taught dispensing in their second year. The students would also have already done some externship hours on work-based placements in a pharmacy environment. Secondly, this module is presented in a semester which would allow for timeous collection of data from lecturer participants and student participants. Lastly, I was not involved in teaching or assessing this module and therefore the ethical issues around power relationships when teaching, assessing and researching on the same module could be avoided, since student participants are considered a vulnerable study sample in any educational research conducted at Nelson Mandela University. For this same reason, the use

of MyDispense could only be researched as a voluntary adjunct to the ZCP311 module and not as an integrated component. Furthermore, only four out of seven available topics were selected from this module for students first exposure to the computer-generated simulation learning. This background to the study gives rise to the problem statement and the study aims and objectives.

### 1.2. Problem statement

The recent shift in focus of the practice of pharmacy requires pharmacists to be trained to achieve high levels of competence in performing the dispensing process, while incorporating their clinical knowledge using an advanced level of cognitive skill. Therefore, there is a need for creating a learning environment for the integration of clinical knowledge-based cognitive skills into the dispensing process. Simulation-based education (SBE), particularly in the form of the virtual dispensing program, MyDispense, may offer an opportunity to fulfil this gap in pharmacy teaching and learning.

### 1.3. Study aims and objectives

The primary aim of this study was to explore ways in which a virtual dispensing program, MyDispense, could be used to facilitate the integration of clinical knowledge-based cognitive skills into the dispensing process.

In support of this aim the objectives of this study were to:

- Develop simulated patient scenarios for MyDispense which require the integration of a hierarchy of cognitive skills into the dispensing process.
- Assess the level descriptors of cognitive skills required to complete the clinical scenarios created, using Bloom's Revised Taxonomy.
- Pilot the developed MyDispense-based clinical scenarios with pharmacy students as an adjunct to the clinical pharmacy module.
- Determine the students' experience of the use of MyDispense to integrate their clinical knowledge into the dispensing process.

### 1.4. Chapter overview

In order to place this study within the context of an existing understanding of the field, an overview of literature pertaining to simulation based-education, dispensing skills and cognitive thinking is provided. Chapter 2 is a review of the literature beginning with work-integrated learning, describing the shortfalls faced within experiential learning and explains the move towards the use of simulation-based education. Simulation-based education is described in detail in terms of the need for this type of education, features which could benefit the use, with a final focus on the use of simulation-based education in pharmacy. In addition, the MyDispense computer-generated simulation dispensing program is introduced in this chapter by reviewing published and grey literature describing the use of the program internationally and the reported benefits thereof. Finally, literature regarding the dispensing process and cognitive requirements expected of pharmacists while practicing the dispensing process are reviewed.

The research methodology and process are described in Chapter 3. The chapter begins with an overview of the research approach and follows with a description of the four phases of the study. The study site and population are described and the study sample, data collection and analysis are also clarified. Chapter 3 concludes by explaining how ethical issues and concerns of trustworthiness of data were addressed.

Chapter 4 consists of the reported results of each of the study phases and includes an in-depth discussion regarding each phase. The first phase of this chapter explains the development of the clinical scenarios using MyDispense and is followed by the evaluation of the clinical scenarios as part of the second phase of the research. The third phase describes the implementation of the MyDispense program, and the chapter concludes with detailed reports of students' experience of using MyDispense during the fourth study phase.

In the final chapter, chapter 5, the study limitations are discussed and conclusions addressing the specific study questions are offered. Recommendations arising from the study and possible directions for future research are also conveyed.

# CHAPTER 2: LITERATURE REVIEW

## 2.1. Introduction

To be able to understand the context in which the study was being undertaken, it was necessary to review literature pertaining to simulation-based education, the dispensing process and the associated cognitive skills in order to gain perspective on where the MyDispense program fits into the pharmacy education domain. In this chapter, the review of work-integrated learning in pharmacy practice describes the shortfalls faced within experiential learning and explains the move towards the use of simulation-based education.

Simulation-based education forms one of the main focal points of the literature review, which explores the need for this type of education, educational features which could benefit the use, and the practice of simulation-based education in pharmacy. Additionally, the published literature concerning MyDispense, a computer-based simulated dispensing program, is reviewed, conveying the benefits of using the dispensing program as reported by authors, and describing design features of the program allowing for use as an educational simulation tool. Finally, literature regarding the dispensing process as practiced in South Africa is discussed and the cognitive requirements expected of pharmacists while practicing the dispensing process are reviewed in terms of the clinical decision-making and the levels of cognitive thinking according to Bloom's Revised Taxonomy.

## 2.2. Work integrated learning

When recalling the history of training for pharmacy, Boschmans, Tiemeier, and Kritiotis (2018) give an account of an apprenticeship system where pharmacy apprentices were given intensive exposure to the practice of pharmacy in the workplace, with a few academic courses given for enrichment. Later, the focus shifted towards acquiring academic knowledge as a type of learning-for-work model. Formation for pharmacy eventually required an internship with exposure to the workplace, but only after academic qualification. When the pharmacy profession started to shift its focus from the product to the patient, thus becoming more patient-centred, "pharmacy academics realised that their academic programme required enrichment with workplace exposure" (Boschmans et al., 2018). Thus, in pharmacy education greater emphasis started to be placed on work integrated learning (WIL).

The term WIL became the “umbrella term to describe curricular, pedagogic and assessment practices, across a range of academic disciplines that integrate formal learning and workplace concerns” (Council on Higher Education, 2011, p. 4). Within the scope of WIL are multiple practices and interventions all aimed at enhancing formation for professions where WIL is taken to describe “an approach to career-focused education that includes classroom-based and workplace-based forms of learning that are appropriate for the professional qualification” (Council on Higher Education, 2011, p. 4). These practices and interventions include experiential learning, work-based learning (WBL) and simulation-based education (SBE).

This study will focus particularly on SBE, and will contrast it with experiential or work-based learning (WBL) as two differing examples of WIL practices. Kritiotis (2018, p. 1), citing the Association for Experiential Education (AEE), highlights that the value of experiential learning comes from its “philosophy that informs many methodologies in which educators purposefully engage with learners in direct experience and focused reflection, in order to increase knowledge, develop skills, clarify values and develop people’s capacity to contribute to their communities”. While experiential learning requires time in the actual workplace, SBE in its multiple forms does not require actual work placement and yet allows for many of the same benefits of experiential learning as highlighted by Kritiotis (2018). This study will specifically explore the use of simulations for medical and clinical teaching and learning purposes.

### 2.3. Simulation-based education

SBE can be broadly described as a learning model which provides learners with an opportunity to experience a particular simulated world or system as a reflection of reality (Pale, Petrovic, & Jeren, 2012). Within the medical environment specifically, SBE is referred to when one is considering the use of any simulation technology to provide learners with the means to “engage in acquisition and practice of clinical skills without using live patients” (McGaghie, Issenberg, Petrusa, & Scalese, 2010, p. 52). SBE is reported as currently being used across many different platforms in a variety of healthcare educational fields such as medicine, nursing and pharmacy (Koo et al., 2014; Labuschagne, Nel, Nel, & Van Zyl, 2014; McDowell et al., 2016).

There are various forms of simulations all of which have been created to cater for specific needs in particular teaching and learning platforms. Some examples of simulations currently used in healthcare educational programmes include the use of:

- full-body mannequins, which are physical replications of the human body, programmed to present visible physiological changes;
- part-task trainers for repetitive practice of medical procedures on one particular part of the human body (e.g. a human arm used for blood pressure testing);
- simulated patients, who are real-life patients acting in a manner appropriate for a particular medical case study;
- computer-generated simulators, which create virtual learning environments from simple operation techniques to interacting with virtual patients;
- hybrid simulators, which combine the part-task trainers and simulated patient simulators. (Weller, Nestel, Marshall, Brooks, & Conn, 2012)

For the purpose of this research, the need for SBE will be examined in detail in the following section, and particular attention will be given to how SBE has specific value to pharmacy in enhancing the focus of a patient centred approach. Further, the role which SBE plays in enhancing learning of problem solving and clinical judgment will be highlighted, and finally, a full description will be given of how all SBE interventions are aimed at exposing students to the clinical domain with the intention of improving patient care and safety.

The focus of investigation will be the use of computer-based simulators, specifically the virtual dispensing program MyDispense. This open-source program was developed by Monash University, an Australian university, as a freeware simulation-based learning tool for the purposes of pharmacy education, where it has been proven to be successful in improving the competence of pharmacy students' dispensing skills (McDowell et al., 2016). MyDispense was introduced in 2010 for non-commercial use and is currently being used in 32 pharmacy schools globally (Costelloe, 2017). Nelson Mandela University is the first university in South Africa that has partnered with Monash University to create access to MyDispense using Nelson Mandela University's server.

### 2.4. The need for simulation-based education

Simulation-based education has come to the fore as a valuable addition to experiential learning experiences. It has been shown to have the potential to overcome certain limitations of experiential learning. For example, SBE allows for exposing students to skills required in the management of less common or highly infectious conditions, or even for enabling experienced practitioners to upgrade their skills while being engaged in full time work.

While experiential practice in pharmacy education has been successfully used across various institutions, some limitations have become evident. Hall et al. (2012) argue that experiential practice in pharmacy has led to a more “observational” platform, as students are only given short periods of experiential rotations in the necessary environment, which are frequently switched to enable a full spectrum of exposure. Hall et al. (2012, p. 285) also note how it is to the detriment of their pharmacy education that “students are given minimal opportunity to assume any responsibility or accountability for the development of drug therapy treatment plans and their associated outcomes.” McDowell et al. (2016, p. 2) concur with this, explaining that most pharmacy students have never been exposed to a pharmacy working environment before beginning their professional practice, and therefore experiential learning sites provide their only experience of “the mechanics and responsibilities of dispensing medicines to patients”. Weller et al. (2012, p. 2) describe how it can be “overwhelming for students who are often required to attempt tasks for which they are ill-prepared.”

Within the South African medical teaching domain, Labuschagne et al. (2014) highlighted the need for SBE because of a reduced variety of patient cases in academic and public sector hospitals. This was explained as being a consequence of the high prevalence of human immunodeficiency virus (HIV) and tuberculosis (TB) infections found in the South African healthcare environment. As a result, students receive limited exposure to a comprehensive array of other common and less common clinical conditions experienced in health practice. Vyas, Ottis, and Caligiuri (2011) note that educators have restricted influence over the type and range of patient encounters in any clinical setting, and advocate that seeking out more controlled environments for hands-on clinical opportunities needs to be given attention. In conjunction with this, there has been a steady rise in the number of students enrolling in the health science sector in South Africa and internationally, adding pressure on academic institutions to supply high quality education for each individual student (Labuschagne et al., 2014; McDowell et al., 2016; Weller et al., 2012). This rise in student numbers causes students to compete for a limited number of quality clinical encounters (Labuschagne et al., 2014), therefore resulting in a shortage of experiential clinical learning opportunities for students. Labuschagne et al. (2014, p. 138), however, explain that SBE can offer a “sustainable, feasible and affordable plan to address this shortcoming”. Labuschagne et al. (2014) suggest that this can be addressed by using SBE as a training platform to produce “better prepared and more competent graduates”. Furthermore, Weller et al. (2012, p. 2) emphasise how SBE can aptly allow for the “deconstruction” of clinical skills into their constituent parts as tasks and

scenarios, which can be offered to students in a manner which is consistent with their stage of learning.
Further benefits of SBE, such as the possibility of exposure to a large range of medical conditions within the context of a patient-centred approach, are discussed in the next section.

### 2.4.1. Patient centred approach

A move away from the traditional role of drug control and distribution to patient-centred roles and responsibilities, as noted in Section 2.1, has opened up the need for a different set of knowledge, attitudes, and skills for patient-centred care for pharmacists. Kritiotis (2018) describes how, during their training, pharmacy students learn the importance of patient-centred care, and yet when given the opportunity in a practice-based environment this important learning does not manifest. Rather than taking a patient-centred approach, students resort to using rigid technical practice approaches.

McCartney and Boschmans (2018, p. 29), citing the International Pharmaceutical Federation (FIP), state that pharmacists are “no longer restricted to the provision of medicines but now offer a range of patient-focused services designed to meet the medicine-related needs of the patient”. Weller et al. (2012, p. 3) also explain that SBE provides a “valuable contribution to learning for students, trainees and clinicians, especially for clinical and procedural skills, clinical decision-making, patient-centred and inter-professional communication, and teamwork”. Weller et al. (2012), however, caution that some platforms of SBE are more appropriate for specific types of learning and that virtual patients while helpful to develop clinical reasoning skills are not entirely suitable for the learning of patient-centred care.

There are, however, SBE platforms that attend to procedural skills, clinical reasoning skills. and patient-centred care. An example of such a platform is the aforementioned computer-based program MyDispense. MyDispense has the potential to be used for guiding students through a range of patient-centred responses and clinical reasoning during the dispensing process. An example of this is reported by McDowell et al. (2016, p. 4), who describe how patient-centred exercises, considered to be “authentic to a modern Australian community pharmacy”, were developed within the MyDispense platform and were used to allow students to work through a simulated experience of dispensing. MyDispense requires students to find solutions to patient-centred exercises and in doing so students are required to both problem-solve and use their clinical judgement. The manner in which this can be achieved with MyDispense will be discussed in the ensuing section.

### 2.4.2. Learning problem-solving and clinical judgement in Simulation-based education

While patient-centred exercises are necessary for training pharmacy students, the provision of experiences that challenge students cognitively and are aimed at enhancing students' clinical reasoning and problem-solving skills are recognised as an important component of pharmacy education by a number of authors. In this discussion, aspects of the cognitive domain which will be focused on are those encompassing clinical judgement and problem-solving. Vyas et al. (2011, p. 1) state that "clinical judgement requires compilation, analysis, and synthesis of data to make critical decisions about patient care". The American Association of Colleges of Pharmacy (AACP) Report of the 2009-2010 Academic Affairs Standing Committee describes problem-solving as "a high-order thinking skill that represents the ability achieved by mastery of each level of Bloom's [revised] taxonomy" (Oderda et al., 2010, p. 4). Vyas et al. (2011) concur and mention that this taxonomy can be used to categorise types of high-order thinking, and that problem-solving occurs when a student is able to use knowledge at each level of Bloom's Revised Taxonomy (Bloom's Revised Taxonomy is a hierarchical ordering of cognitive skills which will be discussed in greater detail in Section 2.8.7.).

SBE is recognised for the benefit it offers when used to supplement traditional classroom-based learning experiences in order to engage the cognitive domain in a different manner. Vyas et al. (2011, p. 1) state that student performance in clinical practice simulation experiences can bring together "knowledge, comprehension, application, analysis, synthesis and evaluation". However, the facilitation of a student's engagement of higher order reasoning skills is acknowledged to be a difficult undertaking for pharmacy educators to successfully achieve. Some positive accounts of how the use of SBE has achieved this are provided by Vyas et al. (2011). Citing Seybert (2011), Vyas et al. (2011, p. 2) describe positive changes in "students' self-perceived ability to solve problems, as well as greater student satisfaction" when SBE was used in place of traditional classroom teaching.

McCartney and Boschmans (2018, p. 33) illustrate the transition from the classroom instruction mode to the demands of problem-solving by quoting a student participant in an experiential learning programme, which was aimed at enhancing the cognitive domain: "*Moving from listening to my lecturer and actually making decisions … so I think it's just moving from the fact that we were babied in class and now we have to be independent individuals. I think it's going to be quite daunting".*

The role of the pharmacist clearly requires pharmacists to competently apply pharmaceutical and pharmacological knowledge to individual cases by practicing problem-solving and decision-making in practical and clinical settings (McCartney & Boschmans, 2018). However, McCartney and Boschmans (2018, p. 30), citing several authors, go on to report that pharmacy, medical, nursing, occupational health and students in the other health related sciences experience "difficulty in application of knowledge when problem-solving and clinical decision- making" is required.

McDowell et al. (2016, p. 5) suggest that SBE using a software program, such as MyDispense, provides an opportunity for pharmacy students to develop their "critical-thinking and problem-solving skills" throughout the dispensing process, from initial contact with the patient to handing over the medication. As mentioned previously, while it has been recognised that pharmacy education aims to develop students' cognitive skills, it is difficult to elaborate on how precisely one develops students' clinical reasoning skills and how students' reasoning skills are best assessed (Vyas et al., 2011).

Bloom's Revised Taxonomy is a model which categorises types of knowledge into six cognitive levels arranged in a hierarchical order starting from the lowest level to the highest level (Anderson & Krathwohl, 2001). The three lowest levels are "knowledge, comprehension and application"; and the three highest are "analysis, synthesis and evaluation" (Forehand, 2005). Each level requires the achievement of the skill in the previous level before the student is able to progress, rendering Bloom's Revised Taxonomy a useful tool for the classification of the processes of thinking and learning (Forehand, 2005). For the purposes of this study Blooms Revised Taxonomy was, therefore, chosen as the tool used to interrogate the levels of cognitive demand which were required for successful completion of the clinical scenarios developed during Phase 2 of this study.

Another model of intellectual development has been described by Perry, cited by Vyas et al. (2011), who used consecutive stages to summarise student progress in the cognitive domain. In this model, "dualism" is a lower level of cognition seeking only "black and white" answers to all problem-solving situations (Vyas et al., 2011, p. 2). When progress is made, the recognition that there is no "right" answer to a problem can appear and a higher-level of cognition, requiring "commitment in relativism", engaging sustained complex thinking becomes necessary (Vyas et al., 2011, p. 2). Vyas et al. (2011, p.2) suggest that "this state is usually achieved when students draw upon their accumulated experiences and weigh all possible solutions before selecting a particular answer", and that living in ambiguity is the real-life

experience of pharmacists, with the acknowledgement that “even the experts sometimes disagree”. The underlying need for heightened critical thinking and reasoning in pharmacists lies in the potentially positive influence on the issue of patient safety these skills provide, which is addressed in the next section.

### 2.4.3. Patient safety

Through thorough clinical investigation and planning, patient safety remains at the forefront of successful patient care. The high incidence of medication errors, as reported by Regan, Harney, Goodhand, Strath, and Vosper (2014), creates the continual need for new interventions which can assist in creating improvements to patient safety in the dispensing environment. The danger of negative health outcomes and the consequences thereof in practice prevents pharmacy educators from exposing students to adequate clinical practice during their training. It is of paramount importance to avoid any harm to patients. However, this places a major constraint on the clinical exposure of healthcare students. McDowell et al. (2016, p. 2), when explaining the simulation environment of MyDispense, note that when the teaching method is diverted from direct instruction to a simulation environment, students can experience “productive failure”, where they are able to learn from errors they make in a safe environment. Furthermore, this highlights the benefits of a “hybrid approach”, wherein feedback that is given after the completion of a MyDispense exercise in an “explanatory and corrective” manner can be used as a teaching opportunity within a simulated environment (McDowell et al., 2016, p. 2).

Medical training institutions and facilities face the major ethical challenge of ensuring patient safety throughout their training programmes (Labuschagne et al., 2014; McDowell et al., 2016; Weller et al., 2012). Some medical scenarios are almost only learnt in emergency or high-risk situations which do not occur frequently, and, in addition, allowing inexperienced students to assist in these situations poses a serious risk to patients (Labuschagne et al., 2014). Simulation-based education has proven to assist in this particular area, allowing students to repetitively practice specific emergency or high-risk scenarios and develop their confidence before practising in the work environment (Labuschagne et al., 2014; Weller et al., 2012).

Regan et al. (2014) make comparisons between other high-reliability professions besides medicine which necessitate “safety systems”. Civil aviation and nuclear industry are compared with pharmacy, where mistakes are accepted as unavoidable. However, the need for processes “not only to reduce the possibility of error, but also to facilitate enhanced detection

and correction of errors that do occur" becomes vital for these professions (Regan et al., 2014, p. 51). One example of this is MyDispense, which is proven to be successful in improving the competence of pharmacy students' with regard to safer dispensing skills (McDowell et al., 2016).

In this section, the researcher has demonstrated the potential of SBE as an intervention to address needs, such as the currently recognised requirement for pharmacy graduates to emerge from their training having already had opportunities to practice providing patient-centred care. In addition, the need for students to enter the profession experienced in problem-solving and the use of critical thinking skills, and with prior safe exposure to high-risk interventions in a safe environment, were also discussed. In the next section, the ways in which the features of SBE assist in addressing these needs will be interrogated. The features that this study will explore are: deliberate practice; provision of structured feedback; fidelity of simulation; and the opportunity to integrate SBE into a curriculum. Furthermore, the development of competency and current practices related to instructor training for SBE will also be addressed.

### 2.5. Features of simulation-based education

Simulation-based education has been proven to guide students through progressive tasks of increasing complexity, particularly in clinical settings, such as is required in the pharmacy profession, as mentioned in the previous sections. One particularly helpful feature of SBE which this study will explore is the benefit gained from the manner in which simulation allows for the break-down of various clinical tasks into component parts, which can then be introduced at a gradual pace, allowing for the cognitive load of simulation-based exercises and scenarios to be gradually increased (Van Merrienboer & Sweller, 2005). In conjunction with this, the following paragraphs will explore the features of SBE which are aimed at addressing the need for pharmacists to be sufficiently trained in patient-centred care, by using high-order cognitive thinking and proficient clinical decision-making skills to solve clinical scenarios.

#### 2.5.1. Deliberate practice

Ericsson (2004, p. 72) describes deliberate practice as training activities which are "closely associated with consistent improvements in performance" and involves the improvement of an

aspect of performance for a well-defined task, followed by immediate feedback on the performance. Simulation-based education has been proven to facilitate deliberate practice, which has been used in various successful teaching and learning environments (Ericsson, 2004; McGaghie et al., 2010; Weller et al., 2012). Deliberate practice allows for repetitive practice of various clinical skills in a specific environment, refining students' clinical skills as they become ever more "fluent and instinctive" (Weller et al., 2012, p. 2). Furthermore, Ericsson (2004) states that deliberate practice can encourage multiple practice opportunities consisting of shorter periods, which are more valuable than less frequent practice opportunities of greater duration. Tasks can be designed to consecutively build on existing knowledge and skills in increments, thereby also providing for the accommodation of different learning styles and rates of learning (Weller et al., 2012). On this issue, McDowell et al. (2016) note that the MyDispense program allows for repetition of the exercises for deliberate practice which can be followed immediately by informative structured feedback.

### 2.5.2. Structured feedback

McGaghie et al. (2010) emphasise that SBE has been proven to be of value in providing feedback as a successful educational tool to promote effective learning. Weller et al. (2012, p. 2) added that the well-structured layout of SBE improves the quality of feedback to students, and that feedback is, in turn, an important part of SBE as it encourages "skills development and maintenance". Regan et al. (2014, p. 51) state that feedback of this nature should also be known as "feedforward", so that students are aware of the difference between their own performance and the necessary learning outcomes that need to be achieved. It would therefore be necessary for the feedback to be "diagnostic and couched in the same terms as the learning outcomes" (Regan et al., 2014, p. 51). The MyDispense program provides feedback by providing a report of what the student completed correctly and how they could improve their work. McDowell et al. (2016, p. 4) confirm that feedback provides "best-practice learning". Shin, Tabatabai, Boscardin, Ferrone, and Brock (2017) also agree that MyDispense has the potential to benefit students as a "self-study" tool, since an individual student can receive feedback at any time via electronic methods. Ambroziak, Ibrahim, Marshall, and Kelling (2018) reported that students using MyDispense were provided with exercises designed to give immediate formative feedback which allowed students to self-identify the amount of practice they regarded necessary to gain particular skills relating to the dispensing of medicine. Thus, when using SBE it has been shown that the possibility of feedback with repeated practice has benefits in many disciplines, including pharmacy.

### 2.5.3. Simulation fidelity

Simulation fidelity, described by McGaghie et al. (2010), refers to users' perceptions of the "realism" of a simulated experience. McDowell et al. (2016, p. 3) describe the designing of MyDispense as an attempt to "reflect the real world (i.e., the engineering-psychological fidelity balance)". The physical aspects reflecting the real-world pertain to engineering fidelity, whereas capturing real-task skills with a high degree of accuracy pertain to psychological fidelity. McGaghie et al. (2010) affirm that the educational goals needing to be accomplished must be aligned with the simulation tools available for successful simulation fidelity. Maran and Glavin (2003) agree with the need for alignment, and warn that novice students could be easily distracted from learning basic skills if the simulation is too complex or displays a high level of realism. Regan et al. (2014, p. 52) add that difficulties can occur when simulation is used with different teaching modalities, and that inappropriate simulation designs can lead to "negative learning", whereby the scenario cues trigger misaligned responses from the students. Regan et al. (2014) also suggest that a lack of psychological fidelity can cause the student to lose their focus on the patient resulting in a reduction of safe patient-centred professional behaviour. On the other hand, high psychological fidelity can cause students to become distressed during traumatic scenarios, particularly if the student is not given sufficient and appropriate assistance during such scenarios. Seybert (2011, p. 1) also confirms that the "use of high-fidelity human patient simulation is an example of an acceptable method of simulating patient care activities", and that it is critical that the required patient care activity be aligned with high-fidelity human patient simulation. Thus, it has become clear that fidelity in simulations requires careful planning, and that appropriate support may be required by students when completing simulation exercises.

### 2.5.4. Curriculum integration

Simulation-based education is known to support well planned and structured curriculum integration, ensuring the inclusion of a variety of types of educational events (experiential placements, lectures, reading, and laboratory practicals) to achieve learning outcomes. McGaghie et al. (2010), Weller et al. (2012) and Labuschagne et al. (2014) all emphasise the importance of planning the integration of SBE into the curriculum and not merely using it as an add-on. The use of SBE together with the continual use of real clinical settings is also encouraged. Weller et al. (2012) recommend the incorporation of SBE during the educational planning phases to ensure alignment of the learning outcomes. However, the incorporation of

SBE largely depends on the availability of resources, particularly if there is no pre-existing foundational SBE platform. Weller et al. (2012, p. 2) further suggest that the additional use of SBE can be used to compensate for “teaching and learning in clinical settings that is opportunistic and unstructured”. This can occur when students in clinical settings are required to apply themselves to demands for which they are not fully prepared and which fall outside of the scope of their existing knowledge, capabilities and preparedness in relation to where they are in their planned curriculum. Contrary to this, SBE provides for “deconstruction of clinical skills into their component parts so that students can be presented with scenarios and tasks appropriate for their stage of learning” (Weller et al., 2012, p. 2). Curriculum integration could be further enhanced by using SBE in creative combination with other educational approaches. McGaghie et al. (2010, p. 56) describe examples of using “simulations as a clinical trigger and context for problem-based learning cases”. Kneebone (2009, p. 954) affirms that “procedural skills should not be divorced from their clinical context and that oversimplification of a complex process can interfere with deep understanding”.

Labuschagne et al. (2014) and McGaghie et al. (2010) caution that including SBE into a curriculum requires additional resources and planning, which may hinder the integration of SBE. These, for example, include funding, contact hours with trainers who already have a high work load, and having to convince lecturers of the value of including simulation exercises into their curriculum. McGaghie et al. (2010, p. 56) state that it would be to the detriment of the impact of SBE if practice time is reduced, and note that SBE would then be found to deliver “a less powerful education ’dose‘ than was intended”. McGaghie et al. (2010, p. 56) further state that SBE “complements clinical education but cannot substitute for training grounded into patient care in real clinical settings”.

### 2.5.5. Competency

The features of multiple task complexity, and proven competency-based educational outcomes, in any medical profession, interlink with what SBE offers. The South African Pharmacy Council (SAPC) defines competency as “a quality or characteristic of a person related to effective or superior performance. Competency consists of aspects such as attitudes, motives, traits and skills” (South African Pharmacy Council, 2018). This becomes evident when one notes how the features of SBE as described in Subsection 2.4. can be useful in addressing the development of competencies required by a statutory body of a profession such as, for example, the 2018 SAPC Competency Standards for Pharmacists. The features of competency-based education overlap with the features of SBE, as discussed previously in

Section 2.5.1., under the topic of deliberate practice (McGaghie et al., 2010). This becomes evident when considering the SAPC's definition and description of competency standards as summarized in Table 1.

*Table 1: Extract from 2018 Competency Standards for Pharmacists in South Africa (South African Pharmacy Council, 2018)*

| **COMPETENCY STANDARDS** |
| --- |
| A *competency* (plural *competencies*) represents the individual qualities or attributes of professional activity, the *how* of performance. These are learned behaviours and are thus able to be effectively incorporated into developmental programmes that require practitioners to apply learned behaviours. Since competency standards are developed with a focus on performance, they facilitate identification of the aspects of performance in the workplace and provide the best means to deduce professional competence.<br><br>Competency is a broad concept that includes all aspects of practice, including:<br><br>(a) skills to perform particular tasks; (b) managing a number of different tasks/activities within an occupation or profession; (c) responding to problems and non-routine events; and (d) dealing with all aspects of the workplace including working with others. |

The term mastery learning is introduced by McGaghie et al. (2010) when describing the rigorous approach of competency-based education. When mastery learning requires "*all* learners to accomplish *all* educational objectives with little or no outcome variation" (emphasis from authors), varying amounts of time, for example, will need to be given to different learners (McGaghie et al., 2010, p. 57). SBE as a new technology resource can allow for a number of individually tailored repetitions on the path to achieve mastery.

In a study using human patient simulation mannequins, Fernandez, Parker, Kalus, Miller, and Compton (2007) report that when students were led to perceive the simulation environment as a "safe" place to try out new skills, the requirement for mastery was able to be set at a high standard of quality. Furthermore, in this study, the authors explained that the safety of the environment was related to the absence of evaluation of clinical knowledge and any form of assessment. This highlights an interesting correlation between the perceived safety of environment and the high level of mastery provided by SBE. In a synthesis of reviews into SBE research, McGaghie, Issenberg, Barsuk, and Wayne (2014) report that SBE, in

combination with mastery learning, can produce influential educational interventions that produce immediate and lasting results.

### 2.5.6. Instructor training

In a study conducted on the implementation of a virtual dispensing simulator, Ferrone, Kebodeaux, Fitzgerald, and Holle (2017) emphasize that when a new technology is introduced into the classroom, three main challenges can appear, falling within the domains of “cultural, process and academic”. They highlight that students should be trained adequately when initiating a new and alternative learning activity, and that students might have greater satisfaction of a simulation activity if more emphasis is given to the promotion of the activity. This points to an issue of faculty expertise through training, which McGaghie et al. (2010, p. 60) note “contribute significantly to the success or failure of SBME”. The effectiveness of SBME (Simulation-Based Medical Education), as referred to in this case, is impacted by the skills and training of instructors. Presently, it would appear that simulation instructors for healthcare professions are trained by buyers and users of the equipment or program.

SBE has proven to assist in the development of pharmacists’ clinical skills by supplying useful education tools which can be tailored to suit the needs of the education programme. Deliberate practice and structured feedback allow for repetitive constructive practice to ensure accuracy. Simulation fidelity, curriculum integration, and competency practice assist in the integration of specific content and can determine the usability of SBE, relating directly to the success of achieving the programme’s learning outcomes. Lastly, the instructor training is dependent on the educators and the programme coordinators.

These features already point to the positive reports of what is occurring when SBE is used in education across the globe. In the next section, the use of SBE in pharmacy education will be discussed.

## 2.6. Simulation-based education use in pharmacy

Simulation-based pharmacy education is comparatively new as mode of supporting learning, but one that is expanding quickly to meet the educational needs of new, competency-based pharmacy professionals. The traditional route of experiential placements has been demonstrated to have limitations, as discussed in Section 2.4, and simulation is now being

relied on to provide some solutions to this situation. Fernandez et al. (2007, p. 5) call simulation-based solutions a “surrogate for true experiential learning”. Simulation offers useful opportunities for providing real-life work situations, in which students can bring their clinical knowledge and human interaction skills into play. Thus, it will be shown that SBE in pharmacy holds the possible promise of providing ample opportunities to all students to engage in aspects of clinical practice, with potentially positive outcomes for the profession. For example, Seybert (2011) suggests that the use of SBE in pharmaceutical education has already proven to be beneficial in decreasing the incidence of medication administrative errors.

In this section, examples of various types of simulation used in pharmacy schools around the world will be further discussed, particularly as they relate to the benefits emerging from the features of SBE. In the context of the study, “pharmacy schools” will include Departments, Schools, or Faculties of Pharmacy. The widespread use of SBE described in the previous sections demonstrate how different types of SBE are currently being used in the pharmacy education domain. These are examined in relation to the issues of patient safety, high fidelity, curriculum integration, deliberate practice, structured feedback, competencies, problem-solving, and clinical judgement.

### 2.6.1. Types of simulation

The educational design of a simulation-based intervention in pharmacy education originates from the desire on the part of educators to address the need for pharmacy students to emerge from their training as multi-skilled professionals. The details of these skills are guided by the competency requirements of the statutory body of their country and are continually updated. As mentioned in Section 2.5.5., the SAPC has recently published new competency requirements for South Africa. Thus, South African pharmacy schools have also begun to use SBE to better enable students to gain the required competencies. For example, one university has begun to use game simulation in their pharmacy school while a further university is also considering using MyDispense.

The particular choice of simulation used in pharmacy related SBE, currently appears to be prompted by efforts on the part of educators of pharmacy schools to address both the competency requirements, as well as the need to use staffing and financial resources effectively. For the purposes of this study the educational design of four types of simulation in

pharmacy will be reviewed and described: human patient simulations; clinical simulations; game simulation; and computer-based simulations.

#### 2.6.1.1. Human patient simulation

Human patient simulation is a type of simulation which uses patients' physical presentation as the subject of the study. These types of simulations can vary from human actors portraying particular patients, to high-fidelity full-body human patient simulators that have the ability to portray a variety of disease states and also respond to administration of drugs or procedural interventions (Fernandez et al., 2007). High-fidelity human patient simulators can be designed to have the ability to "speak, breathe, have realistic heart, lung, and bowel sounds, display hemodynamic parameters in real time, seize, sweat, display cyanosis, and other physiologic responses at various levels depending on the model used" (Seybert, 2011, p. 1). Some specific examples of the use of human patient simulation in pharmacy education will be discussed in the following paragraphs.

Fernandez et al. (2007) used human patient simulation mannequins to teach interdisciplinary team skills to pharmacy students during their second professional year of study. The simulation was part of a problem-based learning course, where students were expected to recommend treatment for an acutely ill patient with a hypertensive emergency. Students were expected to communicate treatment recommendations to nursing and physician staff. The outcome of the research was that students preferred the "safe" environment, where there were no high stakes assessments of their performances, and most of the comments recommended that more simulations should be incorporated into the curriculum (Fernandez et al., 2007, p. 5). Students also felt that the verbal prompts throughout the simulation improved the realistic pharmacist experience, and described the simulation experience as "safe yet challenging" (Fernandez et al., 2007, p. 5). Fernandez et al. (2007) also report the usefulness of a high-fidelity simulation environment to provide students with the opportunity to become aware of the complex nature of the tasks and multiple skills necessary to perform adequately. Debriefing sessions post-simulation were also highlighted as central to the simulation process. Fernandez et al. (2007, p. 6), citing various authors, state that debriefing is an "extremely critical" part of the learning process. However, it is time-consuming and necessitates direct feedback with the educators.

Vyas et al. (2011) report research on the use of human patient simulation to teach higher-order thought processing and problem-solving skills, including critical thinking and the

integration of simulation into the curriculum. In the study described by Vyas et al. (2011), the methods of developing human patient simulation scenarios are discussed in detail, beginning with the scenario preparation or pre-simulation, followed by the clinical encounter, and finally the debriefing period. Reports from the study underline the value of simulation to create patient safe environments which are also considered “high-stress, low-risk” for the students (Vyas et al., 2011, p. 4). This, in comparison to the previous paragraph where Fernandez et al. (2007) report that students prefer safer learning environments, can be interpreted as students preferring lower risk environments where there is no potential for harming real-life patients if their solutions to assist the patient were to be inaccurate or insufficient. However, the exposure to high-stress simulation learning environments where competent acute critical care is required, increases the learnability of the simulation experience. Vyas et al. (2011) reported how students were successfully encouraged to become more meta-cognitively aware of complexities during the scenarios, which included changing the expectation of students to recognise and arrive at multiple correct answers to the simulation scenarios, rather than just the traditional right or wrong answers.

In a study by Bray, Schwartz, Odegard, Hammer, and Seybert (2011), the authors explain how both formative and summative feedback can be provided, thereby showing how in research, student pharmacist performance can be assessed through simulation-based teaching. Furthermore, Bray (2011) and colleagues recommended that reliable and effective tools be used to create the foundation for thorough assessment of professional competency. Various barriers have thus far hindered the development of assessment using simulation, including validation processes of assessment tools, limited resources, and insufficiently trained educators/staff. Bray et al. (2011, p. 3) recommend that the assessment of pharmacy-based human patient simulations be categorized in five ways:

1. Surveys of satisfaction and/or confidence/self-efficacy
2. Assessments of knowledge
3. Assessments of performance-based skills
4. Demonstrations of problem-solving abilities
5. Evaluations of team-based behaviours

Bray et al. (2011) also suggested that pharmacy education needs to expand the range of simulation assessments beyond satisfaction/self-efficacy survey tools and include the assessment of clinical performance and critical thinking.

Human patient simulations are not the only successful simulation used in pharmacy education, clinical simulations have also been proven to assist in teaching the fundamentals of pharmacy practice including inter-professional relationships with other healthcare professionals in a clinical setting, which will be discussed in the following section.

#### 2.6.1.2. Clinical simulation

Simulations have been used progressively to implement learning strategies across many healthcare professions (Koo et al., 2014). More specifically, Koo et al. (2014, p. 741), citing Leonard, Shuhaibar, and Chen (2010), state that clinical simulations can provide "opportunities to experience, among other things, clinical situations involving team dynamics, communication and problem solving making simulation an ideal tool for inter-professional learning".

In a study by Koo et al. (2014) to analyse the skills required for effective professional inter-professional relationships, nurse practitioners and pharmacy students were trained together using standardised patients and accompanied by physicians role-playing in clinical scenarios. A standardised patient can be defined as a person who has been given training to simulate an actual patient, "including not only history and physical finding but personality and body language", in order to provide for high-fidelity simulation (Koo et al., 2014, p. 741). The purpose of the study was to reduce potential conflicts and increase the knowledge of the role of other professionals in a health care team. This type of training is reported to provide clinical situations involving team dynamics, which require effective communication between professionals, while challenging the understanding of overlapping roles. The clinical scenarios that were given to the students required inter-professional communication modes, including in-person telephonic and video conferencing. In order to enhance the benefits of the simulation, debriefings after the experience allowed for reflection on communication strategies and roles. Participants reported their own "lack of understanding regarding the role and full scope of practice of other healthcare professionals" (Koo et al., 2014, p. 744). Participants also reported being challenged during the scenario with regards to which team member was responsible for specific components of the interaction, particularly regarding the patient interview and communication with the physician. In this study, the value of collaboration of nurse practitioners, pharmacists, and other multi-disciplinary team members was shown to improve through simulation training. This has implications for improving the quality of care and reducing costs. Furthermore, Koo et al. (2014) also report that simulation has been successfully used to incorporate learning models amongst healthcare professionals, as well

as to teach inter-professional skills throughout the healthcare system. Koo et al. (2014), citing various authors, list successful examples of inter-professional simulations using healthcare educational activities, such as a learning module on asthma health promotion, a workshop on chronic obstructive pulmonary disease, and other simulations on end-of-life care, patient safety, and teamwork skills.

Monash University originally initiated their contribution to community pharmacy based simulations by creating a curriculum resource platform called Pharmville which was successfully used for a number of years before MyDispense was created (Marriott, Styles, & McDowell, 2012). The designers of Pharmville responded to a need for a platform which sought to apply integrated professional practice concepts within a societal context so that "student pharmacists could identify themselves in the role of a responsible health care practitioner and as a member of a community of people with whom they could develop a professional and emotional connection" (Marriott et al., 2012, p. 2). Pharmville consisted of a virtual community of fictional characters in a number of families, who were introduced to students using video vignettes, photographs, documented health profiles, medical histories, and social histories. The information was designed in a flexible manner so that when the teachers created scenarios based around the Pharmville patients, they would be able to configure and alter the information relevant to specific learning activities in a range of therapeutic areas across the curriculum. Marriott et al. (2012, p. 6) suggest that in a manner consistent with the principles of experiential practice, it is important to ensure that the professional and academic demands of an accredited degree include "creating opportunities for engagement within authentic professional contexts that support cognitive and social development". It was also noted that students were able to define and construct their own professional identity through exposure to the pharmacist role model (the community pharmacist in Pharmville) and the complex, realistic cases of Pharmville. Marriott et al. (2012, p. 6) identified the need for Pharmville to be adequately aligned with the learning outcomes of the activities, and also for the students to have realistic interactions with the characters, instead of insisting on the students being constantly exposed to Pharmville, as there should be a "clear connection between theory and the real world". The developers of Pharmville did highlight barriers to its development, such as the extended time needed for reviews of teaching resources, the lack of awareness of the resources, and the time and workmanship taken to design and implement Pharmville activities. However, these issues were addressed through the provision of support, availability of teaching exemplars, dissemination of evaluations, and sharing of responsibilities for the use of development.

Human and clinical simulations can also be used together to form a new platform of teaching. Instead of using the simulations separately, they can be used in conjunction with each other, allowing students to practice this multi-faceted simulation as a game, and not necessarily as an assessment.

#### 2.6.1.3. Multi-faceted simulation

The University of Groningen in the Netherlands took a different approach and created a pharmacy education game called the Groningen Institute Model for Management in Care Services (GIMMICS) (van der Werf, Dekends-Konter, & Brouwers, 2004). The game includes human simulations and clinical simulations. Today, GIMMICS is being used at four other universities: University of Utrecht (Netherlands), Vrije Universiteit Brussel (Belgium), University of Nottingham (United Kingdom) and Griffith University (Australia) (Taxis et al., 2018). van der Werf et al. (2004, p. 166), citing many authors, explain that GIMMICS was developed as a game because it provided the opportunity to "create processes of integration under conditions controlled by the participants, meaning that the participants can initiate, plan, execute and control activities themselves".

In GIMMICS, students are expected to manage a simulated pharmacy, including human and clinical simulations, by processing prescriptions, conducting various meetings with colleagues (fellow students), dealing with human-simulated patients, wholesalers, and other healthcare professional role-players, whilst striving to achieve their pharmacy's customized mission statement. Students are assessed on their completion of various assignments throughout the management of the pharmacy, but are not always provided with solutions if their answers are incorrect. van der Werf et al. (2004) write that students and staff were not entirely satisfied with this teaching structure, and the game was later changed to provide a "wild card" which students could use once during the game to obtain all the correct answers for one of the assignments. However, the main assessment was the number of the patients which the pharmacy gained during the students' time spent managing it. Schaafsma, Dantuma-Wering, Pilon, and de Gier (2015) report that students appreciate the competition as they feel it improves their professional skills. The students in the study by van der Werf et al. (2004) further commented that the game required an excellent integration of social competences and different fields of knowledge. Contrary to this, van der Werf et al. (2004) concluded that students and staff experienced difficulties with adapting to new roles and teaching styles during the study, and that GIMMICS was a time-consuming exercise which required creation as well as continual maintenance of the game. Pharmacy school staff and external

professionals also encouraged a “rich game setting” which required the management of GIMMICS to allow it to accommodate and monitor more interactions between multiple members of the team, making it difficult to balance “richness on the one hand and standardizing on the other” (van der Werf et al., 2004, p. 169). In summary, GIMMICS has been proven to be beneficial in pharmacy schools and thus continues to be used. One of the simulations not included in this discussion on multi-features simulation, is computer-generated simulation which will be discussed in the following section.

#### 2.6.1.4. Computer simulation

Computer-generated simulations of pharmacy environments are the most recent development in the simulation environment and these simulations, with the spread in use of technology, are continuously developing. Virtual simulations, an alternative term for computer-generated simulations, are described by Bindoff et al. (2014, p. 2) as a scenario where “human players use simulated systems in a synthetic environment”. Until recently, computer-generated simulations were not widely used because of the high cost required for development of the simulations, and the large amount of detail required when high-fidelity virtual environments are expected. Lately, however, there has been a wave of improvements in computational and graphics processing power available, allowing designers to better meet the requirements for programming high fidelity simulation environments, making computer-generated simulation in pharmacy education more accessible and affordable than in the past.

The computer-generated simulations mentioned in this subsection consist of the presentation of dispensing simulation environments, involving clinical scenarios which are either related to prescription, or non-prescription medications. These computer-generated simulations require students to either dispense a prescription presented by a patient in a simulated pharmacy environment, or to assess a patient’s condition and dispense a non-prescription medicine for the patient. During this literature review no literature was found that describes computer-generated simulations within a hospital pharmacy environment, only simulated community pharmacy environments appear to be described. Pharmacists are generally considered to be one of the most accessible health care professionals and are equipped with the necessary clinical and history-taking skills to conduct pharmacist-initiated care, therefore computer-generated simulations which allow the development of these skills are very useful.

A community pharmacy computer-generated simulation, designed by Bindoff et al. (2014) at the University of Tasmania, offers the opportunity for students to experience a virtual

environment in a 3-dimensional format, allowing the students the ability to “walk around all areas of the pharmacy and make context-appropriate interactions with relevant items” (Bindoff et al., 2014, p. 2). Bindoff et al. (2014) describe a detail rich, high fidelity simulated environment in which students are able to communicate with the patient by greeting them and ascertaining the reason for their visit. This interaction also includes history taking, making recommendations, and providing advice to the patient. Students are also able to initiate dialogs “telephonically” with either the prescriber, the hospital staff, or the staff of a nearby pharmacy. Ultimately, students are able to practice their patient interaction skills, as well as their inter-professional communication skills. This simulation also offers the possibility to add additional communication challenges for the students during the scenarios. The verbal communication can include verbal or non-verbal responses (“head-nodding, head-shaking”) to imply irritability or frustration in the other individual. In an evaluation of this simulation described by Bindoff et al. (2014), students reported that they were hindered by not being able to state the verbal communication in their own words, and instead had to select pre-determined sentences. However, it became clear that, especially for less experienced students, the selection of verbal communication was implemented to guide, instruct, and expose students to appropriately phrased counselling points and relevant counselling information. Students did report that the simulation allowed for immediate feedback, which they found to be valuable, because it allowed them to “learn from their mistakes and their successes” thereby providing structured feedback (Bindoff et al., 2014, p. 7). The scenarios were also repeatable if the students wanted to improve their score, also allowing for deliberate practice as mentioned in Section 2.5.1. Bindoff et al. (2014, p. 8) acknowledged that at first the students found the “simulation was difficult to use” and students were “uncomfortable and unfamiliar” with the computer hardware and software. However, Bindoff et al. (2014) report that there was an improvement in the student experience after the initial simulation exercise. This highlights the need for correct sequencing of learning outcomes during the community pharmacy simulation experience as there is a risk that one could assume that students have adequate computer skills for computer-based SBE. Despite the students’ difficulties, a particular student in this study reported that “it was interesting to see the whole process of dispensing and have control over that”, highlighting the benefit which the collaboration between the simulation practice and traditional teaching methods can provide (Bindoff et al., 2014, p. 8).

The simulations described in this section (i.e. those specifically used for the purpose of pharmacy education), have proven to be successful in providing experiential practice for pharmacy students to engage in professional practice while integrating their clinical

knowledge. Furthermore, computer-generated simulation dispensing programs, which form a major focus of this study, have proven to achieve educational outcomes relating specifically to the need of cognitive-based and competency-focused skills, into simulation dispensing environments. In particular, the MyDispense computer-generated simulation program will be discussed in the following section, as it focuses on the ability of the program to integrate the above-mentioned skills into the simulation dispensing environment.

### 2.7. MyDispense computer-generated simulation dispensing program

The computer-generated dispensing simulation program MyDispense will be introduced in further detail in this section, and its benefits and features will be discussed in terms of the usability of the dispensing program as compared to the previously mentioned pharmacy orientated SBE programs in Section 2.6.

The MyDispense computer-generated simulation program was developed by the Faculty of Pharmacy and Pharmaceutical Sciences at Monash University in Melbourne, Australia. Version 1 of MyDispense was launched in March 2011 and was soon followed by several revisions of the program as proposed adaptations and changes were instituted. Version 5 of the program is the latest version available to users. With skilled computer-generated simulation, users of the program are able to engage in the role of a pharmacist as if they were in an actual community pharmacy. McDowell et al. (2016, p. 2) defines MyDispense as a "simulated learning environment to help students develop skills and competency in dispensing medicinal products systematically, safely and accurately at a level of detail and difficulty corresponding to their knowledge and expertise".

When and how MyDispense is used varies across pharmacy schools around the world. It depends on the ability of pharmacy students to complete computer-generated simulations, which will vary according to the structure of the curriculum. For example, a pharmacy school may decide to teach the legalities of pharmacy practice from the first year of study, or they may opt to introduce the topic in later years of study. However, common to all pharmacy schools is the expectation that students should be capable of increasing their level of cognitive thinking and decision-making skills the further they progress in the pharmacy course. Each university that opts to use MyDispense can therefore begin to implement the use of MyDispense at any level or stage that suits its students' capabilities.

### 2.7.1. Initial implementations of MyDispense

Monash University's Faculty of Pharmacy and Pharmaceutical Sciences were the first to successfully implement MyDispense as their own simulated dispensing program; they began their implementation with face-to-face tutorials which were part of the first-year curriculum. They prepared ten tutorials, each with multiple MyDispense exercises focusing on the safe dispensing process. The faculty members also included demonstration exercises to assist tutors in explaining new steps to the students, and for students to practice their skills "while beginning to develop an understanding of the patterns that underpin best practice" (McDowell et al., 2016, p. 5).

Monash University created MyDispense as freeware, and for this reason were determined to share this resource when the opportunity arose. United States (US) universities became aware of the dispensing program, and soon collaborated with Monash University to adapt the newly released MyDispense version 3 to the US context in 2014 (Ferrone et al., 2017). The US version required the development of a US drug formulary (consisting of branded and generic medicines of the top 100 dispensed drugs), with this development requiring all drug information and corresponding, non-copyrighted photos of each drug's bulk container. Adjustments in software were also required to change the label format, professional jargon, inventory placement, documentation practices, and methods of prescription receipt from the Australian version to the US version. Ferrone et al. (2017, p. 2) complimented the developers of MyDispense for "rapidly [responding] to any technical issues affecting the user experience". Monash University has also developed a version for the United Kingdom (UK), however, no research appears to have been done on the development or implementation of that particular version.

MyDispense has been successfully implemented in a number of pharmacy schools in the US, and research on the initial implementation of MyDispense into four US pharmacy schools has been documented (Ambroziak et al., 2018; Ferrone et al., 2017). The University of California San Francisco (UCSF) was, as of 2014, the first US university to use MyDispense in their curriculum, followed by the University of Connecticut (UConn), and later the St Louis College of Pharmacy (STLCOP) in 2015 (Ferrone et al., 2017). All three pharmacy schools initiated the use of MyDispense for their third-year students, however, UConn soon included its second-year students, and UCSF included both its first- and second-year students. The University of Michigan (UMich) also implemented the MyDispense program in 2015 (Ambroziak et al., 2018), but initiated the use of MyDispense with its first-year students only.

The majority of the module topics addressed with MyDispense concerned pharmacy practice and the dispensing process, with some schools including pharmacy law and ethics, patient communication, and pain management. UCSF began its MyDispense journey using a pilot to test the usability of the program, which began with a 60-minute face-to-face demonstration, followed by a two-hour small group session, where students could complete several dispensing exercises under the supervision of staff members and community pharmacy preceptors. Similarly, UConn and STLCOP also conducted demonstration sessions followed by practice sessions under the supervision of staff members, however, the STLCOP students were encouraged to practice the program independently (Ferrone et al., 2017). UMich also explained the use of MyDispense to students and allowed for individual supervised practice time in designated computer laboratories (Ambroziak et al., 2018). UConn and STLCOP replaced their existing dispensing software with the MyDispense program, therefore ensuring that all students were able to use the new program adequately.

### 2.7.2. MyDispense design features

McDowell et al. (2016, p. 3) describe MyDispense as a type of software that allows for "nonlinear navigation", whereby the students do not receive any prompts or reminders to guide them through an exercise, but are expected to determine the logic of dispensing. Ferrone et al. (2017) also state that students are able to complete an activity in the simulated pharmacy in any order they choose, even though the workflow of the dispensing process is recognized to have a linear methodical pattern. Therefore, students are required to make "conscious selections" throughout the exercises, developing their decision-making and problem-solving skills, and to "learn by making mistakes knowing they can fail in a safe learning environment" (McDowell et al., 2016, p. 2). The MyDispense program has provided some form of dispensing guidance to students by including a task bar at the bottom of the exercise screen, which includes toolbar icons which assist students in navigating to different areas of the dispensary. The virtual dispensary displays the patient, the prescription (for prescription scenarios), the telephone, the dispensing software (dispensary computer), the product selection room, the reference materials, and the assembly bench for scanning and labelling of medicine (McDowell et al., 2016).

The programmers of MyDispense considered the need for engineering-psychological fidelity as mentioned in Section 2.6, however, they decided to focus more on the psychological aspect instead of the engineering aspect, as there was no evident educational requirement for the students to use a 3D-immersive experience (McDowell et al., 2016). The program was

designed to be web-based so that students and staff could access the program inside and outside of the classroom, thereby allowing students to practice the exercises in their own chosen environment.

Healthcare professionals, particularly medical practitioners, veterinarians, pharmacists and nurses, use Latin abbreviations as a form of documentation, and to communicate inter-professionally for descriptions and instructions usually seen on prescriptions and other medical documentation. These abbreviations are commonly programmed into commercial dispensing software to provide the pharmacist with a shortcut to entering the unabbreviated version onto the dispensary computer. Some dispensing software programs can also be programmed to inform the pharmacist about drug interaction information, cautionary label usage, and product storage tips. McDowell et al. (2016) however discusses that MyDispense has not included this functionality, and the student does not receive any prompting or optional shortcuts.

### 2.7.3. Exercise themes and development

As mentioned previously in Section 2.6.4., computer-generated pharmacy-based scenarios have the option of being focused on a prescription which a patient would bring into the pharmacy, or around a patient who does not have a prescription but seeks medical advice or assistance (non-prescription scenarios). A non-prescription scenario is also classified as one which requires over-the-counter (OTC) medication that the pharmacist is usually permitted by law to recommend and dispense to a patient without a prescription. However, this varies from country to country, depending on the laws which define the scope of practice of the pharmacist and the registered schedules of the medicine. MyDispense can be adapted to ensure that everything required of the pharmacist is within the law of a particular country, and the relevant list of medicines on the program are accurately classified or scheduled.

Ferrone et al. (2017) document that the complexity of the exercises within the program can be structured with increasing levels of complexity consistent with the year level for which they are designed to be practiced. More complex exercises can be created within the program to include a full patient profile with medical history, encouraging the student to analyse a new patient prescription in the context of their documented patient profile and medical history. This stimulates the “identification, resolution and documentation of medicine related problems” (Ferrone et al., 2017, p. 3). McDowell et al. (2016, p. 2) state that various tutorials are available to guide the development of exercises that could include “product selection, controlled drug

dispensing, and adding cautionary advisory labels". Ambroziak et al. (2018, p. 752) list various pharmacy practice topics in their curriculum which are completed using the MyDispense program:

1. The process of medicine dispensing
2. Pharmacy law related to dispensing of outpatient medications
3. Point-of-care drug information resources
4. Obtaining new telephone prescriptions
5. Transferring prescriptions between pharmacies and medication profile review to assess the appropriateness, safety, efficacy, and adherence of a regimen.

These exercises were created by the chief facilitator of the pharmacy practice skills module at UMich, with the assistance of a few students and residents[1], and were based on existing exercises as well as personal experiences of the facilitator, students, and residents. They estimated that each exercise took approximately 1.5-2 hours to create and test. Piloting of the exercises was completed by a minimum of two people before the exercises were released to students in the classroom setting.

### 2.7.4. Benefits of using MyDispense

McDowell et al. (2016) describe how, prior to MyDispense, Monash University was making use of a functioning model pharmacy to teach its students dispensing skills. However, this required a large amount of space, was costly to sustain, required the input of many staff members, and ultimately proved to be difficult to consistently maintain. Furthermore, the educators had not yet trained the students to use computers as part of the dispensing process, and students were required to hand-write their medication labels. However, work integrated learning, as described in Section 2.2., is a vital part of the development of a pharmacy graduate and is necessary for students to successfully transition from their undergraduate dispensing practice into the clinical setting. McDowell et al. (2016) contend that even though some form of dispensing is taught as part of all pharmacy degrees, not all students have had previous experience working in a pharmacy. In such instances, experiential placements become the students' first exposure to material dispensing functionalities in an actual pharmacy environment. Experiential placements provide the opportunity for pharmacy students to become accustomed with dispensing pharmaceutical products in the context of a

[1] medical graduates who specialise in a particular practice

patient-care situation. However, due to large student classes and limited numbers of experiential placements, as discussed in Section 2.4., opportunities for such practical experiential learning are very limited. MyDispense also extends the opportunity for students to experience WIL without the student having to be placed in a physical pharmacy work-place, reducing the pressure of finding enough WIL placements for the large student classes.

Similarly, in the US, where the number of experiential placements are insufficient to meet demand, UMich recommend the use of MyDispense to create a “more realistic learning environment” (Ambroziak et al., 2018, p. 751). Ambroziak et al. (2018) suggested that MyDispense provides the opportunity for standardized and personalized learning of students coming from a wide variety of pharmacy practice backgrounds. They further propose that MyDispense has the added benefits of allowing the exchange and sharing of information between institutions, easy usability for students and pharmacy schools, and low costs involved.

In the US, one of the main focal points of pharmacy education is to challenge the student to actively apply their didactic curriculum knowledge to patient care (Ferrone et al., 2017). Ferrone et al. (2017, p. 2) go on to note that because of the “consistent growth of content, complexity of patient care and demands for technology”, pharmacy educators are preparing students to work at an advanced level of practice, which necessitates the use of simulation exercises. Although originally developed for the Australian context, Ferrone et al. (2017) suggest that with the opportunities that MyDispense provides for the learning of safe and accurate patient-centred dispensing skills, it also holds potential value and benefit for US students. This was confirmed by Shin et al. (2017) at UCSF, who researched the integration of MyDispense into a therapeutics course, comparing paper-based case-studies to simulation-based cases. Shin et al. (2017) emphasize that simulation-based cases provide an environment where students can seek out relevant patient information in real-time, thereby allowing them to solve problems in a manner consistent with the actual practice environment, rather than gaining all the information in the beginning as with paper-based cases.

MyDispense has proven to provide a variety of specific dispensing education needs to pharmacy programs with large class numbers and limited resources. As a high-fidelity computer-generated simulation, it has the potential to substitute work-based learning placements and can be programmed to present tailored exercises for specific learning outcomes at varying levels of cognitive difficulty. MyDispense has proven to necessitate that students to engage their clinical knowledge in order to complete clinical scenarios. Students

are therefore expected to competently practice the dispensing process during dispensing clinical scenarios. The next section will therefore focus on the dispensing process, which is an important part of the simulation dispensing environment.

### 2.8. The dispensing process

Effective pharmaceutical services are embedded as the fundamental core of successful healthcare systems around the globe, and pharmacists are therefore required to be adequately trained in advanced medicine dispensing. Medicine dispensing is therefore taught as a competency-based skill which pharmacy students are expected to master and practice before working in the real pharmacy environment. Every country has its own legislation to govern the dispensing of medicine, including official supporting regulations and standards to guide the minimum requirements of the dispensing process. In the following sections, the author explores the manner in which the SAPC defines the dispensing process and explains in detail the necessary requirements for each dispensing phase. Throughout the various dispensing phases, it becomes clear that clinical decision-making is necessary for successful completion of scenarios. The stages of the clinical decision-making process are described using the analyses of Croft, Gilligan, Rasiah, Levett-Jones, and Schneider (2018) and Wright et al. (2018). Finally, the level of cognitive thinking is also identified and interpreted using Bloom's Revised Taxonomy. These academically recognised assessment tools are further discussed to deepen the understanding of the integration of the cognitive domain into the dispensing process.

#### 2.8.1. Regulation of the dispensing process

In South Africa, the SAPC is the statutory body which serves to ensure the commitment of the "pharmacy profession to promote excellence in practice for the benefit of those they serve" (South African Pharmacy Council, 2010, p. 1). The SAPC have, in response to legal requirements (Section 35A of the Pharmacy Act 53 of 1974, as amended, Regulation 20(1) of the *Regulations Relating to the Practice of Pharmacy* and Regulation 7(a) of the *Regulations Relating to the Ownership and Licensing of Pharmacies* published in terms of the Pharmacy Act as well as Regulation 18(7)(b) of the General Regulations published the Medicines and Related Substances Act 101 of 1965, as amended), developed and published a set of standards - Good Pharmacy Practice Standards (GPP) - for all pharmacists to comply with in an effort to ensure high quality service to the public. (South African Pharmacy Council, 2010).

The Pharmacy Act 53 of 1974 defines dispensing as the “interpretation and evaluation of a prescription, the selection, manipulation or compounding of the medicine, the labelling and supply of the medicine in an appropriate container according to the Medicines Act and the provision of information and instructions by a pharmacist to ensure the safe and effective use of medicine by the patient and ’dispense’ has a corresponding meaning" (South African Pharmacy Council, 2010, p. 59). The GPP standards divide the dispensing process into three distinct phases. The first phase involves the interpretation and evaluation of a prescription in the context of the patient’s information and medical history (South African Pharmacy Council, 2010). The second phase involves the physical preparation of the medicine required for the patient, and the third phase entails the handing over of the prescribed medicine to the patient, as well as the provision of essential information to the patient through appropriate counselling (South African Pharmacy Council, 2010). Each phase requires various levels of cognitive thinking skills, depending on the tasks and the clinical knowledge or skill required to adequately complete the phase (see Figure 1).

The SAPC describes the dispensing process not only by its minimum standards required, but it also stipulates the personnel who may perform the particular tasks during the dispensing process, which is described under the scope of practice of the personnel working in a pharmacy. The scope of practice requirements must be abided by, and a Responsible Pharmacist (RP) must always be on duty. A pharmacist and pharmacist intern may perform the entire dispensing process; however, the pharmacist intern must be under the direct personal supervision of a pharmacist. The pharmacist’s assistant (post-basic) may only perform parts of Phase 1 and all of Phase 2 and 3, but also only under the direct personal supervision of a pharmacist. The scope of practice of a pharmacist's assistant (post-basic) states that “he/she may read and prepare a prescription, select, manipulate or compound the medicine, label and supply the medicine following the interpretation and evaluation of the prescription by a pharmacist. [They] may also provide instructions regarding the correct use of medicine supplied” (South African Pharmacy Council, 2010, p. 59). It therefore becomes the responsibility of the pharmacist to ensure that all three dispensing phases are completed and performed by the appropriately authorised personnel when necessary and that all three dispensing phases are validated by the pharmacist (See Figure 1).

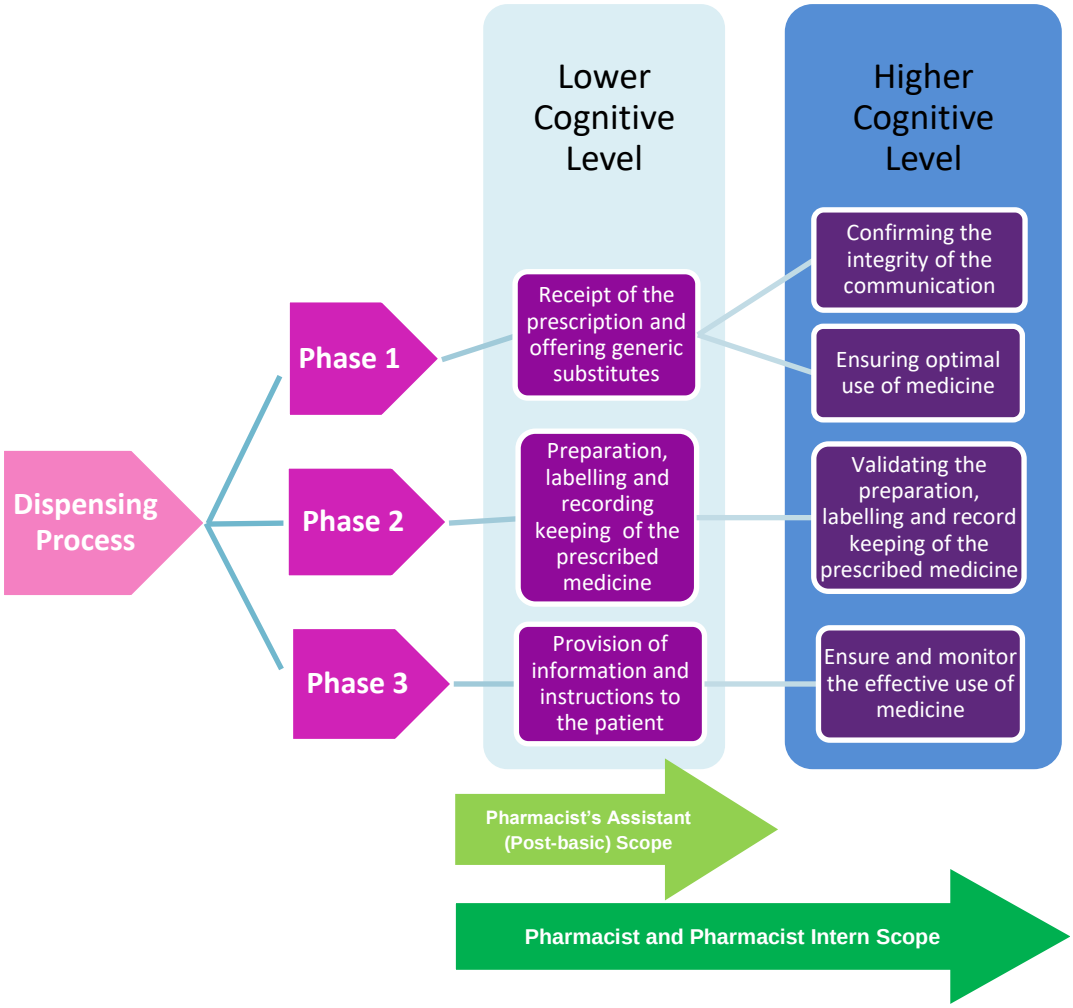


*Figure 1: The Hierarchy of the Dispensing Process Categorised into Lower and Higher Cognitive Levels and Scopes of Practice*

In the following subsections the three phases of the dispensing process will be elaborated on, and the tasks performed in each phase will be discussed. These will be briefly compared with examples or reviews of identified cognitive processes which other researchers (Croft et al., 2018) have highlighted in other clinical decision-making studies. Croft et al (2018) performed a study in Australia focusing on the thinking process during the dispensing process in pharmacy practice, using their own analysis together with previous research on the same topic.

### 2.8.2. Phase 1 of the dispensing process

In Phase 1 of the dispensing process (Figure 1), the first requirement is the receipt of the prescription, where the patient, the prescriber, and the entity responsible for payment of the medicine need to be identified. This information would ordinarily be available on the

prescription, otherwise the information must be obtained by the pharmacist from the patient or the prescriber. This is also the first interaction that the pharmacist will have with the patient, and appropriate professional communication is required at this stage. It must be ensured that the original prescription should either be retained after dispensing the prescription, or otherwise a permanent copy should be made to be retained in the pharmacy. If the prescription is in the form of a faxed, emailed, telephonic or otherwise electronically transmitted version, a permanent copy should also be made and kept in the pharmacy. The pharmacist is also required to inform the patient of the availability of a generic substitution, and the benefits and implications of an interchangeable multi-source medicine.

This initial step is often termed the receiving of the prescription, and up to this point tasks are considered to be administrative, as they require data to be requested and captured and do not necessitate the pharmacist to apply or analyse any information at this stage. Croft et al. (2018, p. 8) affirm that during the consideration of the prescription there is "reviewing" and "recalling" of information, therefore these tasks can be considered to be lower cognitive tasks. The pharmacist, pharmacist intern, or pharmacist's assistant (post-basic) may complete the tasks up to this point, however, according to the limitations of the scope of practice of the pharmacist's assistant (post-basic), only the pharmacist and pharmacist intern can perform the remainder of Phase 1 of the dispensing process.

The remaining Phase 1 tasks require the pharmacist to confirm the integrity of the communication (see Figure 2), which includes confirming that the prescription is serving its potential purpose by requiring that the pharmacist correctly interprets and understands the prescriber's intentions. The pharmacist should first confirm that the prescription received is legal and/or authentic by ensuring it includes all the necessary information and signatures according to the Pharmacy Act 53 of 1974, and that the prescription was not written more than 30 days prior to the date of dispensing as it would be considered expired if this were the case. The prescription should also be checked for physical abnormalities or potential signs of plagiarism/forgery. The pharmacist then needs to interpret the nature of the treatment which the prescriber intends for the patient to use, while also identifying the medicine, and checking the pharmaceutical form, strength, appropriate dosage, presentation, method of administration, and duration of treatment. If there are any issues with the prescription, the pharmacist is expected to assist the patient to solve the problem. These tasks require the pharmacist to fully analyse the prescription, especially the prescriber's intentions (South African Pharmacy Council, 2010). In doing so, the pharmacist is expected to check and compare the prescriber's intentions with their own clinical knowledge to make the necessary

judgements required in this phase. Croft et al. (2018, p. 8) confirm that pharmacists are expected to “investigate new information” while retrieving information and begin to “recognise the difference between normal and abnormal by comparing information”. They are also expected to “relate information to identify patterns of information” while processing information during the dispensing process (Croft et al., 2018, p. 8). Therefore, Phase 1 of the dispensing process requires a higher level of cognitive thinking from the pharmacist.

The pharmacist is also required to assess the prescription during Phase 1 to ensure the optimal use of medicine (see Figure 2). This assessment is divided into three important aspects which are described as follows: the therapeutic aspects (i.e. safety of the medicine, possible contra-indications, drug/drug interactions, drug/disease interactions, and treatment duplications); the individual patient aspects; and the social, legal and economic aspects. If the pharmacist identifies any possible or necessary changes to the treatment, they are required to communicate these with the prescriber. This requirement is, firstly, for legal reasons as the pharmacist may not alter the prescription before communicating and confirming with the prescriber, and, secondly, for reasons benefiting the final treatment outcome for the patient (South African Pharmacy Council, 2010). These tasks can also be said to necessitate a higher level of cognitive thinking as the pharmacist is not only expected to evaluate the treatment, but is also expected to devise a plan for the way forward, thereby using their clinical knowledge to generate a solution to solve the problem. Croft et al. (2018) confirm this by stating a number of descriptive phrases that fall under the tasks of processing information, identifying medication-related issues, and decision-making. The pharmacist is expected to “distinguish between information which is relevant and irrelevant, relate information to identify patterns”, “synthesise information to formulate immediate issues that need to be addressed” and “select appropriate interventions to optimise patient outcomes” (Croft et al., 2018, p. 8).

### 2.8.3. Phase 2 of the dispensing process

The next phase, Phase 2, involves the preparation and selection of the medicine after the pharmacist has authorised the prescription during Phase 1 of the dispensing process. The preparation and selection stage depend on what medicine is to be dispensed to the patient, as such medicine could be stocked in patient-ready packs, final primary or secondary packaging, or as extemporaneous products which still need to be prepared for patient use. The pharmacist needs to ensure accurate selection of medicines, while also guaranteeing that after the medicines have been stored in the pharmacy, they still have full product integrity prior

to being dispensed to the patient. Medicines which need to be dispensed from bulk packaging medicine containers should be counted accurately and separated by following medicine pre-packing minimum standards and standard operating procedures (SOP). The preparation of extemporaneous medicines can take place in any pharmacy, but only if all the particular minimum standards and standard operating procedures of compounding medicine are adhered to. This is to ensure the pharmacist always provides patients with the highest quality of medicine possible.

Following medicine selection, the medicines should then be clearly labelled with the label containing all the correct directions for use, along with any other information for the safe, proper, and effective use of the medicine. The labels should also be clear, legible, and indelible, and should be appropriately positioned on the medicine packaging in such a way that other important printed information already printed on the packaging, such as the expiry date, is not concealed.

The next stage of Phase 2 must guarantee correct record keeping of the dispensing of the prescription. The information legally required for dispensing is also set out in the Pharmacy Act 53 of 1974 and the Medicines and Related Substances Act 65 of 101, and consists of the patient's details, prescriber's details, medicine details, applicable dates, dispenser's details, and generated prescription reference numbers. The records must be kept on the premises for up to five years. The process of capturing data and record keeping should be done using a computer system with a dispensing program to assist in storing and capturing the relevant information.

All of the above-mentioned dispensing procedures in Phase 2, whether performed by the pharmacist, pharmacist intern, or pharmacist's assistant (post-basic), must be carefully checked for accuracy and completeness by the pharmacist. The pharmacist must finally sign the prescription to validate that they accept accountability for the correctness of the dispensing of the medicine and to confirm that the medicine was supplied.

The first three stages of Phase 2 require the performance of more technical tasks of picking, packing and labelling of medicine as well as recording keeping. Therefore, this phase does not require in-depth clinical knowledge, experience or skills to evaluate the dispensed medicine and can, therefore, be said to only require a lower level of cognitive thinking. Croft et al. (2018, p. 8) provide an example as having to "match similar information", however, the final stage of Phase 2 also requires the validation of the prepared medicine for correctness,

necessitating the pharmacist to evaluate, judge, assess and decide that the dispensing is accurate and complete, requiring a higher level of cognitive thinking. Croft et al. (2018, p. 8) further provides evidence for a higher level of cognitive thinking by categorising the function to "verify correct information" (i.e. validating the dispensing) in the dispensing phase as an example of performing "decision-making".

### 2.8.4. Phase 3 of the dispensing process

Once the medicine has been prepared, it should be provided to the patient or the patient's caregiver/agent together with relevant counselling on its use. The information provided to the patient or the patient's caregiver/agent should be structured in a way that meets the needs of the individual. The patient or their caregiver/agent should also be provided with a patient-information leaflet containing necessary medicine-related information as prescribed in the General Regulations published in terms of the Medicines and Related Substances Act 101 of 1965. It is also the pharmacist's responsibility to ensure that all information provided by the pharmacy is up-to-date, safe, and complies with the relevant local and national guidelines.

The pharmacist, in collaboration with the patient, either during the dispensing process or during a consultation, must assess the effectiveness and safety of the patient's treatment to ensure that the patient is experiencing positive outcomes to the therapy. The patient's compliance to the treatment should also be determined, and the patient's records should be fully assessed. The pharmacist must decide if any modifications are necessary, and the prescriber should be consulted to discuss all potential modifications. If necessary, the pharmacist may need to refer the patient to another healthcare professional if the expertise and practice required for the patient's care falls outside of the pharmacist's scope of practice. If any modifications are recommended, approved, and made, the pharmacist should record them accordingly.

Phase 3 includes both technical aspects, which require a lower level of cognitive thinking, and also more cognitive tasks of greater complexity. The physical provision of medicine to the patient is a technical task, which can be completed by support personnel, however, knowing what information to impart to the patient requires understanding and application of clinical knowledge, and an ability to analyse the patient-specific context. Therefore, the provision of information to the patient should either be completed by a pharmacist or under the guidance and supervision of a pharmacist. However, the final stage of Phase 3 requires a higher level of cognitive thinking as the pharmacist is expected to analyse the patient's records and

generate modifications for the treatment plan. This notion is supported by Croft et al. (2018) who state that the pharmacist is expected to " elicit ideas and opinions" on the treatment plan and also "anticipate what to expect" during treatment, all the while being able to "justify thoughts and actions" in order to offer an appropriate and correct treatment plan.

### 2.8.5. Cognitive requirements of the dispensing process

The focus of the pharmacist's role in the dispensing phase is shifting from practising the entire dispensing process to only completing the cognitive aspects of the process, while also supervising the rest of the dispensing process.

Dispensing medicine does not merely entail technical skills, but a combination of "specialist knowledge, functional and behavioural competence, and judgement, and is underpinned by appropriate ethics and values" (McDowell et al., 2016, p. 1). McDowell et al. (2016, p. 1), citing Cheetham and Chivers (2005), describe medicine dispensing as "the integrated application of knowledge and cognitive proficiency, professional values and attitudes, technical and cognitive skills, reflection, and personal skills within a specific context". Such competencies can be developed by gradually integrating separate dimensions while completing professional activities (McDowell et al., 2016).

The integration of clinical knowledge and cognitive skills into the dispensing process is highly complex. McDowell et al. (2016), citing James (2011), state that while undergraduate pharmacy students can learn proficiency in the development of accurate dispensing, professional practice following graduation is usually where the advanced-level dispensing skills are acquired. It is a skill which requires practice to properly develop, therefore, teaching and learning of the dispensing process at an advanced level is a challenge and lends itself towards the use of SBE. Simulation-based education could be used to provide practice in dispensing exercises in the form of clinical patient scenarios, which are cognitively challenging.

Wright et al. (2018, p. 5) suggest that there is a missing area between the objectives of the pharmacy profession and the acquired skills available to pharmacists. Previously, pharmacists have not been considered "primary decision makers" in patient care settings, and hence the deficit of clinical decision-making training. They encourage the "pharmacy education community to explore purpose-built curriculum and new teaching methods that can support the development of clinical decision-making skills across practice settings" (Wright et al., 2018,

p. 5). Wright et al. (2018), citing Cook (2018), agree that clinical decision-making is an important aspect of pharmacy practice, but state that the diagnostic decisions which are well-recognized as an important component of practice in medicine over-shadow the need for decision-making skills required for therapeutic decisions. Croft et al. (2018, p. 12) concur that the clinical reasoning processes of pharmacists could be enhanced by acknowledging and encouraging "an awareness of the systematic and complex process that guide(s) decision-making by pharmacists".

### 2.8.6. Interpretation of clinical decision-making

While it may be clear that the dispensing process requires certain levels of cognitive thinking, it also necessitates clinical decision-making. Although Wright et al. (2018, p. 2) have explored the current models for clinical decision-making in pharmacy practice, they conclude that there is insufficient research to draw comprehensive conclusions on the topic, and that the impression is that clinical decision-making in pharmacy practice is either "innately obvious or will only be acquired with practice experience and mentoring". Wright et al. (2018) have since used the work of Hepler and Strand (1990), Sexton et al. (2007), and Bryant et al. (2008) to design a model for clinical decision-making in pharmacy practice by focusing on the cognitive processes required for decision-making (see Figure 2 below).

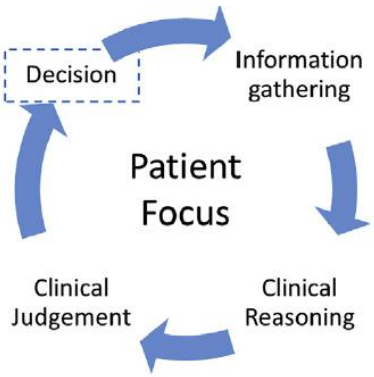


*Figure 2: A General Model of the Clinical Decision-making Process in Pharmacy (Wright, Anakin, & Duffull, 2018) (p.2)*

The cognitive process in Figure 2 is designed to illustrate the tasks that enable decision-making and is illustrated as a 4-stage cycle. The dashed line around the decision icon identifies this step as the final stage which will be enacted with the patient. The cycle is designed to revolve around the patient, in order to highlight the patient-centred focus of the model. Table 2 includes an identification of the tasks expected of the pharmacist during the

dispensing process, and how they fall under each of the stages of the clinical decision-making process highlighted in Figure 2.

*Table 2: Tasks of the Dispensing Process Identified in the Wright et al.'s (2018) Clinical Decision-making Process*

| STAGES OF THE CLINICAL DECISION-MAKING PROCESS | SIMILAR TASKS IDENTIFIED IN THE DISPENSING PROCESS |
|---|---|
| **Information Gathering** | "identifying the need for a decision, an assessment of laboratory results, the identification of drug-related problems, the initial delineation of treatment and patient-centred goals, patient assessment (physical and psycho-social), a review of literature related to therapeutic entities, and a consideration of patient factors that may impact therapies (e.g. risk of adverse effects)." (p.2) |
| **Clinical Reasoning** | "curate the information gathered and synthesise a viable set of options in the context of the patient's goals." (p.3) |
| **Clinical Judgement** | "the process of weighing-up the options available and prioritising them on their impact. Include financial considerations, social implications, effects on the patient's family, or how the patient interacts with other health services". (p.3) |
| **Decision** | "(i) patient-centred consideration of the pertinent judgements through an open and supportive communication framework and (ii) the enactment of the decision." (p.3) |

Wright et al. (2018, p. 2) cite their own previous research on this model and suggest that the tasks in the cycle are "inherently teachable as a series of skills, so the model can be adapted into an educational program or personal practice".

While Wright et al. (2018) have emphasised the tasks which could occur during the various stages of clinical decision-making, Bloom's Revised Taxonomy assists in interpreting the level of cognitive thinking required of each task, allowing for a more complex understanding of the cognitive requirements necessary during the process of clinical decision-making.

### 2.8.7. Interpretation of the level of cognitive thinking

Bloom's Taxonomy was developed by Benjamin Bloom, who began innovative discussions with a group of educators on classifying educational goals and objectives according to cognitive complexity during the 1948 Convention of the American Psychological Association. Their goal was to determine a method of classifying thinking behaviours necessary for the

process of learning. The framework derived from the discussions became a taxonomy of three domains: the cognitive domain (knowledge based); the affective domain (attitudinal based) and the psychomotor domain (skills based) (Forehand, 2005). In 1956, the work on the cognitive domain was completed and “Bloom’s Taxonomy” was published as a handbook pertaining only to the cognitive domain (Bloom & Krathwohl, 1956). It has since been translated into 22 languages and is one of the most often cited and broadly used references in education, often being referred to by curriculum planners, administrators, researchers, and classroom teachers. Bloom’s Taxonomy is therefore a “multi-tiered” model of classifying thinking according to six cognitive levels of complexity, arranged in order of hierarchy (Forehand, 2005). The levels proceed from the simplest functions to more complex ones, and also require the student to master the functions in increasing order, as each level requires the mastery of the previous levels (Wilson, 2016).

Sixty years after the initial development of Bloom’s Taxonomy, from 1995-2000, David Krathwohl, one of Benjamin Bloom’s partners during the creation of the cognitive taxonomy, and Lorin Anderson, a student of Bloom’s, revisited Bloom’s Taxonomy. Krathwohl and Anderson included cognitive psychologists, curriculum theorists, instructional researchers, and testing and assessment specialists in the revision process (Anderson & Krathwohl, 2001). The revised version also considered Bloom’s own criticisms and concerns about his original taxonomy. Anderson and Krathwohl (2001) implemented structural changes and changes to the terminology which are illustrated in Figure 3 below.

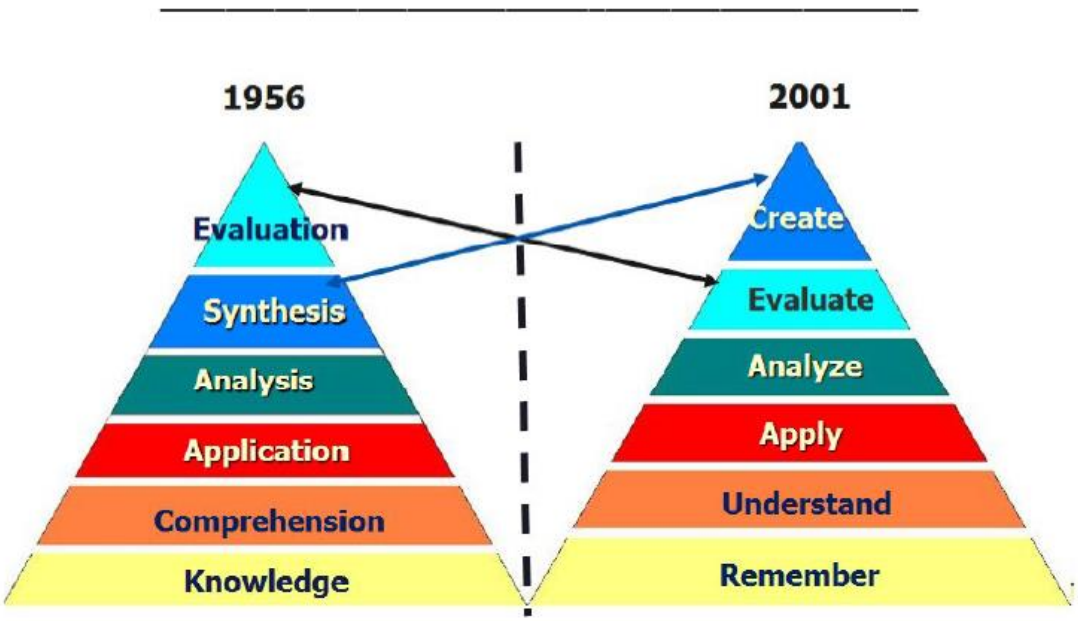


*Figure 3: Bloom's Taxonomy vs Anderson and Krathwohl's Revised Bloom's Taxonomy (Wilson, 2016)*

Bloom's six categories were changed from noun to verb forms and the "evaluation" category was shifted downward and replaced as the highest category with "synthesis" renamed as "create". The categories were also described with new definitions as laid out in Table 3 below (Anderson & Krathwohl, 2001, p. 3).

*Table 3: Bloom's Revised Taxonomy Terms and Definitions (Anderson & Krathwohl, 2001; Forehand, 2005; Wilson, 2016)*

| LEVEL | TERMS | DEFINITIONS |
|---|---|---|
| 1 | Remembering | Retrieving, recognizing, and recalling definitions, facts, or lists from long-term memory or previously learned information. |
| 2 | Understanding | Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining. |
| 3 | Applying | Carrying out or using a procedure through executing or implementing. Relating or referring to models, presentations, interviews, or simulations using learned materials. |
| 4 | Analysing | Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose. Mental actions include differentiating, organizing, and attributing, and can be illustrated by creating surveys, spreadsheets, diagrams, or charts. |
| 5 | Evaluating | Making judgments based on criteria and standards through checking and critiquing. Evaluating could be demonstrated in the form of recommendations, critiques and reports. |
| 6 | Creating | Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing. Creating requires users to synthesise or situate parts together in a new way to make something new and different. This is the most challenging mental function in the new taxonomy. |

Bloom's Revised Taxonomy has proven to be useful in many educational settings and has become a necessity for teachers who need to measure their student's abilities. Forehand (2005, p. 3) agrees that Bloom's Revised Taxonomy assists in the "classification of levels of intellectual behaviour important in learning" and that Bloom's Revised Taxonomy can provide a "measurement tool for thinking". Bloom's Revised Taxonomy has also contributed to the educational concepts of high and low order thinking. Forehand (2005, p. 4), citing Noble (2004), states that Bloom's Revised Taxonomy has also been linked with "multiple intelligence problem-solving skills, creative and critical thinking, and, more recently, technology integration". Athanassiou, McNett, and Harvey (2003, p. 539) report that a student's self-analysis of their level of work using Bloom's Revised Taxonomy can contribute to supporting

their own higher level of thinking and that this type of educational concept “would seem suitable for many integrative modules, including those whose goals include critical thinking”.

Due to the documented success of Bloom’s Revised Taxonomy in teaching and learning, it would be a useful tool for developing and assessing the integration of varying levels of cognitive thinking required in the dispensing process. Furthermore, Bloom’s Revised Taxonomy would be a useful tool to guide the clinical decision-making required in clinical scenarios, and particularly in a simulation-based program such as MyDispense.

### 2.9. Summary

In this chapter, SBE has been described in terms how it has the potential to fill the missing experiential pharmacy educational gap with the use of its beneficial features and ability to provide flexibility to lecturers and students. SBE has proven to be an effective education tool to implement competency-based education in pharmacy schools across the globe. The objectives and uses of SBE have also been proven to assist in teaching students to integrate their clinical knowledge into their professional practice. By these means, SBE can integrate clinical decision-making as a skill required of students, thereby requiring them to practice a range of cognitive-thinking skills. This chapter also described how, internationally, MyDispense, a computer-generated simulation dispensing program, has been utilised to provide opportunities for clinical knowledge to be applied during the dispensing process to address clinical scenarios, thereby allowing for the practicing of clinical decision-making by using cognitive-thinking skills.

# CHAPTER 3: METHODOLOGY

## 3.1. Introduction and description of study approach

This study used an explorative, qualitative research approach to explore ways in which clinical knowledge-based cognitive skills can be integrated into the dispensing process. Strauss and Corbin (1990) describe qualitative research as a method which can be used when there is little known regarding a phenomenon and a greater understanding is required. A qualitative research method is therefore a suitable method for this study as it enables the researcher to clarify a deeper and all-encompassing understanding of the research aim at hand.

## 3.2. Study process

The study was completed in four major phases, summarised in Figure 4, and discussed in greater detail below.

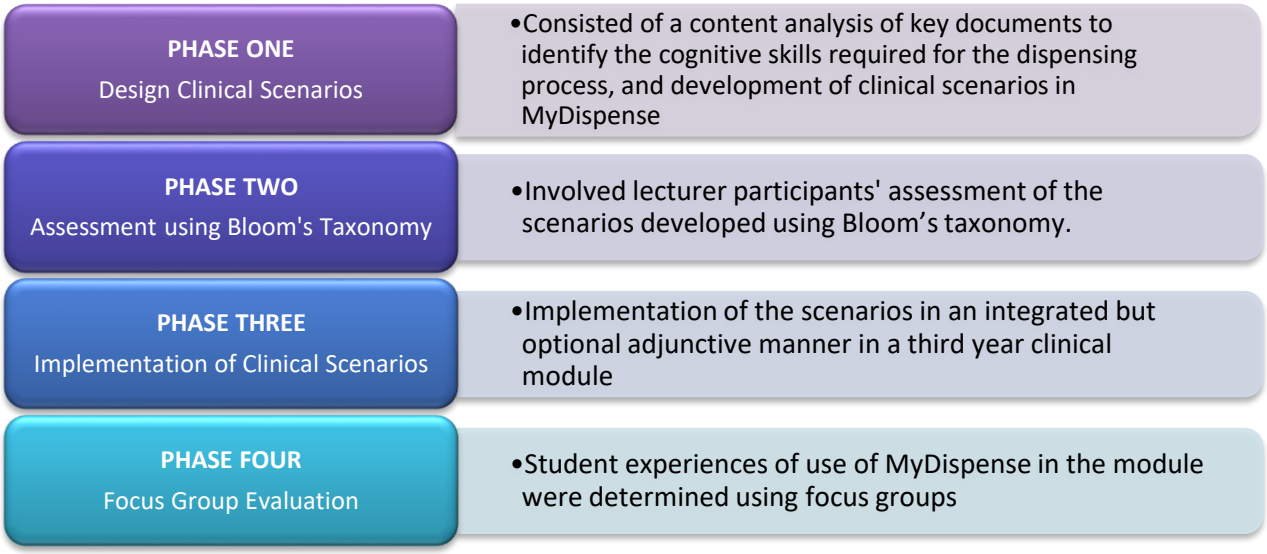


*Figure 4: Flow Diagram of the Research Process*

### 3.2.1. Phase One

Phase One entailed a content analysis of key documents in order to identify and extract the cognitive skills and clinical knowledge required at each stage of the dispensing process. These documents consisted of the clinical module's learning outcomes, the clinical knowledge

necessary to accomplish the learning outcomes, the GPP guidelines which state the minimum standards of the dispensing process as set out by the SAPC (see Section 2.8), and assessment criteria. The content analysis identified the clinical knowledge content which was covered in the BPharm third-year clinical module. A third-year clinical module was selected, as it covered a larger quantity of clinical knowledge at various levels of cognitive difficulty in comparison with other clinical modules, and therefore offered the opportunity for varied levels of cognitive assessment. The third-year clinical module was selected according to the time at which it was presented in the academic calendar, and the expected time at which the data collection of the study would take place. It was also selected so that the researcher would have no involvement in the presentation of clinical knowledge and assessment of the chosen clinical module.

The researcher analysed the clinical knowledge covered in the selected clinical module and randomly selected four topics from which clinical scenarios would be developed. The researcher familiarised herself with the content covered in these topics by accessing the lecturer slides available to the students, the prescribed textbooks for the clinical module, and other relevant prescribed reading. The researcher also analysed the module's previous tests and exams to gauge the level of cognitive difficulty at which the lecturers assessed the students. The researcher then developed a set of clinical scenarios based on the cognitive skills and clinical knowledge required, creating new patient profiles, medicine histories, and supporting patient medical history and documentation. These scenarios were then converted into a simulation-based format using MyDispense (see Appendix A). The clinical scenarios were designed in such a way that the student would need to use the appropriate cognitive skills and clinical knowledge learnt during the presentation of the chosen clinical module to successfully complete the scenario, to complete the minimum standards of the dispensing process . The scenarios were also created using different levels of cognitive difficulty in order to develop the student's cognitive ability.

The MyDispense program, which Nelson Mandela University has acquired access to, is an Australian version. However, Monash University has encouraged universities worldwide to adapt the program to suit each country's individual needs and specifications as mentioned in Section 2.7. The researcher, therefore, created names and selected avatars which characterized the demographical representation of South African patients. The images of medicines pre-loaded onto MyDispense were also Australian based, and these were also adapted to the South African pharmacy setting. Once scenarios for a particular topic were completed, they were saved onto the MyDispense program and converted into a readable

format for the second phase of the research. The scenarios for each topic were created consecutively. Once the researcher had completed the scenarios for a topic, they were assessed in the second phase of the research, after which the next set of scenarios were created for the next topic.

### 3.2.2. Phase Two

The second phase involved the use of purpose-designed assessment forms (see Appendix G) by voluntary participants (seven academic pharmacy staff members) to assess the clinical scenarios created in Phase One of the study. The participants were asked to assess the clinical scenarios by categorising the requirements for completion of the clinical scenarios according to Bloom's Revised Taxonomy levels. Blooms Revised Taxonomy was used to guide this process, as it describes a hierarchy of six levels of cognitive complexity as previously explained in Section 2.8.7 (Anderson & Krathwohl, 2001). The participants were also asked to select specific descriptors from each level of Bloom's Revised Taxonomy with which they had categorised the clinical scenario. The academic staff were also asked to identify and document the clinical knowledge which the student would need to be familiar with in order to accurately complete the scenario. This process involved recognition of the clinical knowledge required and the categorisation of cognitive difficulty of each clinical scenario.

Participants were also requested to provide feedback on the appropriateness of the clinical knowledge required, and to recommend corrections or adjustments which needed to be made to improve the clinical scenarios. During the second phase of the study these scenarios were modified and refined. Based on feedback received from the lecturer participants on the purpose-designed assessment forms, the scenarios were revised by the researcher to ensure the fullest integration of clinical knowledge with clinical skills, and any errors found in the clinical scenarios were corrected. Because of the exploratory nature of the study, it was deemed not necessary to conduct a pilot study.

### 3.2.3. Phase Three

The third phase consisted of the implementation of the clinical scenarios created. A volunteer group of students, who were registered for the identified module, attended a workshop where the use of MyDispense was introduced using an exemplar clinical scenario which included similar aspects to those used in the research study. The workshop consisted of a one-hour, face-to-face session in a computer laboratory, with the researcher as the instructor. The

sessions were arranged such that they were outside of any normally timetabled lecture or practical sessions. The workshop was repeated a number of times on different occasions to ensure that students who were willing were able to attend at least one workshop. Thereafter, the students were asked to complete the clinical scenarios on MyDispense in their own time and in their own chosen environment, using any electronic device that could access MyDispense online which they preferred. The clinical scenarios were released in parallel with the clinical module, in that the timing of Phase Three was such that the students had recently completed the didactic components of the clinical knowledge in the module that was required for the completing the scenarios. By the end of the module, the students were able to access all the scenarios created in the study and after having completed any scenarios, they received immediate feedback on their performance. As mentioned previously, there was no need to conduct a pilot study as the study was explorative in nature.

### 3.2.4. Phase Four

The fourth phase of the research entailed a determination of the participants' experiences of the use of MyDispense for integrating clinical knowledge into the dispensing process. A focus group was used in this phase as focus groups provide a method of data collection which leads to richer and more in-depth data, in comparison to an in-depth interview (Kitzinger, 1995). Gibbs (1997) suggests that "focus groups elicit a multiplicity of views and emotional processes within a group context" which might be less likely to surface in an individual one-on-one setting. Kitzinger (1995) states that focus groups are able to direct the research into new and un-anticipated directions if the dynamics of the focus group work well and the participants are able to successfully collaborate with the facilitator. For the purposes of this study, one focus group was held whereby six student participants, who had participated in Phase Three, discussed a series of seven questions as posed to them by an independent facilitator. An independent facilitator was asked to conduct the focus group as the researcher, who is known to the students as a lecturer in the Pharmacy Department, could have positively or negatively influenced the students. The researcher met with the independent facilitator prior to the focus group to provide a briefing of the research methodology and to discuss the open-ended questions (Appendix G) designed to be used during the focus group. The open-ended questions were constructed in such a way so as to retain the focus on the topic at hand, ensure participation from each participant, and probe for details when necessary (Gibbs, 1997). The researcher also requested an independent note-taker to take notes during the focus group. The focus group was digitally recorded and thereafter transcribed. The transcription was then

coded using inductive coding, analysed thematically, and the themes identified were confirmed by an independent reviewer.

### 3.3. Study site and population

#### 3.3.1. Study site

The research was conducted in the Pharmacy Department, on South Campus at the Nelson Mandela University, based in the Nelson Mandela Metropole. More specifically, the third phase of the research began with workshops, repeated multiple times in a computer laboratory in the Pharmacy Department, where instructions on how to use MyDispense were presented by the researcher. After that, participants were asked to complete the clinical scenarios; they were able to do this from any location that afforded them internet access. The focus group, in the fourth phase of this study, was held in a convenient, quiet, and private venue in the Pharmacy Department, which was agreed on by the student participants. For the focus group, the student participants were seated in a semi-circle to create a more relaxed and inviting atmosphere in the group.

#### 3.3.2. Study population

In Phase Two, the research population, to evaluate the designed clinical scenarios, consisted of academic pharmacy staff members within the Pharmacy Department of Nelson Mandela University. In Phases Three and Four, the research population consisted of undergraduate third-year BPharm students who were enrolled in the Pharmacy Department at Nelson Mandela University, and who were registered for the identified clinical pharmacy module.

### 3.4. Study sample

Participants in the second and fourth phase were recruited using purposive sampling. Purposive sampling is a “deliberate seeking out of participants with particular characteristics, according to the needs of the developing analysis and emerging theory” (Lewis-Beck, Bryman, & Futing Liao, 2004). The research sample for the second phase involved seven academic pharmacy staff members within the Pharmacy Department of Nelson Mandela University. Academic pharmacy staff members were approached to participate because they held

BPharm qualifications and were, therefore, competent in understanding the content presented in the chosen clinical module. The academic pharmacy staff consisted of members who were lecturing or who were involved in other academic activities within the Department. The academic pharmacy staff were all familiar with the concepts presented in Bloom's Revised Taxonomy, as the Pharmacy Department uses Bloom's Revised Taxonomy to evaluate cognitive levels of assessment of test and exam papers during moderation processes. The academic pharmacy staff members were therefore able to conduct the assessment of categorising the clinical scenarios into the various levels of Bloom's Revised Taxonomy, as was required for the assessment. The academic pharmacy staff members were sent an email by the researcher explaining the purpose of the research and were invited to participate in a voluntary basis (see Appendix B). The lecturers were first invited to attend an information session regarding the MyDispense program, as most of the lecturers had no experience with the simulation program. The information session provided further details about participation as a lecturer participant and involved a short demonstration of the MyDispense program. The session also provided the lecturers with a broader understanding of how the program would present the clinical scenarios, which the lecturer participants would assess independently, into simulated MyDispense exercises. The demonstration also created the opportunity for any lecturers who were interested in participating in making a more informed decision, as the researcher also explained that they were not expected to know how to use MyDispense, but only to assess the clinical scenario which would be provided to them in a Microsoft Word® format.

Participants in the third phase were recruited using convenience sampling. Convenience sampling is when the researcher approaches possible participants who are known to be available at the particular time of the study (Hancock, Ockleford, & Windridge, 1998). The research sample for the third phase was 45 student participants from the third-year BPharm class. The researcher visited the relevant class on two separate occasions to introduce the research study and provide information on participating in the study. The researcher invited the students to attend further information sessions, after which the students could decide if they wanted to participate in the research. All students registered for the module were invited to participate, and the voluntary nature of participation (see Appendix C) was explicitly explained to potential participants on recruitment (see Appendix E). Participants and potential participants were made fully aware that non-participation in the study would in no way influence their academic results for the module. The researcher also emailed the students providing the same information and invited any questions to be emailed back to the researcher if further study details or clarification were required.

Sampling for the fourth phase, the focus group, was also done using a purposive sampling approach. The researcher emailed the student participants from Phase Three (see Appendix D) to invite participation in the focus group. Again, the student participants were informed that participation was voluntary and that the documentation and recordings of the focus group would be kept confidential. The researcher also included in the email a web link to a descriptive video explaining focus groups, which was sent to the student participants, as most undergraduate students have not had previous exposure to focus groups and would therefore not be able to make an informed decision about participation. Six student participants agreed to participate in the focus group.

### 3.5. Data collection

The researcher applied for and received ethical approval for the study from the Nelson Mandela University Research Ethics Committee (Human) prior to beginning the sampling for the second phase of the study. Once the participants were recruited for the second phase, they were asked to read the research background to the study and complete an informed consent form (Appendix B). Thereafter they were asked to assess the scenarios developed using the purpose-designed assessment form (Appendix G). The data collected from the forms was collated, scrutinised, and used as a basis to adapt and adjust the clinical scenarios from the first phase of the study.

The participants in the third and fourth phases of the study were also provided with the research background and an informed consent form to complete before data were collected. In the fourth phase one focus group was held, consisting of six student participants. The participants included in the focus group had all attempted at least one of the clinical scenarios on MyDispense. The date and time of the focus group was arranged such that it fell outside of any ordinarily timetabled lecture or practical session and was individually agreed upon by all student participants. The student participants were each allocated a letter of the alphabet to assist the note-taker in recording the sequence of interactions and contributions. This was done to prevent the confusion of participants during the transcribing process, and to protect the anonymity of the participants. The focus group was recorded electronically using three different voice-recorders, and the audio files were uploaded onto the researcher's computer. The recording was transcribed thereafter. Member checking was completed by asking a participant from the focus group to verify that the themes identified by the researcher reflected the proceedings of the focus group.

### 3.6. Data analysis

In order to follow a suitable qualitative research approach, a thematic analysis was conducted according to guidelines set out by Braun and Clarke (2006), who outline a six stage approach to analysing data. The researcher initiated the analysis by familiarising herself with the data, which was done by transcribing the data, as mentioned in the previous subsection, and revising the transcripts. The data were read and re-read, all the while noting initial ideas. Initial coding then took place by manually coding the transcripts using various functions in Microsoft Word® to highlight and code the transcript. The researcher could not use the coding program Atlas.ti®, as was previously envisaged, as the university was still awaiting their renewal of the license at the time of the data analysis. The transcript was read inductively by identifying interesting features and coding them. Subsequently, by analysing the codes, themes were identified, and data was gathered according to these identified themes. The themes were then reviewed and refined in relation to the coded extracts to form clear definitions and names for each theme. Finally, a report was generated by outlining the themes identified with the data extracts in conjunction with the research aim and literature.

Once the researcher had finalised the data analysis, an independent reviewer studied the analysis to ensure appropriate inductive thematic analysis was used.

### 3.7. Ethical considerations

#### 3.7.1. Trustworthiness of data

Trustworthiness of data is an important aspect of qualitative research, as the reliability and validity of data must be maintained throughout the study. Guba (1981) has provided a framework to ensure trustworthiness of data that can be described under four main headings: credibility; transferability; dependability; and confirmability. Credibility ensures parallel internal validity of the study, meaning that a true reflection of the research being studied is presented. In other words, the conclusions drawn from data are consistent with the participants' original data and a correct interpretation of their views. Transferability differs in that it ensures parallel external validity confirming that adequate information and detail of the study is being provided if the same study were to be applied in another setting. Transferability is comparable to generalisability and refers to the extent to which the results of the study can be transferred to other contexts and settings. Dependability refers to the quality assurance of the data

collection, data analysis, and conclusions drawn from the study. Lastly, confirmability assures that the researcher was not biased in drawing up conclusions of the study, and that they used the data obtained as a frame of reference. The provisions that were made in this study to ensure trustworthiness of data are summarised in Table 4.

*Table 4: Provisions that will be made by the researcher to address Guba's (1981) four criteria for trustworthiness*

| QUALITY CRITERION | PROVISION MADE BY RESEARCHER |
|---|---|
| Credibility | Member checks of transcripts and themes identified were employed.<br>An independent reviewer was used to review the transcripts, coding, themes identified, and conclusions drawn. |
| Transferability | The methodology of the study was well researched and recognised.<br>A thick description of the research context and process was provided, and the research process and methods were explained and reviewed.<br>Convenience sampling was used in Phase Three to maximise the information collected. |
| Dependability | In-depth description of thematic analysis was provided.<br>Member checks of data interpretation was completed after the focus group.<br>A research audit trail was maintained and all research documents, including raw data, observational notes, analysis, and coding details, were scrutinised by the independent reviewer.<br>A code and re-code process was used for the thematic analysis. |
| Confirmability | In addition to the audit trail a reflective research journal was kept by the researcher, which allowed for cross-checking of the data. The independent review also addressed the confirmability of the results. |

### 3.7.2. Ethical considerations

Ethics approval was obtained from the Nelson Mandela University Research Ethics Committee (Human) (REC-H) as the study involved the participation of pharmacy staff and students. The participants were given a letter informing them of the nature of the research, the research phases and the use of the results. For the purposes of this study, ethical considerations were followed in accordance with the Belmont report, namely respect for persons, beneficence, and justice (United States National Commission for the Protection of Human Subjects of Biomedical Behavioral Research, 1978).

Respect of persons entailed the voluntary nature of participation of the pharmacy staff and students after a detailed explanation of the research purpose and process (De Vos, Strydom, C, & Delport, 2002). No pressure was placed on pharmacy staff or students to participate and they were asked to complete an informed consent form (Appendix B, C and D) to acknowledge their willingness to participate. Participants' autonomy was respected at all times. Beneficence entailed the fundamental principle that no harm was brought to the participants, and that the researcher protected participants from any form of physical discomfort or emotional harm which may have emerged during the research project (De Vos et al., 2002). Finally, justice was ensured by maintaining confidentiality and anonymity of participants at all stages of the study, including research presentations, publications, or reports. Purposive and convenience sampling were used to recruit participants for the study and the participant incurred no cost for participation in the study.

### 3.7.3. Avoidance of harm

The researcher, who also developed the clinical scenarios in the study, did not have any involvement in the presentation of the delivery and assessment of the clinical module chosen. This was to avoid any possible notion that the researcher could have awarded participants an advantage in their academic results for the specific clinical module as a consequence of their participation in the study. Although it was hoped that participation in this study would have a positive bearing on participants' performance in the associated module, the participants were made fully aware that taking part in the study would not have any direct effect on their academic results in the module. Students were informed that the MyDispense program and scenarios were to be made available to all students whether they consented to participation or not, and that participation or non-participation in the study would in no way influence their academic results of this module. All information sessions and research sessions were conducted outside of timetabled lectures or practical times.

### 3.7.4. Voluntary participation

Participants were made aware that participation was strictly on a voluntary basis and that they could withdraw at any stage during the study.

### 3.7.5. Informed consent

The participants were asked to complete an informed consent form as proof of consent to participate in this study (see Appendix B, C and D).

### 3.7.6. Confidentiality and anonymity

Participants were informed that all personal information would remain anonymous, and a coding system would be used to identify participants in this study. The usernames on MyDispense were lettered and no participant names were used. No identifying information was attached to any assessment forms, evaluations, recordings, or transcriptions. Confidentiality of data was kept throughout the duration of the study and thereafter. All data collected, including completed forms, recordings, and transcripts, will be retained at the university, by the study supervisor, for a period of five years after which it will be destroyed.

# CHAPTER 4: RESULTS AND DISCUSSION

In this chapter, the results of the study will be presented and discussed in the context of existing and pertinent literature. In line with the aim of the study, which is to explore ways in which MyDispense can be used to facilitate the integration of clinical knowledge-based cognitive skills into the dispensing process, the research objectives provide a platform for the aim to be addressed.

In the first phase of the study, simulated scenarios for MyDispense were developed and created while integrating a hierarchy of cognitive skills into the dispensing process. Section 4.1 provides an in-depth description of the development process, focusing particularly on how the clinical knowledge-based cognitive skills were incorporated into the dispensing process.

Subsection 4.2 focuses on the second phase of the study, where the cognitive skills required in the developed scenarios were evaluated by the lecturer participants according to Bloom's Revised Taxonomy. Feedback from the lecturer participants regarding improvements or adjustments of the scenarios is also presented and discussed.

In an effort to pilot the MyDispense scenarios, students were invited to use MyDispense as an adjunct to the clinical module, ZCP311, during the third phase of the study. Subsection 4.3 describes how the MyDispense scenarios were implemented and includes an explanation of the recruitment of student participants.

Finally, in Subsection 4.4., the last phase of the study will be reported on and discussed. This includes the outcomes of the focus group conducted to determine the student participants' experiences of using MyDispense to integrate their clinical knowledge into the dispensing process, focusing on the use of the scenarios as an adjunct to ZCP311 and the students' recommendations for future use of MyDispense.

### 4.1. The development of clinical scenarios using MyDispense

In this first subsection of the results and discussion chapter, the development of simulated clinical scenarios using the computer-generated simulation program (MyDispense), which formed Phase One of the study, will be discussed. The clinical scenarios were designed with the specific aim of integrating clinical knowledge-based cognitive skills into the dispensing

process. Furthermore, the scenarios were designed in such a way that the application of a hierarchy of cognitive skills was required in order for students to successfully complete the scenarios.

The researcher began the development of the scenarios by conducting a content analysis of required learning outcomes and clinical knowledge of the selected third-year BPharm module, Clinical Pharmacy 311 (ZCP311). An analysis of minimum requirements for dispensing according to the GPP guidelines, as stipulated by the SAPC, was also included. Following the content analysis, the researcher acquired the MyDispense administrative skills necessary to produce a simulated scenario using MyDispense. However, particular design adjustments were made to the program to ensure scenarios were appropriate for students dispensing within a South African context, since the program was originally developed for use in Australia. The learning outcomes and clinical knowledge identified in the content analysis, were combined with the minimum requirements of the dispensing process within the MyDispense environment to produce seven different MyDispense clinical scenarios.

### 4.1.1. Learning outcomes and clinical knowledge required

The content analysis provided a platform for the design of the scenarios and was conducted by accessing key documents and identifying cognitive skills and clinical knowledge necessary at each stage of the dispensing process. The content which the researcher analysed consisted of the learning outcomes of the ZCP311 module, the clinical knowledge underpinning the learning outcomes, and the minimum requirements for the dispensing process according to the GPP guidelines (see Section 2.8). Together, these were evaluated by the researcher and provided the basis for structuring and development of the clinical scenarios.

#### 4.1.1.1. Learning outcomes

Learning outcomes are statements that define important learning that learners will have achieved and can consistently demonstrate at the end of a learning program or module. Simply put, learning outcomes identify what the learner should know and be able to do by the end of a module. Successful achievement of the learning outcomes of a module will enable students to continue further with their degree once they have successfully passed the module. The learning outcomes, therefore, also create a guideline for assessment requirements in order to ensure students have acquired the content and are able to apply the skills once they have passed the module. The assessments in the third-year clinical module (ZCP311) take the form

of assignments, practical sessions, two written semester tests, one Objective Structured Clinical Examination (OSCE), and one written examination.

As a basis for identifying scenarios to develop within the MyDispense program, the learning outcomes of the module ZCP311 were analysed (see Table 5).

*Table 5: Learning Outcomes of the Clinical Pharmacy 311 Module According to the Nelson Mandela University Curriculum*

| ZCP311: CLINICAL PHARMACY 311 | |
|---|---|
| **Learning Outcome Number** | **Learning Outcomes According to Outlay of Nelson Mandela University Curriculum** |
| **1** | Integrate the key terms, concepts and principles of the pathophysiology of endocrine and renal disorders and apply to the clinical management of these conditions. |
| **2** | Apply theoretical structure activity relationship knowledge to the molecular mechanism of activity of drug molecules used in the management of endocrine and renal disorders. |
| **3** | Use a comprehensive and systematic knowledge of the pharmacology of drugs in the management of endocrine and renal disorders and apply the knowledge to the clinical management of the conditions. |
| **4** | Clinically manage patients with endocrine and renal disorders in the professional practice setting. |
| **5** | Identify and evaluate appropriate pharmaceutical delivery systems relevant to the clinical management of the endocrine and renal disorders. |

Learning Outcome 1 requires students to integrate and apply key terms, concepts, and principles of the module content which the researcher considered to be directly related to the expectations of necessary skills to complete simulated clinical scenarios on relevant content. Learning Outcome 3 implies that students would need to be able to use their “comprehensive and systematic knowledge” and “apply the knowledge to the clinical management of the conditions”. This can also be considered an expectation of the simulated clinical scenarios, since students would need to apply theoretical knowledge covered in the module to be able to complete the simulated clinical scenario. Finally, Learning Outcome 4 directly relates to the purposes of this study, as the outcome mentions the students’ needs to manage patients with diagnosed endocrine and renal conditions “in the professional practice setting”. MyDispense

provides an ideal computer-generated simulation of the community dispensing environment, offering students the opportunity to achieve the learning outcomes within a simulated professional practice setting.

The researcher was therefore able to identify the particular learning outcomes that could be achieved by using the MyDispense program. The following steps in conducting the content analysis necessitated that the researcher identify the clinical knowledge required to accomplish the learning outcomes.

#### 4.1.1.2. Clinical knowledge content

By analysing the learning outcomes, the researcher was able to review the clinical knowledge covered in the ZCP311 module, which focuses on endocrine and renal conditions in particular. These conditions are presented during the ZCP311 module and are divided into various topics which are all taught within the four major subjects of pharmacy education: pharmacology; pharmaceutical chemistry; pharmaceutics; and pharmacy practice. The core content covered in ZCP311 covers all four major subjects and is listed below:

- Pathophysiology of endocrine disorders
- Pharmacology of drugs used in endocrine disorders
- Chemistry of drug molecules used in endocrine disorders
- Role of the pharmacist in endocrinology
- Drug delivery systems used in endocrine disorders
- Pathophysiology of renal conditions
- Pharmacology of drugs used in renal conditions
- Chemistry of drug molecules used in renal conditions
- Role of the pharmacist in renal conditions
- Drug delivery systems used in renal conditions
- Practicals: relevant to theory.

The researcher reviewed the core content listed above and chose four different topics within the module, which were presented at various times during the semester. These topics included: diabetes mellitus; female reproductive hormones; thyroid hormones; and diuretics.

The third-year BPharm students are didactically taught the content of the module in a typical lecture-style setting, and are required to practice integrating their clinical knowledge into

practice while completing the module's assessments. The assessment criteria together with assignments, semester tests, OSCE's, and examinations (from the year 2015 to 2017), were analysed by the researcher to create a platform of reference while designing the MyDispense clinical scenarios. The past semester tests and examination papers consisted of questions which required varying levels of cognitive skills. This provided an example for the researcher of how the clinical scenarios could be designed to necessitate a hierarchy of cognitive skills.

The clinical content covered in the module, also known as the module material, consisted of lecture notes, prescribed textbooks, and recommended texts. The lecture notes include slides created by the lecturer using Microsoft Powerpoint®, which lecturers use as a guide while presenting lectures. Lecture notes are designed to assist students with notetaking during lectures, provide a guideline of the content covered, and can also be viewed as a summary of the content covered in addition to providing direct links to prescribed textbooks, recommended texts, guidelines, and articles. The lecture notes are made available for students to download for personal use prior to the lecture from the university's electronic learning platform, Moodle. Prescribed textbooks and recommended texts are suggested by the lecturers and are listed in the ZCP311 module outline, see Table 6 below:

*Table 6: Prescribed Textbooks and Recommended Texts for the Clinical Pharmacy 311 Module*

| **PRESCRIBED TEXTBOOKS** | |
|---|---|
| **TITLE OF THE BOOK** | **EDITOR, AUTHOR AND PUBISHER** |
| Basic & Clinical Pharmacology (12th Edition) | Editor - Katzung<br>*Appleton & Lange* |
| Pharmacology (7th or 8th Edition) | Authors – Rang, Dale and Ritter<br>*Churchill Livingstone* |
| South African Medicines Formulary (12th Edition) | Department of Pharmacology, Medical School, University of Cape Town |
| Essential Drugs Programme – Standard Treatment Guidelines | National Health of Department, South Africa |
| Community Pharmacy – Symptoms, Diagnosis and Treatment (2nd Edition) | Authors - Rutter and Newby<br>*Churchill Livingstone* |
| Foye's Principles of Medicinal Chemistry (7th Edition) | Authors – Lemke, Williams, Roche and Zito<br>*Wolters Kluwer* |
| | |

| RECOMMENDED TEXT | |
|---|---|
| TITLE | **EDITOR, AUTHOR AND PUBISHER** |
| **Integrated Pharmacology (3rd Edition)** | Editors - Page, Curtis, Suffer, Walker and Hoffman<br>*Mosby* |
| **Basic and Clinical Pharmacology Exam & Board Review (10th Edition)** | Editors – Katzung,<br>*McGraw-Hill* |
| **ACCESSPharmacy** | Online Nelson Mandela University Library |

Once the researcher had analysed the clinical content covered under the four selected topics, the process of planning possible clinical scenarios began, and the integration of clinical knowledge according to the objectives described in the module's learning outcomes formed the main focus of the process.

### 4.1.2. Minimum standards of the dispensing process

As the aim of the study suggests, the clinical scenarios to be designed for practice through MyDispense necessitated that students integrate their clinical knowledge into the dispensing process. Therefore, the researcher needed to analyse the minimum requirements for dispensing in South Africa according to the GPP guidelines as stipulated by the SAPC. The dispensing process as defined by the SAPC describes the tasks that need to be performed to competently and responsibly dispense medicine to patients. In the literature review, the researcher used the GPP guidelines to describe the minimum standards required to perform the dispensing process (see Section 2.8). In Section 2.8 (see Figure 1), the researcher analysed the three dispensing phases, including the cognitive and technical tasks required during each phase. This highlighted the various skills required for each phase of the dispensing process. In the literature review, the researcher states that Croft et al. (2018) and Wright et al. (2018) identified that students were expected to use various levels of cognitive thinking skills to successfully complete the dispensing process, and were also required to perform clinical decision-making. This was also an important aspect of the content analysis, as it confirmed the different requirements of each dispensing phase and assisted in the design process of the clinical scenarios, allowing the researcher to incorporate varying levels of cognitive requirements. Finally, the researcher was able to identify the clinical knowledge described in the learning outcomes of the module and recognise how it could be integrated

into the dispensing phase, thereby also creating the design or basic structure of the clinical scenarios.

### 4.1.3. MyDispense program administration

Once the basic structure of the clinical scenarios was formulated during the content analysis, the clinical scenarios needed to be converted into computer-generated simulation scenarios using MyDispense. This required the researcher to be sufficiently acquainted with the MyDispense program in order to create the simulated clinical scenarios.

The MyDispense Team at Monash University granted the researcher a MyDispense user profile by allowing the researcher administrative rights to create tutorials and scenarios (also commonly referred to in the MyDispense program as “exercises”, therefore the term “scenario” and “exercise” will be used interchangeably throughout the study as they essentially imply the same thing). In particular, the researcher could design purpose-specific scenarios to suit the needs of the study.

Monash University has designed the MyDispense program to have a user-friendly interface for administrators, lecturers, tutors and students, providing step-by-step guides for each type of user. The guides explain all tasks, ranging from how the scenarios could be completed by students, to how lecturers could assess students. MyDispense is also designed with an efficient way of categorising each topic or section of a module into their own particular units (see Figure 5). A unit can be divided into various tutorials which individually contain exercises.

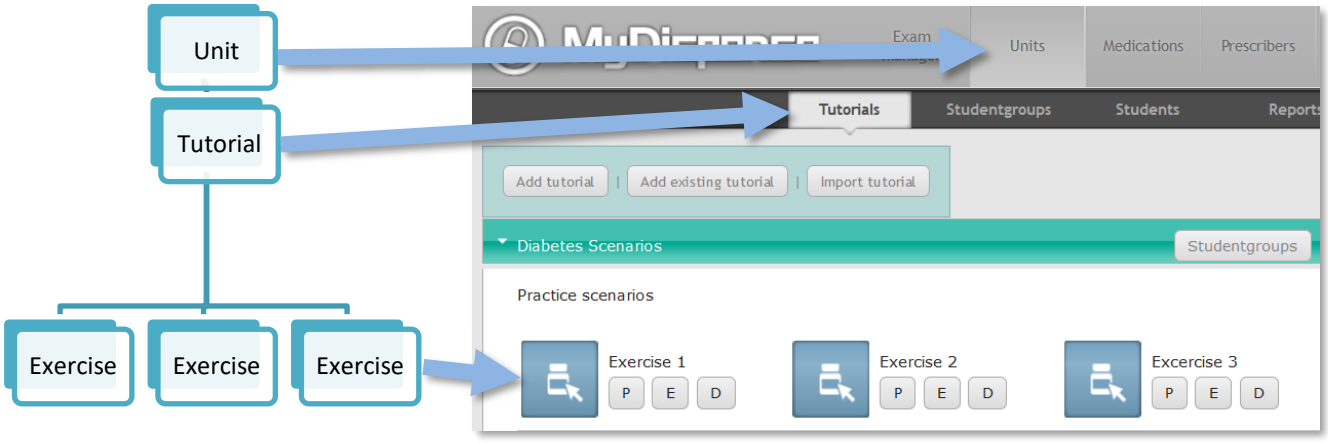


*Figure 5: Illustration of the Hierarchy of the Different Section on the Administrator’s MyDispense Home Page*

To be able to create an exercise, the administrator of the MyDispense program, in this case the researcher, needed to be familiar with the MyDispense exercise template which could be adjusted accordingly to create individualised scenarios. The exercise template contained an exercise menu bar with subsections which required completion before the exercise could be published as an active exercise on the MyDispense unit home screen. These sections included details of: the exercise; the prescription; the patient; the prescriber; and, lastly, counselling and hand-over notes (see Figure 6 below) and will be discussed in further detail in Section 4.1.4.


*Figure 6: Summary of the Exercise Menu Bar for Creating Exercises on MyDispense*

The researcher, as the MyDispense administrator, was therefore able to design exercises, each with different clinical content and at varying levels of cognitive difficulty, owing to the varied flexibility of the exercise design. The MyDispense team had also effectively designed the program to accommodate the complexities of dispensing scenarios, however, the dispensing layout and requirements of the program were suited more to the Australian dispensing environment and not to the South African dispensing environment.

### 4.1.4. Adjusting MyDispense for a South African pharmacy experience

As mentioned in the previous paragraph and in the literature review (see Section 2.7), MyDispense is designed to suit the Australian community pharmacy environment. It was for this reason that the researcher wanted to design clinical scenarios which were more

contextually suitable for the South African dispensing environment, providing a more realistic experience for the students.

Patient profiles, consisting of typically recognisable South African first names, surnames, and street addresses, representing most South African races and cultures, were created and corresponding avatars were also assigned to particular patient profiles (see Figure 7 below).


*Figure 7: Examples of the MyDispense Patient Profiles Created for the South African Practice Setting*

Similarly, medicines in the simulated dispensary of the MyDispense program used in this study were also adapted for the South African context. This involved photographing South African medicines and medicine packaging, manipulating them to suit the MyDispense image hosting requirements, and uploading them together with the correct product information onto the Nelson Mandela University's (South African) version of the program.

MyDispense has been recognised by researchers to provide a realistic simulated dispensing environment (see Section 2.7.2.). By adapting the program to provide a more contextual version of MyDispense, the researcher intended for the scenarios to also be seen as a realistic dispensing environment for the students.

### 4.1.5. Designing a MyDispense exercise

As mentioned in the previous Subsection 4.1.2., the creation of scenarios within MyDispense required specific information to be input into the program. These will be discussed in the following paragraphs and include details of the exercise, prescription, patient, prescriber, counselling, and hand-over. The researcher created seven clinical scenarios in total: three diabetes mellitus scenarios, two female hormone scenarios, one thyroid hormone scenario,

and one diuretic scenario. The number of scenarios were approximately proportional to the portion of the module spent focused on each of the selected topics. The information included in each exercise is summarised in Table 7 and will be referred to in each of the following subsections to illustrate the individualised design of the scenarios (see Table 7).

#### 4.1.5.1. The exercise details

The first stage of exercise development required the researcher to state-specific exercise details according to the menu bar (see Figure 6). An exercise name was decided on, and an introduction to the exercise was created. The exercise introduction, which was displayed on the screen as students opened the exercise, consisted of information about the patient and/or the intended purpose behind the patient's visit to the pharmacy. For each exercise, it was also necessary to decide what information should be provided to the students through the exercise introduction, and what information the students needed to identify on their own via investigation during the dispensing process. This was categorised in Table 7 under the column titled, "patients' background" to summarise the information provided for each scenario.

In the early stages of exercise creation, the type of exercise to be created was decided upon depending on the cognitive and technical dispensing tasks needed to be performed. MyDispense provides many options to choose from, such as label-only exercises, which only require students to perform the first and second phases of the dispensing process (Section 2.8.), or full exercises which require students to perform all three phases of dispensing. Furthermore, exercises can be categorised as non-prescription or prescription exercises, as discussed in Section 2.7.3. in the literature review. The researcher decided to create five prescription scenarios (diabetes mellitus, thyroid and diuretics scenarios), and two non-prescription scenarios (female hormone scenarios).

While designing the exercises, the researcher could decide whether students would be able to "reset" the exercise, essentially allowing them to repeat the exercise over without assessing the students' performance. In this study, it was decided to enable the exercises to be reset so that students had the freedom to practice the exercises as many times as they desired. The opportunity for repetitive practice relates to the features of SBE, as previously described in the literature review, as deliberate practice (see Section 2.5.1.). Ericsson (2004); McGaghie et al. (2010); Weller et al. (2012) all emphasise the value of deliberate practice in mastering particular skills and the ability to build on existing experience in small increments with shorter, more repetitive practice opportunities. By setting the scenarios as resettable, students were

not assessed on their performance or success of completing the scenarios during the study. As previously described in Section 2.5.5, the absence of assessment in SBE has been considered by students to be beneficial, as they feel that the learning environment is safe to practice newly acquired skills (Fernandez et al., 2007).

Once the students had submitted their clinical scenarios, they would be able to receive immediate feedback, as MyDispense allows for this functionality (see Section 2.5.2.). The researcher also emphasises that, as shown in Section 2.5.2., structured feedback is valued as an integral component of successful educational tools, providing students with the opportunity to learn from their mistakes and improve on their work. Shin et al. (2017) and Ambroziak et al. (2018) highlight that MyDispense especially creates a self-reflective learning opportunity for students to identify their learning needs. Therefore, if students could reset the scenario, they would be able to evaluate their work according to feedback and then retry the exercise while attempting to correct their previous errors.

In the early stages of the exercise development, the researcher could decide if the prescription would be the only documented patient communication received from the prescriber during the patient-pharmacist consultation, or whether additional patient documentation would be provided. Further patient documents could be provided as attachments, which could offer information pertinent to the successful completion of the exercise. In some of the scenarios, it was decided to attach laboratory patient test results as additional patient information. Students essentially needed to decide how the information from the provided laboratory test results could be used to assist in effectively completing the clinical scenario. The column in Table 7 entitled “summary of extra documentation available to pharmacist”, summarises the information provided, if any additional patient information was attached. After deciding on the specifics of the type of exercises, the resetting of the exercises, and the additional patient documentation, the researcher progressed to the next stage: formulating the prescription.

#### 4.1.5.2. The prescription details

The prescription details of each scenario pertained to information found on the prescription, which the simulated patient, or “avatar”, would bring into the pharmacy as part of the patient-pharmacist consultation, or the beginning of the first dispensing phase. This is relevant only in the case where the exercise type included a prescription and excludes “non-prescription” exercises. As mentioned previously, the non-prescription scenarios (female hormone scenarios) required students to recommend and dispense OTC medicine without a

prescription from another healthcare professional. The difference is represented in Table 7, where the female hormone scenario columns do not include medicine prescribed, but rather include ideal medicine that students should have recommended at the end of the consultation.

As mentioned in the literature review, different countries have different legal requirements in terms of their dispensing practices and documentation thereof. Therefore, it was necessary to note that because MyDispense was designed to be used in an Australian dispensing environment, there were two sections on the MyDispense prescriptions that did not apply to the South African dispensing environment. These consisted of the sections considering the entity responsible for payment and the type of authorised prescriber (see Figure 8 below).

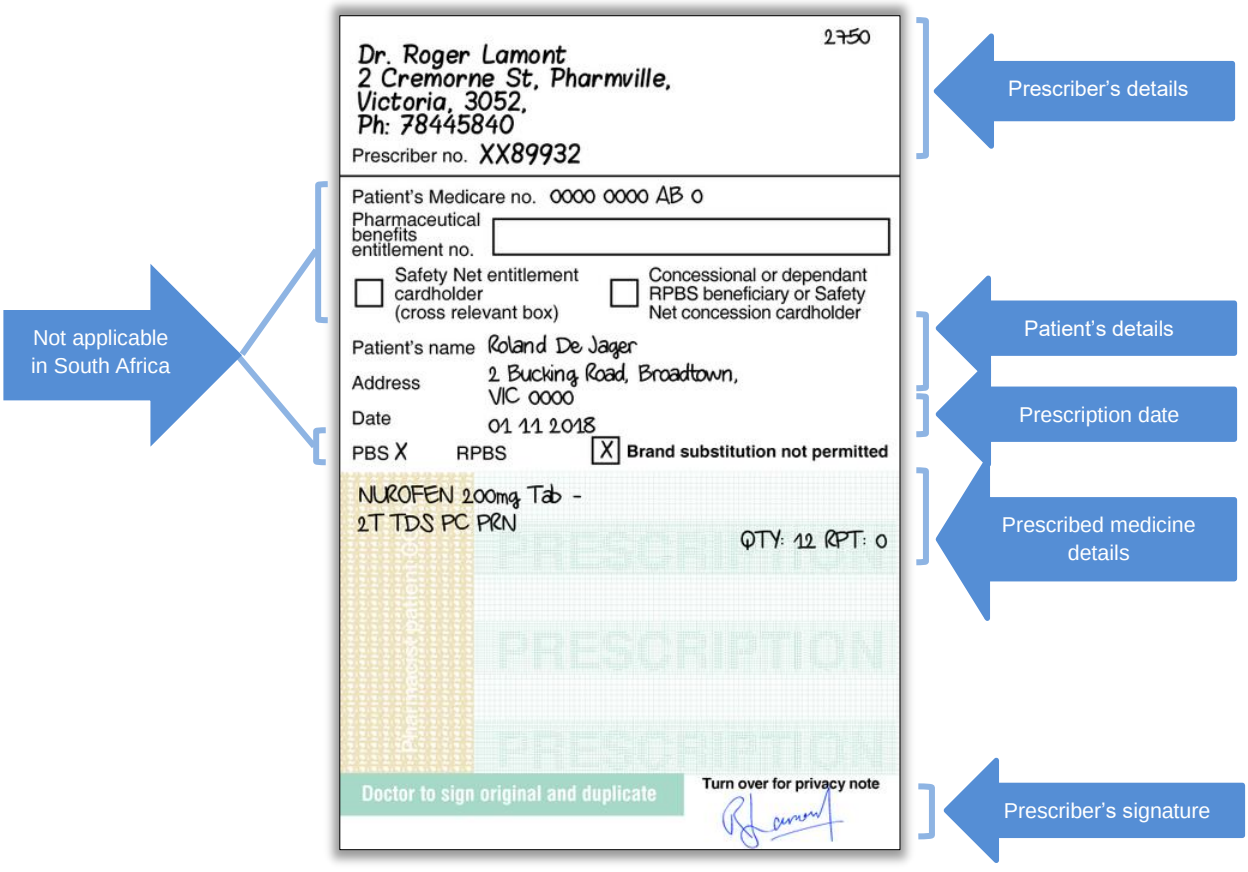


*Figure 8: An example of prescription showing the information required to be used in the MyDispense exercises*

Figure 8 shows an example of a prescription seen on MyDispense and illustrates the different information on the prescription in terms of the date, prescriber details, patient details, prescribed medicine details, and prescriber's signature. As mentioned in the literature review, in Section 2.8.2., the researcher elaborated on the tasks required during the first phase of the

dispensing process, where pharmacists are expected to confirm the integrity of the communication by ensuring the prescription is legal and authentic. According to the Pharmacy Act No. 53 of 1974, all prescriptions must be dated and must be brought to a pharmacy to be dispensed within 30 days; otherwise the prescription will be considered expired. Therefore, the date on the prescription was set to be variable depending on the date that students completed the exercises in real-time and not on the date that the exercise was created. The date on the prescription must be checked by students during the first phase of the dispensing process to ensure the prescription is valid and therefore forms an essential part of the clinical scenarios (see Figure 8). Suitable prescribers for each exercise were selected and prescriber profiles which were already loaded on MyDispense were used for the exercises, on account of all the prescriber profiles having the necessary qualifications to legally prescribe medicine in South Africa (see Figure 8). According to the Medicines and Related Substances Act 101 of 1965, an "authorised prescriber" in the South African healthcare system is either a medical practitioner, dentist, veterinarian practitioner, nurse, or person registered under the Health Professions Act of 1974 (South African Government, 1965).

Thereafter, the researcher selected the patients for the exercises (see Figure 8). When creating the patient's profile, specific information regarding the patient's current health status, the patient's age, weight, ethnicity, smoking status and/or history, as well as any allergies, were required to build a comprehensive profile. Another vital part of the prescription which needed to be created was the medicine prescribed by the authorised prescriber. While confirming the integrity of the prescription, the students needed to ensure that they understood the prescribers' intentions and that they correctly interpreted the nature of the treatment which the prescriber intended for the patient to use (see Section 2.8.2). In conjunction with this, they were expected to evaluate the correct recommended use of the prescribed medicine. The researcher, therefore, chose the trade/generic name, strength, dosage form, quantity, and directions for use of the medicine prescribed on the prescriptions. This was also followed by the number of permitted repeats of the prescribed medicine, which the patient could receive after an appropriate amount of time after the prescribed medicine is dispensed for the first time. A summary of the medicine prescribed per scenario can be seen in Table 7 under the column entitled "medicine prescribed".

Students were also required to take into consideration patients' health status and prior use of the medicine prescribed. The first dispensing phase, as stated in the literature review, requires students to ensure optimal use of medicine by analysing the therapeutic aspects, consisting of the safety of the medicine, drug-drug interaction, drug-disease interactions, and treatment

duplications (see Section 2.8.2.). Therefore, each patient could have a pre-existing medicine history stored on the dispensing software, which students were required to assess in the context of the newly prescribed medicine in order to ensure the optimal use of medicine. The researcher, therefore, needed to add comprehensive medicine histories containing information appropriate to the prescribed medicine: the trade/generic name of the medicines; strength; dosage form; quantity; and directions for use of the medicine (see Figure 9). This history needed to include the date the medicine was dispensed, the name of the prescriber, and the number of repeats which the patient would still be able to receive in the future. Patient medicine histories were created for some of the clinical scenarios in this study, which could be used by students to evaluate the suitability of the newly prescribed medicines in the context of past medication history. This was also summarised in Table 7 for each scenario under the column entitled “relevant medicine history”.

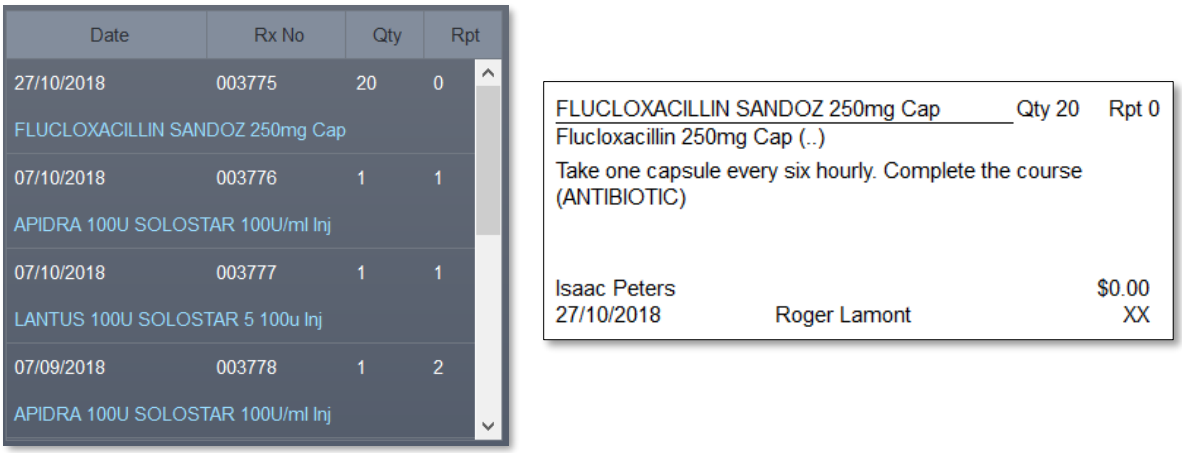


*Figure 9: Example of A Patient's Medicine History and an Accompanying Medicine Label*

#### 4.1.5.3. Patient fact-finding

During patient-pharmacist consultations, pharmacists are expected to communicate with patients, gathering valuable information to make an informed decision about the patient’s medicines. MyDispense, therefore, provided a section where students could communicate with the patient and vice versa. Initially, the patient could introduce themselves, with this introduction potentially including information pertaining to the patient, or information pertaining to the reason for the patient’s visit. As mentioned previously in this subsection (4.1), the researcher needed to ensure that students did not receive too much information and that there was still a need to ask appropriate questions of the patient in order to make informed decisions during the exercise. This section of the scenarios also allowed for patient profiles to be

created, so that students could select suitable questions to ask the patient in order to collect information necessary to make informed patient-specific pharmacotherapeutic decisions. The researcher had to anticipate reasonable and appropriate questions which students would pose to the patient and create corresponding patient responses. In this way students were able to ask a question and receive an immediate response (see Figure 10).

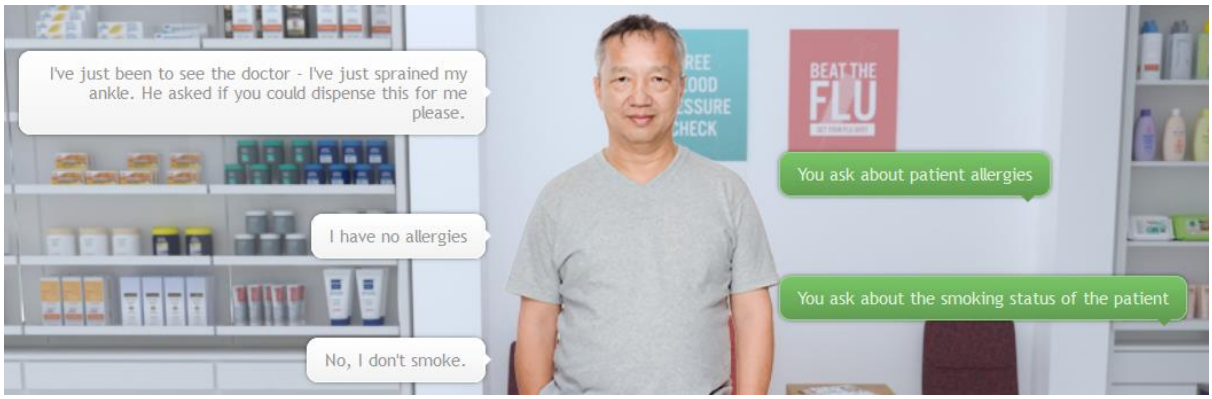


*Figure 10: An Illustration of an Example of Patient Fact Finding Questions and Answers*

MyDispense allowed for immediate feedback to be provided to students, as mentioned previously in this subsection (4.1). The feedback relating to this part of the scenario enabled students to distinguish between questions they should have asked the patient (i.e. ”must ask” questions), questions they could have asked but did not necessarily need to (i.e. “can ask” questions), and questions which should not have been asked (i.e. “do not ask” questions). Feedback was also constructed such that the reasons behind categorising the questions was also provided to students and students would have been able to understand why they should or should not have asked specific questions (See Figure 11).

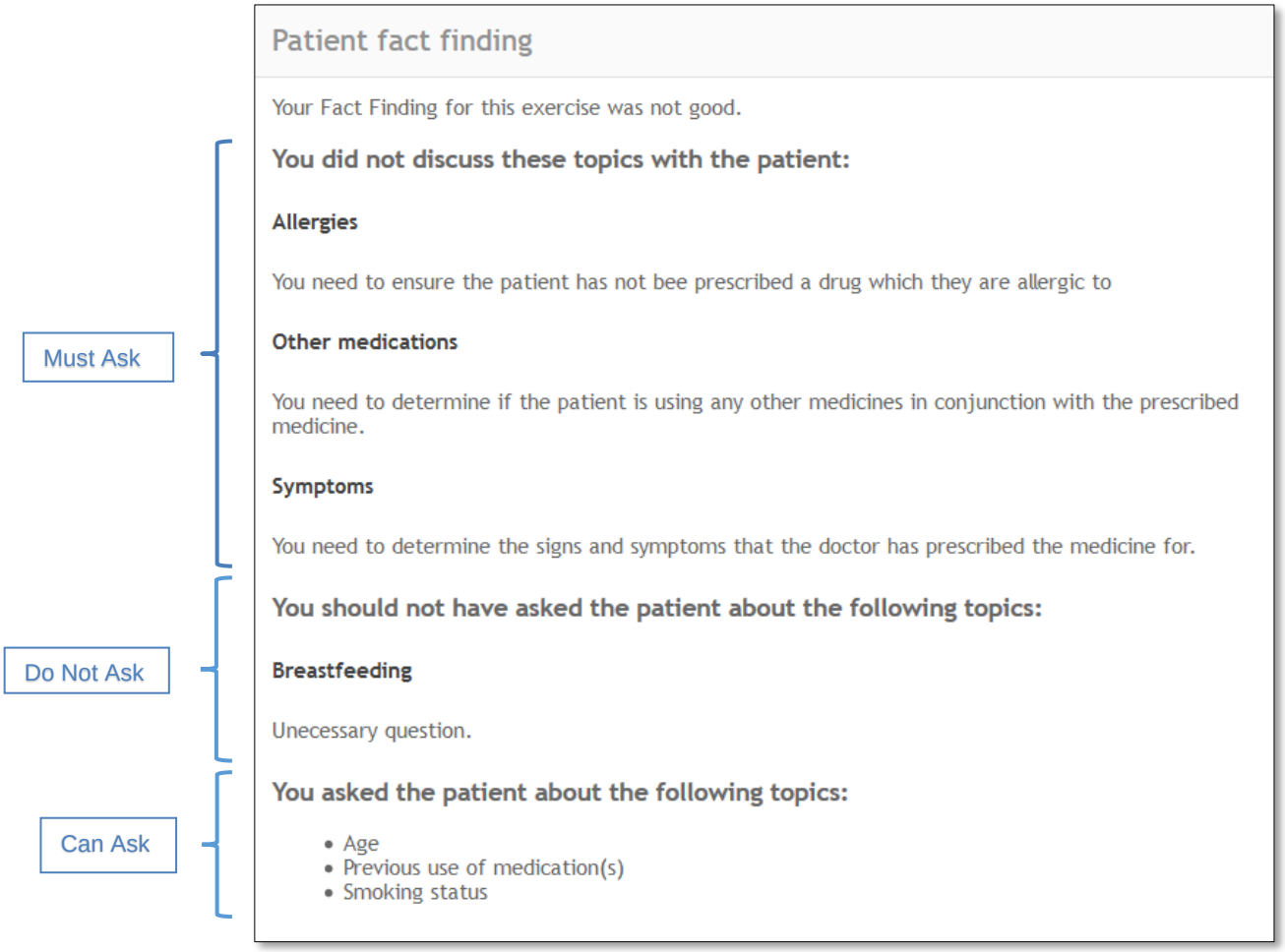


*Figure 11: An Example of Patient Fact Finding Feedback indicating the categories of "Must Ask", Do Not Ask" and "Can Ask"*

Figure 12 demonstrates how students were provided with reasons for why they should have asked particular questions. Students needed to ensure that they had asked all the necessary questions in order to collect the required information to make an informed decision. Table 7 includes a summary of patient fact-finding questions and answers under the column entitled "'must ask' patient fact-finding questions and answers". Only the "must ask" questions were included in this summary as they influenced the overall outcome of the scenario. However, during the second phase of the research (see Subsection 4.2), the lecturer participants were able to evaluate all patient fact-finding questions and answers in order to assess the scenarios.

MyDispense also allowed the researcher to customise patient fact-finding questions. Therefore, it was possible to create patient or scenario specific questions which were not included in the pre-formulated MyDispense patient fact-finding list. Some examples of

questions which the researcher developed pertained to chronic illness management, enabling students to determine if patients were managing their illness correctly by monitoring their blood glucose levels (see Table 7 - Diabetes Mellitus Scenario 1). In the emergency hormonal contraceptive scenario, the researcher was also able to include a question regarding the relevant sexual activity of a young female (see Table 7 - Female Hormones Scenario 1). Apart from questioning the patient about relevant information for the scenarios, students were also able to consult with the prescriber of the prescription.

#### 4.1.5.4. Prescriber fact-finding

During the design and configuration of the scenarios, an opportunity could be created for students to consult with the prescriber during completion of MyDispense scenarios, if students decided that it was necessary. The inclusion of a consultation required students to first identify the need to consult the prescriber, which ordinarily occurs during the first dispensing phase, as this is when students evaluate the prescription in the context of the patient's medical history. In a pharmacy practice setting, if the pharmacist identifies a discrepancy on a prescription, they are legally obligated to consult the prescriber if any adjustments are necessary, since the prescription may not be altered without the verbal or written permission of the prescriber (see Section 2.8.2.).

The researcher could choose from a pre-formulated list of questions under the prescriber fact-finding section of the program for each scenario, and then create suitable responses which the prescribers would reply back to the students. During the scenario, if students selected the option to consult the doctor the program would display the telephone screen, as seen in Figure 12 below, with a list of questions which students could select to ask the prescriber. Students then needed to analyse and interpret the prescriber's response without having the ability to follow up with a consecutive question.

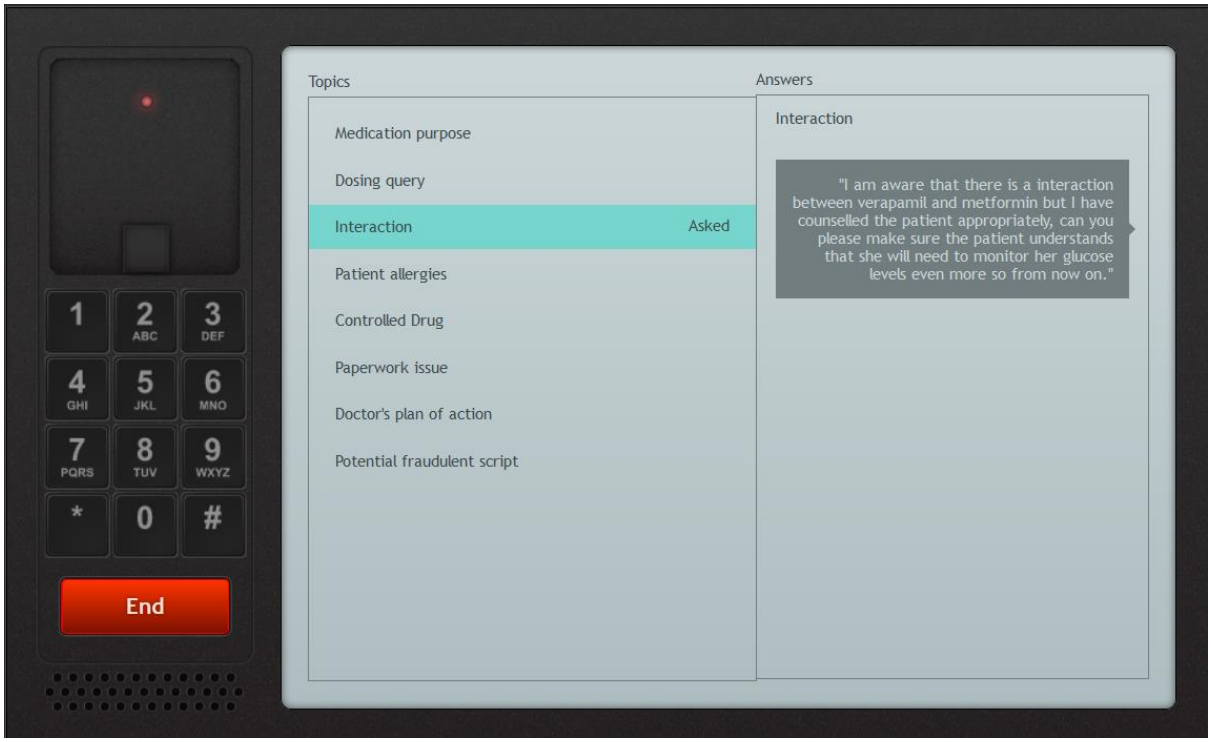


*Figure 12: An Example of Prescriber Fact Finding Question and Answer during an Exercise on MyDispense*

In a similar manner to the patient fact-finding feedback information, prescriber fact-finding questions could be categorised according to questions students should have asked, could have ask or should not have asked, followed by reasons behind the choice of question category. Table 7 represents the summary of prescriber fact-finding, under the column entitled "'must ask' prescriber fact-finding questions and answers". Again, the researcher only included the "must ask" questions and answers in Table 7 as they were pertinent to the final outcome of the scenario.

If students needed to consult a prescriber, it would preferably be for a critical reason relating to whether the prescription should in fact be dispensed or not, as pharmacists should not continue dispensing a prescription if the discrepancies cannot be resolved with the prescriber. In practice, pharmacists are the custodian of medicine and, therefore, they reserve the right to decide whether a prescription will be dispensed or not, and in what manner. Therefore, students needed to construct a therapy plan as to how the patient would be assisted and make decisions based on what would be the most beneficial outcome for the patient. Apart from students being able to ask the patient and the prescriber particular questions, students were also able to ask if the patients had any questions to ask them.

#### 4.1.5.5. Patient questions

MyDispense has provisions in place for questions to be set which the patient could ask the students, and which the students would then need to respond to. It could be decided whether students would be prompted by the program to check if the patient had any questions or if students were expected to ask without being prompted. MyDispense had no pre-formulated list of questions to select from and, therefore, specific questions needed to be devised for each scenario. Once the patient asked a question during the scenario, students needed to respond to the question in their own words and in any format they preferred, conversationally or in point form.

As was the precedent with previous sections, once students had submitted their scenarios, they received immediate feedback suggesting what should have ideally been included in their response to the patient's question. MyDispense does not have a functionality whereby typed sentences or paragraphs are critically assessed word-for-word, and therefore the students needed to manually compare their own responses to the memorandum provided at the end of the MyDispense scenarios, which was created by the researcher. The memorandum consisted of minimum requirements for students' responses to the patient and, in this way, students were urged to go through their own work and identify areas for improvement in comparison to the recommended response.

The researcher did not include the patient questions in the summary provided in Table 7 as the information would not affect the overall outcome of the scenarios but would still require students to practice answering patient-related questions. The patient questions and answers were, however, included in the second and third phase of the research (see Section 4.2), where the lecturer participants had to evaluate the scenarios which were piloted with the student participants.

#### 4.1.5.6. Counselling and handing-over

Once students completed the first and second dispensing phases during the simulation scenarios, they were expected to complete the final phase of the dispensing phase, whereby the patient is counselled and handed their medicine. In practice, this phase entails the pharmacist providing all the necessary information relating to how the patient should administer the prescribed medicine, side effects to be aware of, and when the patient should seek further assistance from the pharmacist or prescriber if therapy is unsuccessful (see

Section 2.8.4). Again, feedback was provided to the students in a similar manner to that described in the previous section for the patient questions response. Students were required to compare the counselling they provided to the patient to the recommended counselling. As mentioned previously, this allowed students to analyse their own work and identify areas for improvement.

The researcher also encouraged students to record professional notes which they could generate during the dispensing process. Professional note taking would assist the documentation of important information, where students could record any critical information discovered during the completion of the scenario, or any methodological reasoning behind difficult decisions made. The documentation and sharing of professional notes in pharmacy also enables continuity of pharmaceutical care and allows for future analysis of patient cases. Again, the researcher then generated feedback consisting of professional notes which students were able to compare with their own professional notes. The professional notes essentially summarised the overall outcome of the scenarios, and these were included in Table 7 under the column entitled, “ideal scenario outcome/professional notes”.

At the final stage of the scenario, students were required to certify that the correct medicine was being handed over to the patient. This was not the only opportunity where students could check the medicine dispensed to the patient, as they would have originally selected and prepared the medicine during the second dispensing phase. The researcher did not need to customise any part of the second dispensing phase for the study scenarios as MyDispense has a structured layout in the simulated dispensary, allowing students to perform all the necessary tasks of the second dispensing phase without any particular customisations. For the purposes of reviewing the second phase of dispensing which students are expected to complete during MyDispense exercises, Appendix J provides an overview of each task required displayed on the simulated program.

Once the dispensed medicine had been checked, students selected the “submit” icon on the MyDispense program to submit their work. MyDispense then immediately compared the students’ submissions to the researcher’s memorandum and laid out the comparison of the two in a comprehensive table format. The students’ answers were contrasted with the researcher’s answers so that the students were able to easily identify areas where they might have made an error, or where they needed improvement.

#### 4.1.5.7. Final versions of the scenarios

MyDispense has a set of structured requirements necessary to design and create a scenario using the program. In this subsection the researcher has discussed the information required for the exercise which included: prescription, patient fact-finding, prescriber fact-finding, patient questions, counselling, and the hand-over. For each of the requirements necessary, the minimum information required before computing the details into a published MyDispense clinical scenario has also been discussed. While the researcher was designing the scenarios on MyDispense and determining how to adequately incorporate the clinical knowledge content while implicating the necessity for a hierarchy of cognitive skills, the scenario design was also recorded into a Microsoft Word® document. This facilitated the orderly compilation of the clinical details and information required for a scenario and was used during Phase Two of the research study whereby lecturer participants would be expected to review the scenarios. The structured layout of the Microsoft Word® format of the MyDispense scenarios were considered to be more user-friendly for Phase Two of the research, as the lecturer participants did not necessarily need to access the MyDispense program to access the scenarios. The Microsoft Word® format provided a clear representation of the clinical scenario so that the lecturer participants were able to analyse and evaluate the clinical scenario and cognitive skills required, according to Bloom's Revised Taxonomy. The researcher also required that the participants identify any errors or information needing clarification, thus necessitating that the content of the designed clinical scenario was arranged in a clear manner using Microsoft Word®. An example of such documents is included as Appendix I.

### 4.1.6. Summary

Subsection 4.1 has described the development of a set of simulated clinical scenarios, using MyDispense to integrate the clinical knowledge-based cognitive skills requiring a hierarchy of cognitive skills into the dispensing process. This was achieved by conducting a content analysis of the required learning outcomes, clinical knowledge, and the minimum requirements for dispensing to provide a basis for producing seven unique purpose specific MyDispense clinical scenarios. This was completed after the researcher acquired the MyDispense administrative skills necessary to formulate the simulated scenarios and was also able to make particular design adjustments to the program, to ensure the scenarios would be appropriate for students dispensing within a South African dispensing environment. After the completion of the design and creation of the MyDispense scenarios, the scenarios were evaluated and categorised by the lecturer participants, according to the cognitive and clinical decision-

making skills required for their completion. This shall be discussed in the following subsection 4.2, where the lecturer participants were provided with the scenarios from phase one of the study.

*Table 7: Summary of Information Used in Clinical Scenarios*

| SUMMARY OF INFORMATION USED IN CLINICAL SCENARIOS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Topic** | **No.:** | **Patient Background** | **Medicine prescribed** | **Summary of Extra Documentation Available to Pharmacist** | **"Must Ask" Patient Fact Finding Questions and Answers** | **Relevant Medicine History** | **"Must Ask" Prescriber Fact Finding Questions and Answers** | **Ideal Scenario Outcome/ Professional Notes** | **Major themes recommended for patient counselling** |
| **Diabetes Mellitus** | **1** | Patient has received a new prescription from the doctor - Doctor did a few tests during her visit yesterday and said to her that the new prescription contained new medicine because of the test results. | **1. Verahexal® 240 SR (Verapamil) 240mg Tab -** (take one tablet daily) - *quantity = 30, repeats = 5* | Laboratory test results:<br>**BP** = above the normal range,<br>**eGFR** = below the normal range,<br>**BMI** = normal,<br>**Hb1Ac** = above the normal range | **(Allergies?)** = "*no allergies*",<br>**(Other medicine use?)** = "*I have been taking paracetamol tablets for my persistent headache but the doctor said that this new medicine should resolve the problem.*",<br>**(Symptoms?)** = *"Just the persistent headache but the doctor said that this new medicine might help resolve the problem."*<br>**(Smoking status?)** = *"I smoke 7-12 cigarettes a day."* | **1. Paracetamol 500mg Tab** - (take one-two tabs every 6-8hourly - when necessary) = *prescribed 3 months ago*<br>**2. Metformin 500mg Tab** - (take two tabs twice daily) = *repeated for past 6 months*<br>**3. Indapamide 2.5mg Tab** - (take one tab in the morning) = *repeated for past 6 months* | **(Prescriber's Intentions?)** = *"I intend to review the patient next week to look at their response to the medicine."*<br>**(Interaction?)** = *"I am aware that there is an interaction between verapamil and metformin but I have counselled the patient appropriately, can you please make sure the patient understands that she will need to monitor her glucose levels even more so from now on."* | Dispense medicine after consultation with the prescribing doctor. | Administration of medicine, consult pharmacist if experience any new symptoms, encourage self-monitoring blood glucose, encourage lifestyle modifications |

| SUMMARY OF INFORMATION USED IN CLINICAL SCENARIOS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Topic** | **No.:** | **Patient Background** | **Medicine prescribed** | **Summary of Extra Documentation Available to Pharmacist** | **"Must Ask" Patient Fact Finding Questions and Answers** | **Relevant Medicine History** | **"Must Ask" Prescriber Fact Finding Questions and Answers** | **Ideal Scenario Outcome/ Professional Notes** | **Major themes recommended for patient counselling** |
| **Diabetes Mellitus** | **2** | Patient's doctor is on leave and patient can't get hold of him - Doctor diagnosed patient with diabetes 3 months ago (started insulin). Doctor took a finger-prick blood glucose test but without any consultation they gave the patient the prescription. Patient also believes to be experiencing side-effects from the insulin. | **1. Apidra® 100U (Insulin glulisine) Solostar 100U/ml** - 15 units to be injected subcutaneously three times a day - *quantity = 5 pens, repeat = 5*<br>**2. Lantus® 100U (Insulin glargine) Solostar 100U/ml** - 20 units to be injected subcutaneously three times a day, *quantity = 3 pens, repeats = 5* | No attachments | **(Other medicine?)** = "*I'm about to finish a course of an antibiotic, you'll see it on your system. It was for a bad ingrown toenail that I have. I've also been using mefenamic acid that was lying around at home for the pain."*, **(Symptoms?)** = *"Sometimes I feel weak and light headed and it's weird, it only happens before lunch and before supper."*, **(Chronic illness management?)** = "*I check my glucose every second day or so. I hate pricking my finger, yoh!"* | ***1. Flucloxacillin 250mg Cap*** - (take one capsule every six hourly) = *prescribed 5 days ago*<br>**2. Apidra® 100U Solostar 100U/ml** - (10 units at the start of a meal for breakfast, lunch and supper) = *repeated for the past 3 months*<br>**3. Lantus® 100U Solostar 100u/ml** - (15 units at bedtime) = *repeated for the past 3 months*<br>**4. Accucheck Performa® Test Strips**- (use when necessary) = *repeated for the past 3 months* | No prescriber fact finding | • Patient was diagnosed with type 1 diabetes 3 months ago<br>• Dr started with 10U Apidra and 15U Lantus<br>• Dr increased to 15U Apidra and 20U Lantus before check-up with patient<br>• Patient experiencing pre-prandial hypoglycaemia<br>• Currently only checking glucose once every 2nd day<br>• Ingrown toenail infection<br>• Needs further DM education<br>• Counselled on insulin use, risks of hypoglycaemia, increase glucose monitoring, diet, foot care<br>• Dispensed insulin with a referral to doctor. | Reasoning behind the increase in units of insulin to be administered. Explanation of possible reasons for light headed symptoms - recommend increases self-monitoring blood glucose. Ensure administration of insulin at the correct time of day. Recommend increased snacking to decrease hypoglycaemia symptoms. Monitoring and recommendations of patient foot care. |

| SUMMARY OF INFORMATION USED IN CLINICAL SCENARIOS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Topic** | **No.:** | **Patient Background** | **Medicine prescribed** | **Summary of Extra Documentation Available to Pharmacist** | **"Must Ask" Patient Fact Finding Questions and Answers** | **Relevant Medicine History** | **"Must Ask" Prescriber Fact Finding Questions and Answers** | **Ideal Scenario Outcome/ Professional Notes** | **Major themes recommended for patient counselling** |
| **Diabetes Mellitus** | **3** | Patient has type 2 diabetes mellitus and has come to ask for the prescription to filled. Patient would also like to know what she should do during Ramadan as she will be fasting but knows that she must not let her sugar drop too low. She starts fasting the following week. | **1. Accucheck Performa® 100 - Test Strip**s - use when necessary - *quantity = 1 box, repeats = 5* | No attachments | **(Previous use of medicine?)** = *"I use these strips about twice a day usually."* **(Chronic therapy adherence?)** = *"I am pretty good about my sugar. It's just that I don't have a choice but to fast for Ramadan and I need to know what will help."* | **1. Metformin 850mg Tab** - (take one tab twice daily) = *repeated for the past 6 months* **2. NovoMix® 30 Penfill (30% insulin aspart, 70% insulin protamine aspart)** - (10 units twice daily) = *repeated for the past 6 months* | No prescriber fact finding | • Patient about to start fasting for Ramadan<br>• Advised not to, as Type 2 diabetes patient with unknown control of glucose<br>• But counselled on regular self-monitored blood glucose (SMBG), being prepared to break her fast for hypo- or hyperglycaemic episodes<br>• Patient was then advised to change insulin regiment to: 5 units of NovoMix® at Suhur (pre-dawn meal) and 10 units of NovoMix® at Iftaar (breaking fast meal) | Recommendation to consult with the doctor, increase frequency of self-monitoring blood glucose (SMBG) on regular basis, breaking of fast if hypoglycaemia or hyperglycaemia are experienced, recommended dose adjustment of insulin and metformin for Suhur and Iftaar. |

| SUMMARY OF INFORMATION USED IN CLINICAL SCENARIOS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Topic** | **No.:** | **Patient Background** | **Medicine prescribed** | **Summary of Extra Documentation Available to Pharmacist** | **"Must Ask" Patient Fact Finding Questions and Answers** | **Relevant Medicine History** | **"Must Ask" Prescriber Fact Finding Questions and Answers** | **Ideal Scenario Outcome/ Professional Notes** | **Major themes recommended for patient counselling** |
| **Thyroid Hormones** | **1** | Patient has been to see the doctor who says that the patient should start with the medicine on the prescription | **1. Euthyrox® 100mcg Tab (Levothyroxine)** - take one tab daily - *quantity = 30, repeats = 5* | Laboratory test results:<br>**BP** = normal,<br>**TSH** = above the normal range,<br>**T4** = below the normal range,<br>**Free T4** = below the normal range | **(Allergies?)** = *"I am allergic to bee stings and I get hay fever"*,<br>**(Other medication?)** = *"I use antihistamine tablets for my hay fever"*,<br>**(Symptoms?)** = *"I'm tired all the time, I feel weak, I get cold easily, my muscles cramp and as soon as I try to exercise, I feel out of breath. I also feel really down all the time."* | No past medicine history | **(Doctor's plan of action?)** = *"I plan on letting the patient use the medicine for a while and then I will test their thyroid hormone levels again."*,<br>**(Dosing query?)** = *"I forgot that I needed to start the patient on lower levels of levothyroxine. Please start the patient on 50 micrograms for four weeks and tell them to come and see me to have their levels tested."* | • Patient experiencing hypothyroidism<br>• Phoned Dr Aman – discuss patient initiated on Euthyrox® 50mcg and not Euthyrox® 100mcg<br>• Dr Aman confirmed – patient to see Dr after 4 weeks of therapy - Rx with 50mcg to be sent in next 7 days<br>• Dispensed **Euthyrox® 50mcg** with NO REPEATS – Patient to see Dr first | Discussion with patient regarding the dose change. Recommendation to visit doctor if experiencing any side-effects, warned of particular side-effects to be vigilant of. Encouraged to adhere to healthy lifestyle. Reminded to return to doctor after 4 weeks. |

| SUMMARY OF INFORMATION USED IN CLINICAL SCENARIOS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Topic** | **No.:** | **Patient Background** | **Medicine prescribed** | **Summary of Extra Documentation Available to Pharmacist** | **"Must Ask" Patient Fact Finding Questions and Answers** | **Relevant Medicine History** | **"Must Ask" Prescriber Fact Finding Questions and Answers** | **Ideal Scenario Outcome/ Professional Notes** | **Major themes recommended for patient counselling** |
| **Diuretics** | **1** | Patient has sprained his ankle and has brought a prescription to be dispensed. | **1. Nurofen® 200mg Tab (Ibuprofen)** - take two tabs three times a day - *quantity = 30, repeats = 0* | No attachments | **(Allergies?)** = *"I don't have any"*, **(Other medication?)** = *"I am taking a water tablet to help with oedema - seems to be working."*, **(Previous use of medication?)** = *"I've used it a couple years back I think - not sure."* | **1. Lasix® 40mg Tab (Furosemide)** - (take one tablet twice daily) = *repeated for the past 6 months* | No prescriber fact finding | Student should NOT dispense the prescription. Ibuprofen will interact with furosemide, decreasing the efficacy of furosemide causing fluid retention as a consequence. The patient's doctor is currently unavailable for consultation - need to wait until consulted with the doctor. Meloxicam should be prescribed instead - more selective for the COX2 isoenzyme than ibuprofen. However, need to wait to speak to the prescribing doctor as meloxicam is a schedule 3 medicine - require a prescription. | Discuss the situation with the patient, unable to dispense ibuprofen. Recommend non-pharmacological treatment until the doctor prescribes alternative medicine. Offer delivery of medicine to patient's residence. |

| SUMMARY OF INFORMATION USED IN OVER THE COUNTER (OTC) SCENARIOS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Topic** | **No.:** | **Patient Introduction/ Query** | **"Must Ask" Patient Fact Finding Questions and Answers** | **Patient Question and Answers** | **Ideal Medication Recommended** | **Ideal Scenario Outcome/ Professional Notes** | **Major themes recommended for patient counselling** |
| **Female Hormones** | **1** | Patient says that she is married and had unprotected sex with her husband. They don't want to have any children at the moment. She usually goes to her pharmacy closer to home but it's rather urgent, can she please helped with something to make sure she doesn't fall pregnant. | **(Age?)** = *"I am 25 years-old"*, **(Allergies?)** = *"I have no allergies"*, **(Breastfeeding?)** = *"No, I don't have any children and my husband, and I do not want any children at the moment."*, **(Pregnant?)** = *"No, I took a pregnancy test a month ago and it was negative."*, **(Previous Use of Medication?)** = "*I have never used any kind of emergency medicine not to fall pregnant before."*, **(Other medicine?)** = *"I have been using the Nur-Isterate® injection for the past 5 years, apart from the past three months. I missed my latest appointment, which was 3 months ago, I've been so busy that I haven't been able to go back to make another one."*, **(Purpose of medicine?)** = *"I don't want to fall pregnant."*, **(Symptoms?)** = *"I feel fine - no different to usual."*, **(Sexual Activity?)** = "*Um.... I think it was about 48 hours ago. My husband has been away for the past month, so this was the first time since about a month ago that I have been sexually active."* | **(Question)** = *"Should I just have the injection right now, instead of taking something to prevent the pregnancy?"*, **(Answer)** = *"Because we can confirm that you are not pregnant, it will be best for you to take the emergency contraceptive as soon as possible. The injection does work as a contraceptive but not in an emergency situation like this, where you have been off the injection for a few months. The emergency contraceptives are designed to work immediately and should therefore prevent you from falling pregnant after sexual activity which occurred within the past 72 hours for which you were not protected against."* | **1. Norlevo® 0.75 mg Tab (Levonogesterel)** - (take two tablets immediately, may cause nausea), *quantity = 2 tablets* | • Married patient requested emergency contraceptive for intercourse occurring 48hours ago<br>• Pregnancy - not probable as pregnancy test 1 month ago indicated negative - and no sexual activity since<br>• Uses Nur-Isterate® but hasn't received last injection (over 3 months ago)<br>• Dispensed emergency contraceptive (Norlevo®) and recommended to receive Nur-Isterate® thereafter at healthcare facility preferred.<br>• Counselled on abstinence and barrier contraceptives until protected via Nur-Isterate® | Administration of medicine, warning of nausea as a possible side-effect, if nausea leads to vomiting - refer to pharmacist or doctor, possibility of "spotting" minor bleed, suggestion of receiving Nur-Isterate® injection, abstaining or use of condoms |

| SUMMARY OF INFORMATION USED IN OVER THE COUNTER (OTC) SCENARIOS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Topic** | **No.:** | **Patient Introduction/ Query** | **"Must Ask" Patient Fact Finding Questions and Answers** | **Patient Question and Answers** | **Ideal Medication Recommended** | **Ideal Scenario Outcome/ Professional Notes** | **Major themes recommended for patient counselling** |
| **Female Hormones** | **2** | Patient is 5 months pregnant and is struggling with constipation. She has just seen a medicine on the shelf and wants to know if she can use it for the constipation. Medicine is **Dulcolax® Tabs (bisacodyl) 5mg** | **(Age?)** = "I am 32 years old", **(Allergies?)** = "I have no allergies", **(Breastfeeding?)** = "Yes, I have a 16-month-old that I am still breastfeeding.", **(Previous use of medicine?)** = "I've never really suffered from constipation before.", **(Other medication?)** = "I am taking multi-vitamins and recently I started taking an iron supplement as the doctor said my iron levels were low." | **(Question)** = *"Should I be drinking more coffee, I've heard that it can get the stomach going?"*, **(Answer)** = *"Alice can drink coffee however because she is breastfeeding and pregnant, she will need to limit her intake. It is recommended to rather consume beverages with a low caffeine content however, caffeine does not have to avoided completely. Caffeine may have a minor effect on the baby she is breastfeeding and also her pregnancy. Caffeine may also cause her to be dehydrated owing to the diuretic effects of caffeine which could worsen the constipation. It is suggested then that she reduce her caffeine intake and to rather drink more water which would be more effective in alleviating the constipation."* | **1. Fybogel® 3.5g powder (Ispaghula husk)** - (Dissolve one sachet in a glass of water, after meals, in the morning and in the evening.)<br><br>**OR**<br><br>**2. Lacson® Syrup (glycerin syrup)** - (Initially, use three medicine measures (15ml) to six medicine measures (30ml) as a single or two divided doses. Thereafter use two to three medicine measures (10-15ml) daily.) | • Patient - 5 months pregnant<br>• Complaining of constipation<br>• Possible cause - iron multi-vitamins she started taking two weeks ago<br>• Recommended bulk-laxative, increase fluid-intake, limit caffeine intake.<br>• Referral to doctor: check on iron levels as constipation may be caused by iron supplements | Warn patient of unsafe medicine for constipation, recommend that the patient consult the doctor regarding iron supplement as they may be the cause of the constipation. Recommend food which are rich in fibre for the constipation and foods which are rich in iron. |

### 4.2. The evaluation of the clinical scenarios and feedback by the lecturer participants

This subsection of the study will focus on the evaluation of the clinical scenarios developed during Phase One and the feedback by the lecturer participants to improve or adjust these scenarios. As described in Subsection 4.1, a set of simulated clinical scenarios were created using MyDispense to integrate the clinical knowledge-based cognitive skills, requiring a hierarchy of cognitive skills, into the dispensing process

The dispensing process, which has been previously described in detail in Section 2.8, involves competency-based skills which are required for successful completion of the tasks appropriate to each phase of dispensing (see Figure 1, p38). These dispensing tasks require the application of cognitive skills to be able to interpret and problem solve for a suitable solution to each individual dispensing scenario. As mentioned previously in Section 2.8.7, the cognitive requirements expected of pharmacy personnel during the dispensing process can be classified at varying levels of Bloom's Revised Taxonomy as outlined by Anderson and Krathwohl (2001). Similarly, the tasks expected during the dispensing process can also be classified according to four consecutive stages of the decision-making process, as described by Wright and colleagues (2018) (see Section 2.8.6 – Figure 2, p44). This second phase of the research provides the evaluation and categorisation of the clinical scenarios designed in Phase One, according to the cognitive and clinical decision-making skills required for their completion.

Phase Two of the research study included input from seven lecturer participants who were employed as lecturers in the Pharmacy Department at Nelson Mandela University. As mentioned previously in Section 3.2.2, the lecturers were all qualified pharmacists and were experienced in using Bloom's Revised Taxonomy to analyse assessments. The purpose-designed assessment form (Addendum G) completed by the lecturer participants was based on a cognitive assessment tool used by lecturers in the Pharmacy Department to analyse the academic tests, assignments, and examinations for the modules presented in the BPharm curriculum. The assessment form was divided into three main sections: Bloom's Revised Taxonomy level classification, clinical knowledge analysis, and recommendations; each of which are fully described in this section. The purpose of this classification, analysis, and feedback from the lecturer participants was to ensure an accurate comparison according to Bloom's Revised Taxonomy and to ensure effective alignment of the researcher's planned clinical outcomes which were envisaged when designing the scenarios. The lecturer

participants were provided with the clinical scenarios in the Microsoft Word® format as mentioned in Subsection 4.1 (see Appendix I).

### 4.2.1. Analysis of cognitive skills according to Bloom's Revised Taxonomy level descriptors

The first part of the purpose-designed assessment form, the Bloom's Revised Taxonomy section, was used to categorise which levels of cognitive skills the lecturers perceived to be necessary for each clinical scenario according to the taxonomy. As mentioned in Section 2.8.7., Bloom's Revised Taxonomy is a well-known, effective tool often used by educators to identify six different levels of cognitive skills in academic assessments. The purpose-designed assessment form presented to the lecturers showed each Bloom's Revised Taxonomy level in order from left to right, starting from level one to six. On the form, each level of Bloom's Revised Taxonomy had accompanying descriptive words which aided in the identification of the cognitive skills into various levels (Anderson & Krathwohl, 2001). The lecturers were requested to select the Bloom's Revised Taxonomy levels which they perceived to be appropriate for particular clinical scenarios and elaborate on their specific selection/s with one or more descriptive word/s for the particular level of Bloom's Revised Taxonomy selected.

Although this study follows qualitative research methods, the researcher has laid out the results of the purpose-designed assessment form in a table format which allows for more effective and thorough analysis of this section of the research (see Table 8). By analysing the table, and without placing numerical or percentile values against any outcomes, the researcher noticed that the majority of the lecturer participants recorded that they perceived most of the clinical scenarios to require students to use cognitive skills which are at the higher levels of Bloom's Revised Taxonomy. As previously mentioned in Section 2.8.7, a student who is able to practice the cognitive skills required at the higher levels, and especially at level 6 of Bloom's Revised Taxonomy, would be assumed to be competent in practicing the cognitive skills required in the previous levels. Only once a student has mastered a particular level would they be able to begin to accomplish what is required in the next subsequent higher level.

Cognitive skills at the Bloom's Revised Taxonomy levels of 1 to 5 were identified by the lecturers to be practiced in the MyDispense clinical scenarios. The "remembering" Level 1 of Bloom's Revised Taxonomy (Table 3: Bloom's Revised Taxonomy Terms and Definitions, p47), requires the student to retrieve information from lists, facts, or definitions. The descriptor words, "identifying", "recognising", and "recalling" (Table 8) were used to describe this level.

Bloom's Revised Taxonomy's Level 2, or the "understanding" level, is known for the way by which meaning is constructed from the data gathered in Level 1. This level was represented by selection of the following descriptor words by the lecturers: "explaining"; "interpreting"; "clarifying"; and "comparing" (Table 8). Furthermore, Bloom's Revised Taxonomy's "applying" Level 3 requires the student to take the information obtained through earlier levels of learning (Level 1 and 2) and integrate it with the problem at hand to achieve an outcome or solution. Level 3 was identified by the lecturers through the descriptor words "using", "implementing", "carrying out", and "executing" (Table 8). The "analysing" Level 4 of Bloom's Revised Taxonomy relates to the deeper understanding of the knowledge obtained and the application thereof, to be able to organise or categorise knowledge in a structured manner. Level 4 was represented by the selected descriptor words "integrating", "distinguish", "differentiate", and "structuring" (Table 8).

Bloom's Revised Taxonomy Level 5, also known as the "evaluate" level, requires the student to check, co-ordinate, detect, monitor, test, or judge the clinical scenario with relevant resources. The most popular Bloom's Revised Taxonomy descriptor words selected by the lecturers for Level 5 were "checking", "detecting", and "judging" (Table 8).

The highest Bloom's Revised Taxonomy level, Level 6, also known as the "create" level (see Table 3, p47), was selected for most scenarios and was accompanied by Level 6 descriptive words (Anderson & Krathwohl, 2001). The descriptive words as outlined by Anderson and Krathwohl (2001) in Level 6, require the student to "plan", "generate", "construct", "design", "produce", or "construct" a new resolution or way forward for any problem presented. In this study, the pharmacy students were presented with particular problems in each MyDispense clinical scenario which required them, in most cases, to create their own solution to the problem which focused on finding a method of providing the best possible pharmaceutical care to the patient. The most overall frequently used descriptive words for cognitive skills required to complete the scenarios, as selected by the lecturer participants, appeared to be "planning" and "generating" (Table 8).

Therefore, it was perceived that the students would be required to practice cognitive skills from a range of Bloom's Revised Taxonomy levels, but that the higher levels of Bloom's Revised Taxonomy would certainly be expected to be practiced during each MyDispense scenario. Furthermore, it was necessary to understand the clinical decision-making process which the students were expected to perform if they practiced cognitive skills categorised into a range of Bloom's Revised Taxonomy levels. This will be discussed in the following paragraphs.

*Table 8: Summary of Analysis of Clinical Scenarios Using Bloom's Revised Taxonomy*

| SUMMARY OF ANALYSIS OF CLINICAL SCENARIOS USING BLOOM'S REVISED TAXONOMY | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (The number in parentheses represents the number of times that the descriptive word was used by lecturer participants for each scenario.) | | | | | | | | | | | | | |
| **CLINICAL SCENARIO** | | **DESCRIPTIVE WORDS SELECTED BY PARTICIPANTS ACCORDING TO THE BLOOM'S REVISED TAXONOMY LEVELS** | | | | | | | | | | **HIGHEST LEVEL OF BLOOM'S REVISEDTAXONOMY ANALYSIS SELECTED BY PARTICIPANTS** | |
| | | **1** | | **2** | | **3** | | **4** | | **5** | | **6** | | **No. of Participants Selecting Level < 6** | **No. of Participants Selecting Level 6 (n = 7)** |
| **Topic** | **No.:** | **Remembering** | | **Understanding** | | **Applying** | | **Analysing** | | **Evaluating** | | **Creating** | | | |
| **Diabetes Mellitus** | **1** | Identifying | (4) | Interpreting | (3) | Executing | (4) | Integrating | (2) | Detecting | (4) | Generating | (4) | 1 (Selected Level 5) | 6 |
| | | Recognising | (2) | Clarifying | (3) | Using | (1) | Differentiate | (2) | Checking | (3) | Planning | (3) | | |
| | | Recalling | (2) | Explaining | (2) | | | Structuring | (1) | Judging | (1) | Constructing | (1) | | |
| | | | | Comparing | (1) | | | Finding Coherence | (1) | Monitoring | (1) | | | | |
| | | | | Classifying | (1) | | | Distinguish | (1) | | | | | | |
| | **2** | Recognising | (4) | Interpreting | (3) | Using | (3) | Integrating | (3) | Judging | (4) | Planning | (3) | 1 (Selected Level 5) | 6 |
| | | Identifying | (2) | Clarifying | (3) | Implementing | (2) | Structuring | (3) | Checking | (3) | Constructing | (3) | | |
| | | Recalling | (1) | Explaining | (3) | Executing | (1) | Differentiate | (1) | Detecting | (2) | Generating | (2) | | |
| | | | | Interpolating | (1) | | | Distinguish | (1) | Co-ordinating | (1) | Designing | (2) | | |
| | | | | Summarising | (1) | | | Focusing | (1) | | | | | | |
| | | | | Classifying | (1) | | | | | | | | | | |
| | **3** | Recognising | (2) | Explaining | (3) | Using | (3) | Distinguish | (3) | Checking | (2) | Planning | (6) | 0 | 7 |
| | | Identifying | (1) | Interpreting | (2) | Implementing | (2) | Structuring | (3) | Judging | (2) | Designing | (3) | | |
| | | Recalling | (1) | Clarifying | (2) | Executing | (1) | Differentiate | (1) | Co-ordinating | (1) | Constructing | (2) | | |
| | | | | Categorising | (1) | | | Focusing | (1) | Testing | (1) | Generating | (2) | | |
| | | | | Comparing | (1) | | | Integrating | (1) | Monitoring | (1) | | | | |
| | | | | Summarising | (1) | | | | | | | | | | |
| | | | | Classifying | (1) | | | | | | | | | | |

| CLINICAL SCENARIO | | DESCRIPTIVE WORDS SELECTED BY PARTICIPANTS ACCORDING TO THE BLOOM'S REVISED TAXONOMY LEVELS | | | | | | HIGHEST LEVEL OF BLOOM'S REVISED TAXONOMY ANALYSIS SELECTED BY PARTICIPANTS | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | No. of Participants Selecting Level < 6 | No. of Participants Selecting Level 6 (n = 7) |
| Topic | No.: | Remembering | Understanding | Applying | Analysing | Evaluating | Creating | | |
| Female Hormones | 1 | Identifying (3)<br>Recognising (2)<br>Recalling (1) | Explaining (4)<br>Interpreting (2)<br>Classifying (1)<br>Comparing (1)<br>Clarifying (1) | Carrying out (3)<br>Using (3)<br>Implementing (2) | Differentiate (3)<br>Distinguish (3)<br>Integrating (3)<br>Structuring (1) | Checking (2)<br>Judging (2)<br>Testing (2)<br>Co-ordinating (1)<br>Monitoring (1) | Planning (5)<br>Generating (2)<br>Designing (1)<br>Constructing (1) | 1 (Selected Level 3)<br>1 (Selected Level 5) | 5 |
| | 2 | Recognising (4)<br>Identifying (1)<br>Recalling (2) | Explaining (3)<br>Clarifying (2)<br>Comparing (2)<br>Classifying (1)<br>Categorising (1)<br>Interpreting (1)<br>Understanding (1) | Using (5)<br>Implementing (2)<br>Carrying out (2)<br>analysing (1) | Differentiate (3)<br>Distinguish (2)<br>Integrating (2)<br>Structuring (1)<br>Focusing (1) | Checking (5)<br>Judging (2)<br>evaluating (1) | Planning (3)<br>Generating (3)<br>Designing (2)<br>Producing (1) | 2 (Selected Level 5) | 5 |
| Thyroid | 1 | Recognising (3)<br>Identifying (2)<br>Recalling (2) | Explaining (3)<br>Interpreting (3)<br>Clarifying (2)<br>Summarising (1) | Implementing (2)<br>Carrying out (2)<br>Using (2) | Integrating (4)<br>Distinguish (3)<br>Differentiate (1)<br>Focusing (1)<br>Structuring (1) | Checking (4)<br>Detecting (4)<br>Judging (2)<br>Co-ordinating (1) | Generating (2)<br>Planning (1) | 2 (Selected Level 5)<br>1 (Selected Level 3) | 4 |
| Diuretics | 1 | Recognising (3)<br>Identifying (2)<br>Recalling (2)<br>Remembering (1) | Explaining (4)<br>Categorising (2)<br>Clarifying (2)<br>Interpreting (2)<br>Comparing (1) | Implementing (3)<br>Using (2)<br>Executing (1) | Distinguish (4)<br>Differentiate (2)<br>Integrating (2) | Detecting (4)<br>Judging (3)<br>Checking (2) | Generating (3)<br>Planning (3)<br>Constructing (2)<br>Producing (1) | 1 (Selected Level 5) | 6 |

### 4.2.2. Correlation between Bloom's Revised Taxonomy and Wright's Model

In the literature review (see Section 2.8.6.), the clinical decision-making model (Figure 2, p44) designed by Wright et al. (2018), which will be hereafter referred to as Wright's Model, illustrates the cognitive processes required for clinical decision-making in pharmacy practice. It also gives a structured, layered description of tasks expected of the pharmacist during the dispensing process as shown in Table 2 (Tasks of the Dispensing Process Identified in Wright et al.'s (2018) Clinical Decision-making Process, p45). The researcher also vaguely interpreted the cognitive processes required using Croft and colleague's analysis of necessary tasks to be completed during the dispensing process. However, Croft and colleague's analysis focused mainly on the cognitive skills necessary for clinical-reasoning and did not focus on the broader stage of clinical decision-making, which Wright's Model recognises.

Although the lecturers were not specifically asked to analyse the scenario tasks according to Wright's Model, it appears that the tasks required in the clinical decision-making process can be directly related to the cognitive skills listed under the various levels of Bloom's Revised Taxonomy (see Table 3, p47). From the lecturer participants' selections of various descriptor words for Bloom's Revised Taxonomy levels 1 to 4, it was then possible to analyse the scenarios in terms of the appropriate clinical decision-making stage described in Wright's Model.

For example, the cognitive skills described in Levels 1 to 4 of Bloom's Revised Taxonomy can be correlated in particular with the listed tasks in the first stage of Wright's Model, titled "information gathering", which describe the various tasks performed in the dispensing process. By specifically focusing on the "information gathering" stage of the clinical decision-making process in Table 2 (p45), Wright et al. (2018) explain the necessity for: "identifying the need for a decision, an assessment of laboratory results, the identification of drug-related problems, the initial delineation of treatment and patient-centred goals, patient assessment, a review of literature related to therapeutic entities, and a consideration of patient factors that may impact therapies". It can therefore be seen that each clinical decision-making task requires a cognitive skill categorised in at least one level of Bloom's Revised Taxonomy Level 1 to 4. This could also be confirmed by the fact that the latter stages of Wright's Model (clinical reasoning, clinical judgement and decision stages), would only be able to be performed if the initial information gathering stage was completed first. This also emphasises why the student would need to first accomplish the lower levelled cognitive skills as described in Bloom's Revised Taxonomy Level 1 to 4, before practicing the more complex Levels 5 and 6.

Bloom's Revised Taxonomy Level 5 can also be correlated to Wright's Model. This is evident in Table 2 (p45), where the stage titled "clinical judgement", represents the "process of weighing up the options available and prioritising them on their impact" this directly relates to the cognitive skills required in Bloom's Revised Taxonomy Level 5, "making judgements based on criteria and standards through checking and critiquing".

The "clinical reasoning" and "decision" stages of Wright's model require similar cognitive skills categorized under Level 6 in Bloom's Revised Taxonomy. The "clinical reasoning" stage of Wright's Model requires the pharmacist to "synthesise a viable set of options in the context of the patient's goals" (Table 2, p45), which can be understood to correlate with Level 6 of Bloom's Revised Taxonomy. In the dispensing process, the pharmacist uses cognitive skills that "requires users to synthesis or situate parts together in a new way, to make something new and different." (Table 3, p47). Similarly, the second part of Wright's Model - the "decision" stage described as "the enactment of the decision", can be correlated with Bloom's Revised Taxonomy Level 6, "putting elements together to form a coherent or functional whole" (Table 3, p47).

The MyDispense scenarios were therefore perceived to require students to perform complex clinical decisions while practicing high level cognitive skills according to Bloom's Revised Taxonomy, as well as according to Wright's model.

### 4.2.3. Analysis of the clinical knowledge required

The second section on the purpose-designed assessment form required the lecturers to describe the clinical knowledge which the students had to have or interpret while completing the scenario. This section was designed to ensure that alignment was achieved between the required clinical knowledge that the lecturers identified and the clinical knowledge that the researcher specified. As an outcome of the scenario assessments, the researcher analysed the clinical knowledge identified by each lecturer for each clinical scenario and summarised the information in a table format (see Table 9). Thereby, the researcher confirmed that the clinical knowledge identified by the lecturers aligned with the researcher's outcomes when the scenarios were designed. Had this not been the case, the researcher would have needed to adjust the design of the clinical scenario to re-align the possible outcomes for the students with the planned clinical knowledge which the researcher envisaged when designing the scenarios.

*Table 9: Summary of Clinical Knowledge Identified*

| SUMMARY OF CLINICAL KNOWLEDGE IDENTIFIED | | | | | |
|---|---|---|---|---|---|
| **Topic** | **No.** | **Clinical Knowledge Identified** | **Topic** | **No.** | **Clinical Knowledge Identified** |
| **Diabetes Mellitus** | **1** | Identify ideal blood pressure range for diabetic patient<br>Recognition of additional drug required for the treatment of type 2 diabetes<br>Identify 1st and 2nd line treatment for type 2 diabetes<br>Possible drug interaction with other chronic medicine (risks vs benefits) for diabetes<br>General diabetes disease counselling (self-care, monitoring)<br>Oral hypoglycaemics (Metformin)<br>Pharmacokinetics in relation to renal impairment and dosage adjustments<br>Verapamil's class of drug and drug interactions<br>Recognise smoking risk with diabetic patients<br>Analysis of HbA1c, blood glucose, blood pressure, body mass index<br>Drug interactions - differentiate risk over benefit of interaction<br>Cardiovascular risk decreased - use of aspirin only for preventative treatment | **Female Hormones** | **1** | Types of contraception<br>Selection of appropriate contraceptive agent<br>Emergency hormone contraceptive<br>History taking and counselling in a contraception scenario<br>Eliminating possibility of pregnancy<br>Regular contraception methods i.e. barrier and abstinence<br>Nur-Isterate(R) and Norlevo(R) effectiveness |
| | **2** | Kinetics and dosing of insulins<br>Insulin therapy<br>Blood glucose levels and hypoglycaemia<br>Administration of insulin<br>Self-care - hypoglycaemia, hyperglycaemia for better glucose control<br>Understanding the role of the pharmacist in health care team<br>Complications of lack of blood glucose control<br>Recognise possible complications of infection and poor footcare<br>Importance of impact of lifestyle on blood glucose control<br>Importance of snacking<br>Impact of co-morbidities (infection on blood glucose control)<br>Recognition of side-effects relating to insulin use<br>Monitoring blood glucose of the patient | | **2** | Appropriate drugs for constipation in pregnancy<br>Evaluations of drug interactions<br>Effects of caffeine during pregnancy<br>Iron supplementation during pregnancy<br>Lifestyle recommendations for constipation<br>Management of anaemia during pregnancy<br>Safety use of drugs during lactation |
| | **3** | Kinetics of insulin and relationship of dosing change to suit patient's eating patterns<br>Metformin dosing changes relative to patient's eating patterns<br>Blood glucose monitoring<br>Self-management of diabetes<br>Advise on nutrition and possible diet for diabetic patient<br>Recognising hyperglycaemia vs hypoglycaemia<br>Medicine and lifestyle adjustments to be made during religious fasting (Ramadan)<br>Effects of fasting and dieting on blood glucose control<br>Interpretation of blood glucose levels and understanding their relevance | **Thyroid** | **1** | Thyroid function and hypothyroidism<br>Use of levothyroxine to treat hypothyroidism<br>Understanding consequences of initiating levothyroxine at high dose<br>Device a plan to resolve the situation<br>Lowering dose of levothyroxine and increase gradually to appropriate blood levels<br>Management of hypothyroidism<br>Special prescriber points for levothyroxine<br>Drug-drug interactions, drug-food interactions with levothyroxine<br>Interpreting thyroid function lab test results |
| | | | **Diuretics** | **1** | Pathophysiology of hypertension<br>Loop diuretic and non-steroidal anti-inflammatory pharmacology<br>Interpretation of drug interactions between ibuprofen and furosemide<br>Understand consequences of drug interaction and devise a plan<br>Assessing the level of interaction to determine the clinical significance<br>Differences between non-steroidal anti-inflammatories<br>Scope of practice of the pharmacist to alter drug therapy<br>Treatment of inflammation<br>Understand mechanism of action of selective COX2 to be able to suggest alternative |

### 4.2.4. Analysis of lecturer participant feedback via recommendations and subsequent amendments

The final section of participation by the lecturers was to provide them with the opportunity to make recommendations which they thought could improve the designed clinical scenarios. Improvement of the clinical scenario could relate either to the benefit for the students in terms of: the interpretation of the scenarios; correction of clinical errors made by the researcher; or as a tool to assist the integration of clinical knowledge-based skills into the dispensing process.

The researcher analysed the recommendations made by the lecturers and recorded the researcher's subsequent actions in response to each recommendation (see Table 10). The researcher made a number of adjustments to the clinical scenarios, however, not all recommendations resulted in adjustments. For example, in the second diabetes mellitus scenario a lecturer recommended that the patient should be encouraged to rotate injection sites when injecting insulin subcutaneously. The researcher discovered that this was in fact missing from the counselling notes made to be given to the patient and was therefore subsequently added. However, in the same scenario, another lecturer recommended that the mefenamic acid mentioned in the patient fact-finding response should be loaded onto the list of medicines previously used by the patient on the MyDispense pharmacy computer. The researcher decided that the scenario should not be adjusted because the students should not only be checking the medicine history of the patient on the pharmacy computer, but also be asking the patient their medicine history during the patient fact-finding process. The researcher deliberately wanted to encourage the students to be aware that the patient might have purchased the mefenamic acid from a different pharmacy, and it would therefore not always be listed on the pharmacy's medicine history list. This serves as an example of where the outcome which the researcher envisaged was judged to be the best option.

### 4.2.5. Summary

In this subsection, the lecturer participants analysed the cognitive skills required in the MyDispense scenarios according to Bloom's Revised Taxonomy level descriptors. The lecturers' evaluations recorded that they perceived the clinical scenarios to require students to use a range of cognitive skills all ranging from the lowest to highest levels of Bloom's Revised Taxonomy. A direct link was also made between Wright's Model, described as the clinical decision-making process, which illustrates the cognitive processes required during the

dispensing process, to the level of cognitive skills perceived to be required by the lecturer participants according to Bloom's Revised Taxonomy. In addition, it became clear that during the dispensing process students are required to accomplish the lower levelled cognitive skills in order to gather the appropriate information before practicing the higher levelled cognitive skills required to perform clinical reasoning, clinical judgements, and the final clinical decision-making. In this subsection, the researcher was able to confirm that the clinical knowledge identified by the lecturers aligned with the researcher's outcomes, and that the lecturer's recommendations were considered by the researcher and either implemented or ignored according the researcher's judgement.

*Table 10: Summary of Lecturer Participant Recommendations and Subsequent Actions*

| SUMMARY OF LECTURER PARTICIPANT RECOMMENDATIONS AND SUBSEQUENT ACTIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DIABETES MELLITUS SCENARIOS | | | | | | | | |
| Scenario 1 | | | Scenario 2 | | | Scenario 3 | | |
| | Recommendation | Action | | Recommendation | Action | | Recommendation | Action |
| 1 | Correct the normal range of blood pressure on the laboratory results | Corrected on the laboratory results | 1 | Change "use" to "inject subcutaneously" on the prescription | Changed on the prescription | 1 | Change metformin dosing to 2/3's at Iftaar and 1/3 at Suhur | No adjustments made - The SEMDSA 2017 guidelines state that the metformin regimen can remain the same during Ramadan - because metformin is only available in a dosage form of 500mg, 850mg and 1000mg, it would be difficult to change the dose into thirds (patient's total daily dose = 1700mg) |
| 2 | Pharmacist initiated therapy intervention of initiating patient onto aspirin 100mg daily dose - not correct according to last SEMDSA 2017 guidelines | Initiation of aspirin removed from the clinical scenario | 2 | Add rotation of subcutaneous injection sites to the counselling notes | Added to the counselling notes | 2 | Add recommendation of consultation with doctor | Recommendation added to the counselling notes |
| 3 | Verapamil not recommended as 2nd line agent, indapamide is the recommended agent. | In consultation with the lecturer participant, the medicine history of the patient was changed instead from enalapril 20mg to indapamide 2.5mg as indapamide should have been initiated. Additionally, verapamil and indapamide have comparative recommendation according to the SEMDSA 2017 guidelines | 3 | Administration of insulin should be at the start of the meal and not 15 minutes before a meal | In consultation with the lecturer participant, the directions were changed to "a few minutes before a meal" as this was also stated in the SEMDSA 2017 guidelines | 3 | Add recommendation of consultation with doctor | See the previous action for B1 - adjustments made |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **4** | Why is aspirin required? | See the previous action in A2 - adjustments made | **4** | Change quantity of pens on the prescription to 5 pens for Apidra and 3 pens for Lantus | Changed on the prescription so that patient was not dispensed an excessive/unnecessary amount of insulin | **4** | Meaning of the word "good" when patient states "I'm pretty good about my sugar". | No adjustments made - general assumption that the patient has the perception that she is monitoring and controlling her disease - no facts to prove the point correct or incorrect |
| **5** | The reason for including eGFR if it is not needed for the scenario | No adjustment made - student would need to analyse which results on the laboratory test are applicable in the scenario | **5** | Contacting the doctor to discuss increased insulin levels | No adjustments made - the clinical scenario was designed so that the student needed to decide what they should do if the doctor was not available for consultation at the time the patient came into the pharmacy | | | |
| **6** | Verapamil is an unusual choice, perhaps amlodipine | See the previous action for A3 - adjustments made | **6** | Pharmacist checking correct finger-prick technique affecting adherence of short-acting insulin | No adjustments made - Pharmacist checking the technique already mentioned in the counselling notes | | | |
| **7** | Remove recommendation of aspirin use (2017 SEMSDA guidelines) | See the previous action for A2 - adjustments made | **7** | Mefenamic acid could compromise the already reduced pain feedback, deteriorating the foot wound | No adjustments made - as patient would only be using it for the short-term pain of the ingrown toenail infection | | | |
| **8** | Add more counselling with regards to the HBA1c level being high | No adjustments made - improvement in disease monitoring and lifestyle recommendations included | **8** | Explain whether patient ran out of insulin - to gauge if he is using insulin correctly | No adjustment made - patient had finished his insulin at the expected time | | | |
| | | | **9** | Explain how long the patient has had the infection to determine if the reason for increased insulin on the prescription is due to the diabetes or the insulin requirements due to the infection | No adjustment made - doctor has stated that the patient will be returning for a follow up in one week's time | | | |
| | | | **10** | Pharmacist should check the finger-prick technique as this will have an effect on the patient's adherence of monitoring his blood glucose | See the previous action for C1 - adjustment made | | | |
| | | | **11** | No mefenamic acid shown on medicine history | No adjustments made - the patient did not purchase the mefenamic acid from this pharmacy - therefore the student would need to ask if the patient is using any other medicines | | | |

## FEMALE HORMONE SCENARIOS

### Scenario 1

| | Recommendation | Action |
|---|---|---|
| 1 | Addition of patient fact-finding question to ask when the patient last menstruated | No adjustments made - the patient took a pregnancy test one month ago with a negative result and the patient stated that she had not been sexually active within the past month. |
| 2 | Change the use of the word "pregnant" in the patient fact-finding to current instance of unprotected intercourse and not only previous instances | No adjustments made - unable to make such adjustments |
| 3 | Should abstinence be considered if the patient seems responsible and her husband has been away for the past month? | No adjustments made |
| 4 | Change the timeframe of the last pregnancy test to 3 weeks ago | No adjustments made - the student would need to decide what to do with the information |

### Scenario 2

| Recommendation | Action |
|---|---|
| NO RECOMMENDATIONS | |

## THYROID SCENARIO

### Scenario 1

| | Recommendation | Action |
|---|---|---|
| 1 | Increase prescribed dose to 200mcg, rather than 100mcg | No adjustments made - student needed to check with the prescriber according to guidelines |
| 2 | Suggest including a drug interaction | No adjustments made |

## DIURETIC SCENARIO

### Scenario 1

| | Recommendation | Action |
|---|---|---|
| 1 | Questioning whether COX-selective is necessary to include - perhaps paracetamol, rest, ice and topical non-steroidal anti-inflammatory sufficient | No adjustments made - student should first try confirming doctor's possible treatment plan/expectations and then question necessity |
| 2 | Is the drug interaction a complete contra-indication or could it be given, and the effects monitored | No adjustments made - could be possible but the drug-interaction should still be discussed with the prescriber |
| 3 | Meloxicam also had a drug interaction with furosemide | No adjustments made - no drug interactions found in resources |
| 4 | Furosemide for oedema - provide more clinical information here in order to be able to access the seriousness of the condition | No adjustments made - sufficient information |
| 5 | Unusual for a patient to only be on furosemide, perhaps add 1 or 2 other drugs | No adjustments made |
| 6 | Meloxicam will still reduce the renal blood flow - reducing the efficacy of furosemide | No adjustments made |

### 4.3. The implementation of MyDispense-based clinical scenarios

During the first and second phases of this study, MyDispense-based clinical scenarios were developed by the researcher and evaluated by the lecturer participants before being used by the pharmacy students. The third phase of the study, which will be discussed in this subsection, will elaborate on how the scenarios were piloted with the pharmacy students. As the researcher mentioned previously in Subsections 4.1 and 4.2, scenarios were designed after careful analysis of learning outcomes, clinical content, and dispensing process requirements, and were thereafter evaluated and categorised according to Bloom's Revised Taxonomy to verify the cognitive difficulty of the scenarios. In this subsection, the researcher will elaborate on the recruitment of pharmacy students to use MyDispense, the technical process of accessing and working through scenarios using MyDispense on a computer or electronic device, and, finally, the students' continued use of MyDispense.

#### 4.3.1. Recruitment of MyDispense users

In order for the scenarios to be piloted, all pharmacy students registered for ZCP311 were invited to consider using MyDispense as an adjunct to the ZCP311 module. Students were informed of the benefits and workings of the program and could later decide if they wanted to participate in the study after attending an information and demonstration session on the MyDispense program. The researcher committed to the students that further information or support required for using MyDispense would be made readily available through-out the study. Furthermore, it was made clear that access to MyDispense was open to all registered ZCP311 students and that any students who did not choose to participate in the study would still be granted access to MyDispense and supported in the same way as participating students. This was to ensure that all ZCP311 students understood that anyone could have access to MyDispense, encouraging them to consider the program as a learning tool to assist students during their learning process and not only as a subject of research. Therefore, it was important to emphasise that MyDispense could potentially assist students during their learning process.

Finally, the researcher made it clear that she would not be involved in lecturing or assessing the students during their completion of the ZCP311 module and that their participation would remain anonymous.

### 4.3.2. Demonstration of using the MyDispense program

An information and demonstration session focusing on the MyDispense program was presented in duplicate to students so that they could understand and interpret tasks expected of them while using the program, since none of the students had any previous exposure to the program. The researcher presented two repeated information sessions in a computer laboratory in the Pharmacy Department at Nelson Mandela University at suitable times for the ZCP311 students.

The demonstration began with the explanation of the login process, where students could see the screen illustrated in Figure 14, to aid them in understanding how to follow the login steps.

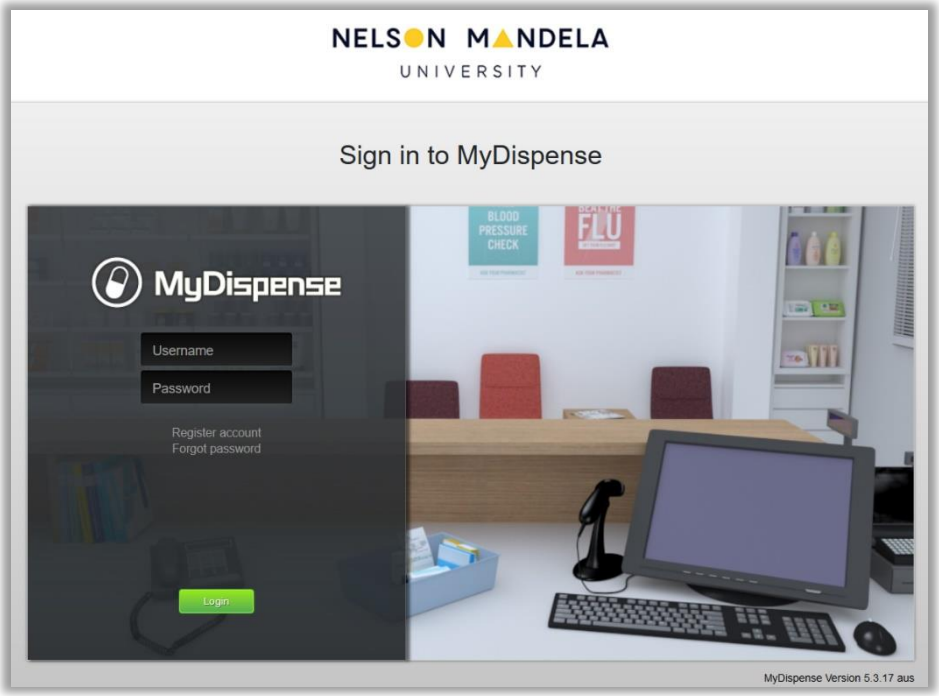


*Figure 13: MyDispense Programme Login Page*

The researcher then demonstrated how to identify and open units on the home page of the program. As illustrated during the development of scenarios (see Subsection 4.1.2.), MyDispense has a hierarchy of units which can be subdivided into tutorials and exercises (see Figure 5 illustrating the researchers view during the development stage). As mentioned previously in Subsection 4.1, MyDispense refers to “scenarios” as “exercises” and the two terms are used interchangeably.

Once students had selected their unit of choice, they could view the tutorials listed under that unit and, similarly, by selecting a tutorial they could view the exercises in each tutorial (See Figure 15 below). For example, students could open the unit entitled, “ZCP311 Clinical Scenarios”, which opened the tutorials labelled according to the four topics used in this study (diabetes mellitus, female hormones, thyroid and diuretics). Finally, the student could open the exercises within each topic.


*Figure 14: Illustrations of the Students' View of the MyDispense Home Page Showing the Units, Tutorials and Exercises*

During the demonstration of working through an exercise, students were guided through a simple trial scenario, based on an unrelated ZCP311 topic, to allow the students to practice using MyDispense. This also allowed them time to adjust and find their own way around the program, before attempting the scenarios developed in the first phase of the study. The

researcher demonstrated how to progress through the trial scenario using MyDispense so that students could see how to perform the tasks. It was thought that it would be best for students to follow the researcher's demonstration before attempting the scenario themselves. Recognising that students may potentially not be able to follow or remember every step demonstrated during the information and demonstration session, the researcher recorded a video which students could watch and consult at any stage. The video consisted of a guided demonstration through the same trial scenario which students were shown during the information session and included a visual of the actions occurring on MyDispense, together with the voice of the researcher explaining the steps.

After the information and demonstration sessions were presented, a total number of 44 students volunteered to participate in using MyDispense as an adjunct to the ZCP311 module. All students interested in using MyDispense received the web address of the MyDispense home page using the Nelson Mandela University's domain and were subsequently requested to create their own username and password on MyDispense to begin using the program.

### 4.3.3. Practicing the MyDispense-based clinical scenarios

As mentioned in the literature review (see Section 2.7.2), MyDispense does not have any prompts guiding students through the scenarios. However, an understanding of the fundamental objective of the dispensing process assisted students with progressing through the three dispensing phases to complete of the scenarios. It's important to note, however, that students did not necessarily need to be proficient with dispensing skills before attempting the scenarios. Students could attempt the scenarios with very little dispensing experience and learn the dispensing process by practicing the scenarios. There were also no time constraints enforced on the time taken to complete the scenarios, and students were able to take as long as they needed to complete the scenario. Students were also able to dedicate the time to use MyDispense in any studying environment they preferred, whether it was on or off campus. This ultimately encouraged students to develop their confidence in completing the dispensing process, thereby cultivating a safe and constructive learning environment. MyDispense also provides immediate feedback, and students were able to compare their results with the memorandum, immediately identifying where they may have made errors (see Section 2.5.2).

MyDispense is not only used as an assessment tool for testing the dispensing skills of students, but also as a learning platform for students to practice their dispensing skills until they are deemed competent. As previously mentioned in the literature review, the researcher

describes what Ericsson (2004) calls “deliberate practice” as an effective training strategy for allowing students to practice scenarios repeatedly with immediate feedback in a low-risk environment, while still deciding “high-stress” clinical decisions. Therefore, student participants were not assessed during the study and were able to repeat the scenarios as many times as they pleased. In this way, students were able to practice the dispensing process in a safe environment without the fear of causing an error in a real pharmacy environment.

In order to illustrate the cognitive and technical skills required during the dispensing process and especially navigating through the MyDispense scenarios, the researcher has included two different summaries for a more comprehensive analysis. Firstly, Table 7, initially included in Section 4.1, summarises the clinical content covered in each scenario and includes the optimal outcome of the scenario. This table also emphasised the clinical knowledge-based cognitive skills required for students to be able to solve for the optimal outcome of the scenario. Secondly, as an appendix to the study (Appendix J), the researcher has summarised the technical dispensing skills required to perform the dispensing process using the MyDispense program. Because MyDispense is a computer-generated simulation, the dispensing environment is simulated and, therefore, students need to know how to perform the dispensing tasks in a simulated dispensing environment rather than in a real dispensing environment. Technical dispensing skills are mainly required during the second dispensing phase and include tasks such as medication selection, labelling, and packaging (see Section 2.8.3). Appendix J consists of a full illustration of the navigation through an example of a MyDispense scenario (“Diabetes Case 1”), to demonstrate each dispensing task required. Appendix J also provides an overview of where in the dispensing process students would need to use their clinical knowledge to be able to complete the dispensing tasks, and where clinical decisions would need to be made to successfully complete the scenario.

### 4.3.4. Summary

It was observed that some of student participants were able to successfully use MyDispense to practice the clinical scenarios designed and assessed in Phase One and Two of the study. For the purposes of the research study, it was envisaged that the focus would not fall on the number of scenarios the student participants attempted or completed, as the objective of the research was only to pilot the developed MyDispense clinical scenarios. However, upon investigation, the researcher identified a low amount of exercises completed and thus it is necessary to mention that only 15 student participants, out of a total number of 44, completed at least one MyDispense scenario. Furthermore, it is also important to note that these numbers

only represent those instances of scenarios which were completed or submitted and did not reflect the scenarios which were opened but incomplete. Students were not necessarily asked to complete the scenarios but to practice using them as an adjunct to the ZCP311 module, therefore, the students might have opened scenarios and practised the various tasks but not finalised the scenarios by completing them. In addition, if the students had not completed the scenarios, they would not have received the immediate feedback and would not have benefited from this additional feature as discussed preciously. None of the students completed all seven of the scenarios, but 9 out of 15 students completed two or more scenarios. This will be discussed in detail later on in the study.

It was envisaged that the ZCP311 students would be able to use the learning opportunities and experiences of practicing the MyDispense clinical scenarios, in combination with the feedback provided, to assist themselves in preparing for their ZCP311 assessments. In the following section, as the fourth phase of the study, student participants who had completed at least one exercise were invited to describe their experiences of using the MyDispense program by way of a focus group discussion. Student participants in the focus group were specifically asked if the scenarios which they piloted in third phase of the study were able to assist them in learning for the ZCP311 module by way of integrating their clinical knowledge into the dispensing process.

### 4.4. Students' experience of MyDispense

The last section of the results and discussion chapter is comprised of the analysis and interpretation of the pharmacy students' experience of using MyDispense to integrate their clinical knowledge into the dispensing process. A focus group discussion was held with six student participants who had completed at least one scenario, and who volunteered to be a part of the focus group discussion. Open-ended questions were used to collect data regarding the students' experiences of the use of MyDispense during the focus group. The focus group took place at the beginning of the second semester, after the clinical module (ZCP311) was completed.

An inductive thematic analysis of the focus group transcript and an interpretation of the themes that emerged are reported in this section. In order to protect the identity of the participants, the alphabetical letters A, B, C, D, E and F were assigned to participants as was described in the methodology (see Section 3.5). Identifiers were used to reference quotes included in the text and quoted directly from the transcripts. For example, [A:306-309] is a reference to what participant A said in lines 306 to 309 of the transcript. The participants of the focus group, five of whom were female and one of whom was male, had all previously completed at least one MyDispense scenario. The highest number of scenarios completed by one student was five. An independent person was used to facilitate the focus group, as previously described in the methodology (see Section 3.2.4.), to avoid any possible influence from the researcher. Seven key, open-ended questions were used to stimulate conversation and focus the discussion (Appendix G).

The open-ended questions asked by the facilitator guided the discussion and allowed for the discussion to flow, creating a safe space for all participants to express themselves during the focus group. The participants expressed their opinions on the use of MyDispense, and by doing so were also able to engage with one another and, on some issues, express mutual agreement of opinions. From the transcriptions of the focus group, various themes and sub-themes were identified by the researcher and will be explained in detail in this section. An inductive thematic approach was used for the analysis of the rich data from the open-ended questions of the focus group, in order to identify the main themes which emerged. The first main theme which was identified will describe the impact which the use of computer-generated simulation, MyDispense, had on students' learning regarding the application of clinical knowledge into the dispensing process. A further main theme which came to light elaborates on students' experience of using MyDispense scenarios as an adjunct to the ZCP311 module.

Furthermore, the researcher identified the ability of MyDispense to assimilate clinical knowledge into the dispensing process as another main theme. Sub-themes identified within this main theme was the blending in of cognitive skills while practicing dispensing skills, as students reported practicing clinical decision-making and problem-solving during the completion of the scenarios and also made comparisons of cognitive difficulty related to prescription and non-prescription scenarios. Finally, the last main theme to be discussed will consist of the general students' report of using my MyDispense, as MyDispense increases student exposure opportunities to the dispensing practice, provides feedback while completing scenarios, and allows for repeatable practice of MyDispense scenarios. The researcher also identified the students' recommendations for future assimilation of MyDispense in the BPharm program and improvements on the initial training required for MyDispense as further themes to explore. These main themes and sub-themes will be described in the following paragraphs.

The research aim of this study was to determine whether the use of simulation, more specifically computer-generated simulation, could assist in the integration of clinical knowledge-based cognitive skills into the dispensing process. The computer-generated simulation is acknowledged to have the potential to integrate the application of clinical knowledge and cognitive skills into the more technical aspects of the dispensing process as was described in the literature review. Thus, the theme of application of clinical knowledge within the dispensing process, has emerged as one of the main themes from the data and ties in critically with the aim of this research.

### 4.4.1. Students' application of clinical knowledge during the dispensing process

A central theme that emerged from the focus group, regarding computer-generated simulation scenarios, was that participants were generally able to recognize the ability of MyDispense to assist them in applying their clinical knowledge during the dispensing process. Participants seemed to identify that not only did the MyDispense scenarios assist them in experiencing the process of dispensing, but that the scenarios also provided them with opportunities to apply the clinical knowledge they had learnt in class. For example, participants E and C made the following comments and provided examples of how they had been enabled to apply their knowledge:

> Well I think it helped 'cause after going through my lecture notes and going through doing the program it was easier for me to apply the knowledge that I gained from the lecture notes and it was easy to do the scenarios and look into it maybe the

> insulin, I *dunno*, [sic] that this insulin is what the lecturer was talking about and how it is used. [E:482-485]

In the quote above, participant E explains how ever deepening clinical knowledge is recalled while completing the scenario.

> Or…for example, if there was a different active ingredient available, and not that one specifically, you would have to be able to apply your clinical knowledge and say, okay it's, or, for example if this patient was for example on a diuretic, what kind of diuretic is she on. [C:589-591]

Here, participant C elaborates further on their opinion that detailed clinical knowledge and differentiation of clinical knowledge on patient specific problems within the scenario were called into play during the simulation experience.

The use of computer-generated simulation has been promoted by other authors, due to its ease of accessibility and adaptability. Ambroziak et al. (2018), Ferrone et al. (2017), McDowell et al. (2016), and Shin et al. (2017) have all described their successes when using MyDispense as a computer-generated simulation to incorporate the practice of applying clinical knowledge into the dispensing process (see Section 2.7.4). It would therefore appear that the computer-generated simulation could indeed strongly promote integration of clinical knowledge into the dispensing process.

Participant F spoke more generally about how the simulated exercises felt more like clinical practice than just another learning exercise, and that they offered benefits other than revision, which would require recall of clinical knowledge: "Well I found that the program was more of a clinical practice, than just revising for the module" [F:213]. This suggests that MyDispense, when used as a learning tool, provides students with a sense of being in a clinical environment. Vyas et al. (2011), citing Seybert (2011) (see Section 2.4.2.), argue that students achieve a higher satisfaction during clinical practice simulation rather than during traditional classroom teaching. The facilitation of giving students the impression of working in the clinical environment can be viewed as one of the objectives of using simulation in teaching.

In the focus group, the participants also commented on their awareness of the necessity to have acquired a detailed level of clinical knowledge as a necessary underpinning to solving the clinical scenarios. Participant A described the application of knowledge in stages, where

firstly an identification of the scope of knowledge was required, before arriving at a point where they could move towards evaluation of all aspects:

> …you read the scenario given to you from the patient and you need to like identify what you need to focus on. Okay say she's pregnant and she's taking this, like you need to ask what other medication was she taking, so you need to take all the information you're gathering from the patient and know what you can give her, and what you can advise her, and what medication you want to give her and…so it's…it's a lot of things you need to incorporate into your answer, into your evaluation and… [A:367-372]

This process of application was supported by other participants, particularly Participant C, who added that they began by firstly freely recalling a wide scope of their clinical knowledge during the scenarios:

> I must say, before playing around with the medications and stuff, as well, I agree, like I wanted to apply my lecture knowledge first *general agreement* to the scenario, to see if I could do it by myself and then from there you build onto that. [C:376-378]

The participant described in this input the sense of satisfaction experienced when "building" the knowledge application into the scenario.

Upon analysis it became clear that the computer-generated simulation did indeed require students to draw upon their clinical knowledge during the dispensing process. Although participants may not have elaborated fully on the richness of their acquired clinical knowledge, it appears in a further section of this discussion of the data that students acknowledged the extent to which their acquired clinical knowledge was also pivotal to the various levels of integration, cognition, and problem-solving required by each scenario. In the next paragraph, the researcher will elaborate on the linkages between the didactic knowledge of ZCP311 and its assessments with the MyDispense scenarios.

### 4.4.2. Students' experience of using MyDispense scenarios as an adjunct to the ZCP311 module

In the design of the study, the researcher envisaged making the MyDispense scenarios an adjunct to the ZCP311 module. When participants responded to a question of how computer-generated simulation interfaced with the ZCP311 module, they mentioned the impact of

integration as preparation for assessments in the module, and also a close alignment of the scenarios with the content of the module.

The ZCP311 module is designed for the learning of clinical knowledge on endocrine and renal conditions. This module requires the students to pass a combination of formative assessments (assignments, practicals, and tests) during the semester, and to pass two summative assessments consisting of an OSCE and a written theory examination, as previously mentioned in Section 4.1.1.1. Although the assessments are in a variety of formats, they all require clinical decision-making skills. In particular, the OSCE requires students to solve case-based scenarios in a non-computer-generated clinical environment, and written assessments require students to solve case-based application questions in the format of a written examination paper. Therefore, students are expected to be able to demonstrate that they can apply their clinical knowledge to be able to pass these assessments. It was in this context that many of the participants in the focus group commented in a variety of ways, about how the MyDispense scenarios assisted them in preparing and gaining confidence for their assessments in the ZCP311 module. It became clear that MyDispense provided students with opportunities to practice integrating their clinical knowledge before their assessments:

> … it really helped me like familiarise myself with the scenarios such that when I got into my OSCE I was familiar with the scenarios, you know, I was relaxed… [D:131-135]

> …they did help during the test and the exams ‘cause I used them for my exams, studying for my exams. [E:207-208]

> … it’s a really really helpful tool. [A:1042]

> Especially before our first test for endocrine as well, last semester, like I didn’t do much before the exams, I didn’t have time *laughs* but when it came to before our first test, to get the idea of a scenario-based question, and how to apply it, and definitely bringing theory into practice, together. [B:175-178]

Participant B particularly mentioned how they were aware of the ability to bring “theory into practice” for the purposes of preparation for assessment in the ZCP311 module as a result of exposure to MyDispense.

Furthermore, Participant E highlighted that the computer-generated scenarios were used in place of the first line traditional sources, such as lecture and student notes, to prepare for the ZCP311 assessments.

> I also think it helped with revising the work, like after studying when you want to revise you just go to the program and you do the scenarios, it really helped. … 'Cause I didn't have to go back to all the notes when I was studying for my exams, so I just went to the program and did the scenarios and they were helpful. [E:1046-1052]

These comments from participants allude to the different ways in which students chose to use the scenarios to practice applying their clinical knowledge for initial learning, revision purposes, and final rehearsal of learning.

Participants B and C also confirmed that the MyDispense scenarios were based on the ZCP311 module content, and that the scenarios created an opportunity for the clinical knowledge learnt in ZCP311 to be used in clinical practice.

> … all the scenarios were based off the topics that we did in 311. So, every single scenario was based off of something that we did in that module, so it provided you that linkage between practice and your clinical knowledge. [B:494-496]

> There was definitely a link between our lectures and the scenarios that were given to us…and very helpful, they were very helpful. [C:489-490]

Toward the end of the focus group discussion, participants began to give feedback on their experience of how the computer-generated scenarios fitted into the ZCP311 module.

> So it's quite hard to actually get time to actually do the scenarios. Cos it was really there and you could have used it but I didn't utilize it as much, because it was limiting cos you wanna learn and you want to do good your pharmacy and not focus on a program that really doesn't count for anything. [A:1007-1010]

The ZCP311 module seemed to not provide sufficient time for students to comfortably complete the MyDispense scenarios as a means of revising when there was no formal module assessment associated with the scenarios. This may be because the study was exploratory in nature and the researcher under-estimated the time constraints which the students experienced. As highlighted in Subsection 4.3.4., many students who volunteered

to participate did not complete any of the scenarios. The researcher also chose not to assess students, so that the learning environment would be considered to be low stakes. The researcher emphasised in the literature review that students have reported to prefer low stake simulation assessments (Fernandez et al., 2007). For students to experience the full benefits of the MyDispense scenarios in the future, the scenarios would need to be integrated into the module so that students would be encouraged to use the scenarios to revise. Furthermore, the use of simulations as a form of assessment could assist in ensuring that students practice the simulations more often in the future.

Further mention was made by a participant of how they foresaw the future possibilities of computer-generated scenarios being used to require integration of didactic knowledge built up in the course of the entire BPharm program where a scenario was designed to require recall and integration of knowledge from earlier modules.

> I mean there can be a lot of things they can incorporate into it, and like ask something from third-year drug, with a first-year drug or second-year drug, to like um make you think back and help you remember work you did and what you are doing. So it really... it's a good, a good thing. [A:1079-1082]

The MyDispense scenarios in the study were mainly based on a third-year module (ZCP311) but only contained minimal information about other medicines covered in the second year and third year BPharm curriculum. Therefore, a broader scope of content could be used in the MyDispense scenarios in the future. This will be further discussed in the later subsection to follow.

Students acknowledged that they had to apply their learnt, didactic ZCP311 clinical knowledge into the dispensing process. They also acknowledged that they were required to use a variety of levels of cognitive skills to be able to make clinical decisions based on the clinical knowledge, to be able to successfully complete the MyDispense scenarios.

### 4.4.3. Suitability of MyDispense to integrate clinical knowledge into the dispensing process

The integration of clinical knowledge into the dispensing process requires adequate competency in various cognitive skills in order to apply clinical knowledge in devising a solution to clinical scenarios. These skills, as discussed in detail in the literature review (see Section 2.8.5), and in the section of this chapter focusing on the evaluation of the clinical scenarios

(see Section 4.2), provide information related to clinical knowledge-based cognitive thinking which empowers clinical decision-making and the ability to solve clinical problems. This subsection will thus place emphasis on how the combination of cognitive skills came into play when solving clinical scenarios orientated within a pharmacy simulation environment, and the comparisons of cognitive difficulty related to prescription and non-prescription scenarios.

#### 4.4.3.1. Blending in cognitive skills while practicing dispensing skills

The necessity for pharmacists to be competent in the use of their cognitive skills during the dispensing process has been described by McDowell et al. (2016) and Cheetham and Chivers (2005) as a complex process. However, these authors express the need for the development of two different but parallel sets of skills, where students apply clinical knowledge through cognitive skill development alongside technical skill development during the dispensing process. Technical skills, for the purposes of this study, refer to the actions performed by the pharmacist during the dispensing process to document and prepare medicine as explained in the literature review (see Section 2.8.3). Therefore, the integration of cognitive and technical skills occurs concurrently throughout the dispensing process. In the focus group participants were able to identify the need for the integration of cognitive skills alongside the technical skills of the dispensing process. Participant C identified some of the pertinent issues needing to be resolved in a dispensing scenario:

> …you aren't just getting the script and dispensing it and giving it to the patient. You aren't just literally doing that, you actually have to look at the script, is there any contraindications, is there drug interactions or whatever, and then apply. [C:631-641]

Furthermore, Participant A identified a particular occurrence during the completion of one of the scenarios, when the integration of clinical knowledge was required in counselling a patient:

> …she came here and said, can she take this laxative, I think. And then we had to say, no she can't because that one is contraindicated with pregnancy. So then you need to apply your technical, or your clinical skills and tell her you can't use that, and then you have to like…explain why not, and just advise the other one rather. [A:854-868]

McDowell et al. (2016), citing James (2011), also assert that integrating clinical knowledge and cognitive skills concurrently can be highly complex, and that SBE can be conducive in

creating effective learning environments. The researcher identified in the literature review (see Section 2.7.1) that pharmacy schools in the US have adopted the use of MyDispense because it has proven to be effective in supporting the need for pharmacy students to learn how to actively apply their didactic curriculum knowledge (Ferrone et al., 2017).

It can therefore be seen that computer-generated simulations, such as MyDispense based clinical scenarios, can assist in blending acquired clinical knowledge, using cognitive skills, with the technical skills of the dispensing process. The cognitive skills required are not only based on clinical knowledge, but also on the ability to engage in clinical decision-making and problem-solving which will be discussed in the following paragraphs.

#### 4.4.3.2. Students reports of practice of clinical decision-making and problem-solving

In the literature review chapter, Wright et al. (2018) explained the practice of clinical decision-making in pharmacy practice as a process that follows four stages, concluding with the clinical decision (see Section 2.8.6). In this subsection, the practice of finding the solution for the MyDispense scenarios is discussed, with the participants recognising the skill of clinical decision-making and problem-solving during this process.

Participant B describes how they would work through a MyDispense clinical scenario acknowledging the various resources available and that, once the necessary information or clinical knowledge was found, clinical decisions needed to be made, thereby requiring the student to problem-solve:

> …so you get a script and you get the medication on it, so you have to solve the problem, yes, you have to figure out what's going on, how you're going to deal with it using all your knowledge you have, using the references, using all the information you're given, so it's definitely focusing you on problem-solving. [B:387-390]

Participant D also identifies the clinical decision thought processes that occurred during the clinical scenarios.

> Yes, and also like looking into like the script also there's a thing of umm history taking, so then if you, if it's written there that the patient is on this medication maybe

> and now, with the, with the thingy[2] that's being dispensed, that you- that you need to dispense, then you need to look as well if they're contraindicated or not, then you know if they can go together with the medication the patient is given and maybe or you need to give an alternative, all those things you need to think about. [D:394-399]

These participants' experiences of clinical decision-making while solving MyDispense clinical scenarios support the findings made by Shin et al. (2017), where the MyDispense clinical scenarios used at UCSF allowed students to practice their problem-solving skill as if they were practicing in an actual pharmacy (see Section 2.7.1).

Ordinarily, students are taught that problem-solving and clinical decision-making will need to be practiced during the dispensing process but, the actual nature of clinical decisions vary between scenarios. Participant B and F explained that the MyDispense scenarios not only required students to make clinical decisions but also provided them with the opportunity to learn the preliminary processes of dispensing and firstly recognise what clinical decisions needed to be made.

> Okay, like some of the decisions, it doesn't force you to do them…You'll have to decide by yourself like I need to call a doctor or not. [F:599-600]

> Yeah if I can just add, the system doesn't force you to do anything, you have all the options available in every single scenario, so, you have to decide what is an appropriate skill or option to choose for this scenario so it helps you to…for example, an administrative is in my mind, calling a doctor, or writing on the script, or doing this. So you don't have to do all of those in every single case, it depends on the scenario itself, so I think it helps you decide on what you should do in what scenario as well. [B:659-671]

Vyas et al. (2011, p. 2), citing Perry (1970), describe the need for clinical decision-making skills to be practiced continuously for students to be able to use an "accumulated experience" of decision-making and apply a higher level of cognition to clinical scenarios. By doing so, students will be able to approach the necessary "commitment in relativism", where the final

[2] It is assumed that Participant D is referring to the medicine prescribed which is stated on the prescription.

outcome may be uncertain and requires the student to make complex decisions in these situations (Vyas et al., 2011, p. 2).

Clinical decision-making by a healthcare professional in practice involves high-risk scenarios, and patient safety is therefore a major concern (Regan et al., 2014). McDowell et al. (2016) emphasised that the simulation environment of the MyDispense program can assist in allowing students to practice high-risk clinical scenarios in safe environments and could also allow for the subsequent experience of "productive failure" through students learning from their mistakes (see Section 2.4.3). Participant D recognised this as a benefit which added an element of freedom to experiment of using the MyDispense clinical scenarios, by saying: "You can go ruin, as much as you want, you will get the answers, and you don't kill them[3]" [D:1143]. Participant B agreed with Participant D and viewed the value of being allowed to make mistakes as part of the learning process, adding: "And that's how you learn" [B:1145]. This was further confirmed by Participant C, who spontaneously added that MyDispense allows students the opportunity to experiment during the MyDispense clinical scenarios without the risk of harming the patient, stating: "[and] not kill a patient" [C:621]. The notion of a safe environment for learning problem-solving was also mentioned by Participant A: "And it's nice because the patient is not getting impatient, they're not shouting at you" [A:1126], whereupon Participant C remarked: "they won't be rude" [C:1129]. This feedback indicates that the students felt less vulnerable, but rather felt safe and comfortable with the learning opportunity when using the computer-generated scenarios for learning problem-solving. This was also suggested by Fernandez et al. (2007) and Vyas et al. (2011), who offered that "safe" learning environments can lead to more meta-cognitive awareness, as students are able to frequently practice scenarios in a "high-stress, low-risk" environment (see Section 2.6.1.1.).

The process of clinical decision-making, as described by Wright et al. (2018), requires deliberate steps including using requisite cognitive skills to solve clinical solutions. However, the level of cognitive skill required varies and can be categorised into various levels, as explained previously in the literature review, according to Bloom's Revised Taxonomy (see Section 2.8.7). In the following subsection, the levels of Bloom's Revised Taxonomy will be discussed in terms of acknowledging the levels of cognitive skills required to successfully complete the clinical scenarios. A surprising sub-theme which emerged from the data was that students noted different levels of cognition related to prescription versus non-prescription scenarios which will be described in the paragraph below.

[3] The patients in the scenarios

#### 4.4.3.3. Comparisons of cognitive difficulty related to prescription and non-prescription scenarios

In the second phase of the study, the researcher aimed to discover the level of cognitive skills required to successfully complete the MyDispense scenarios created in Phase One. In the previous section (Section 4.2), the analysis performed in Phase Two is explained and shows that the majority of the clinical scenarios were perceived to require a higher level of cognitive thinking. It becomes clear that during the dispensing process in the MyDispense clinical scenarios, students would have needed to use cognitive skills which require the higher levels of cognitive thinking as described in Bloom's Revised Taxonomy. From the data gathered from the focus group, it was interesting to find that not only did participants understand that MyDispense scenarios required a higher level of cognitive thinking, but they also identified the similarities and differences with regards to this between prescription scenarios and non-prescription scenarios (see Section 2.6.1.4.).

Within the pharmacy profession, one comes across a generalised notion that non-prescription scenarios only require OTC medicines which fall in the domain of pharmacy support personnel, who handle scenarios with minimal help from the pharmacist. However, in order for non-prescription scenarios to be adequately considered they require the clinical expertise of the pharmacist, right from the beginning of the non-prescription scenario where the patient originally approaches a healthcare professional for the first consultation. Prescription scenarios, on the other hand, already include the result of the patient's first consultation with a healthcare professional and the pharmacist is only continuing the healthcare service by dispensing the medicine. Comparatively, there are differences between the cognitive requirements of prescription versus non-prescription scenarios. In the transcript extracts that follow, Participants A, C and E are discussing how non-prescription scenarios required a greater intensity of application of clinical knowledge, and thus higher levels of cognitive thought, when compared with the prescription scenarios. Towards the end of a discussion around this, Participant A states that the non-prescription scenarios were actually experienced to be more cognitively challenging:

> They're both the same, you need to, an…evaluate the patient, you need to…tell, or ask the medication, you need to dispense, you need to do all the steps you need to do with the prescription you need to do with the OTC[4] as well, so it's not as

[4] Over The Counter (OTC) – meaning that the scenario did not include a prescription (non-prescription scenario)

> different, you just don't get a script that you need to evaluate the practice number as she said, you don't have to evaluate the authenticity … [A:903-907]

Participant C however began to voice disagreement with the above participant:

> "Yeah, but you still have to evaluate the patient as a whole, like that's coming in for that medication requirement" [C:939-940].

Participant A and participant E agree and concur that the non-prescription scenarios were experienced to be more difficult than the prescription scenarios:

> Well it's much more difficult to do an OTC one, because you have to use your own knowledge- [A:919]

> Own knowledge- [E:921]

Furthermore, participants contributed further details particular to non-prescription scenarios, which added contextual information in explaining why these scenarios demand that pharmacists have the ability to apply clinical knowledge and use higher level cognition.

Participant A relates the need for on-the-spot recall of clinical knowledge in a non-prescription scenario, as well as a sense of vulnerability coupled with isolation, while consulting with a patient.

> And you don't have the products in front of you like in the pharmacy, like you can't just turn around and see what … and you can't read the package insert, or you can't… So it's…it's much more difficult so you need to like remember what you've learnt to apply, and not relying on what's behind you, or what's around you, you can't really ask a pharmacist or ask another employee like what would you do. So then you have to like, okay maybe what did the lecturer say in class about pregnancy, or what did they say they can use or not use. And then…afterwards you get the results and say okay maybe ... So the OTC ones felt a bit…more difficult, you probably need to apply that…more than just the prescription. [A:925-959]

The sense of vulnerability and professional responsibility is further described by Participant A by saying: "you don't have the products in front of you like in the pharmacy, like you can turn around and see…" [A:925-926]. The participant continues with describing these

challenges as, “you can’t read the package insert” [A:931] and summarises the experience as being one in which you have “to apply, and not [rely] on what’s behind you, or what’s around you, you can’t ask another pharmacist” [A:943-944].

Another participant recalled how, when they used the computer-generated scenario they experienced uncertainty in the challenge of a non-prescription scenario by asking themselves “does it give, like answers at the end if you selected the correct medication, which one you should have selected if you did not select the correct one” [F:971-973].

Furthermore, participants noted that fewer non-prescription scenarios were made available to students than prescription scenarios.

> There’s only a few OTC recommendations or scenarios because the things in the module we did, wasn’t really OTC things *general agreement*. You can’t really ... everything we learnt in 311 was like prescription based, *general agreement* as they couldn’t have done a lot of OTC. [A:981-984]

As the researcher developed the scenarios, there were no requirements for a particular number of prescription scenarios versus non-prescription scenarios and, as mentioned by Participant A, the content covered in the endocrine and renal sections in the ZCP311 module consisted mainly of medicines which would require a prescription. At the end of Phase One, the researcher created five prescription scenarios and two non-prescription scenarios, however, further consideration could be given to the inclusion of OTC medicine from other modules covered in the BPharm curriculum to provide more non-prescription scenarios.

Participant C began to explore the possibility of “mixing over-the-counter with prescription” [C:1060] scenarios and went on to elaborate that:

> … it’s also a good idea even though most of our 311 module is prescription, a patient can still come in, with a prescription and asking for an over the counter product for something else *general agreement*. So, it’s actually very nice to combine different therapies. [C:1064-1066]

The ability to dispense a prescription and, in addition to that, recommend and dispense OTC medicine using a MyDispense scenario was not possible during the study. The MyDispense version which the researcher used in this study did not allow for merging of both prescription and non-prescription types. However, it could be recommended to MyDispense developers to allow for inclusion in upgraded versions of the program.

It can, therefore, be acknowledged that while students are using computer-generated simulations, they are able to apply their clinical knowledge by means of clinical decision-making and problem-solving, which has been proven to require higher levels of cognitive thinking according to Bloom's Revised Taxonomy. In this manner they are essentially bringing together the necessary skills to successfully complete clinical scenarios in the dispensing simulated environment. Beyond the capacity for MyDispense to integrate students' ability to perform higher level cognitive skills during the dispensing process, students also reported other capabilities of MyDispense which will be explained in the following paragraphs.

### 4.4.4. General students report of using my MyDispense

Students made general reports about the MyDispense scenarios, as they perceived them to provide a good range of student exposure to clinical practice, provide constructive feedback to students, and allow for repeatable practice of the scenarios. Lastly, students recommended that MyDispense be integrated into the BPharm curriculum for wider use of the program in other modules of the degree and also highlighted difficulties experienced during the initial stages of using MyDispense.

#### 4.4.4.1. MyDispense increases opportunities for student exposure to the dispensing practice

The integration of clinical knowledge into the dispensing process using a computer-generated simulation program can create a learning platform with multiple benefits, as pharmacy students are able to practice experientially during their undergraduate education. Not only are students able to identify the direct relationship between their didactic knowledge and clinical practice, but they are also able to learn the logical cognitive thinking processes required to navigate through the dispensing process. Here, students can begin to identify that exposure to the dispensing environment can improve their dispensing skills. In the focus group, participants expressed overall difficulty with linking their didactic clinical knowledge learnt in lectures to the practice setting and recalled how the MyDispense scenarios in the study assisted them in providing the connection between the classroom and the dispensary. For example, Participant B described how MyDispense provided opportunities for learning to apply clinical knowledge:

> … so you don't really know how to connect your clinical knowledge, so this is a very nice program for seeing the whole picture as what you're actually learning to do. [B:1122-1124]

Participants described how the MyDispense scenarios assisted them in learning the logical order of the dispensing process and, therefore, this helped them during their externship placements which take place during the third year of the curriculum. Below, Participant E describes how the MyDispense scenarios assisted in particular with the layout of the pharmacy, so that when they visited the externship placement, the participant felt more at ease:

> I think she mentioned it with um…you were talking about like that, like the logic way of doing it, like how they, how you first have to ask the patient questions maybe, um…you have to look at the history and you know, all those things. Even when I was doing my placement program in… June, July, June yeah, umm…it kinda really helped me, 'cause I, I knew where to go when I get the script, what to do and…I knew that, you know, I can't just find this medication sitting next to this one, it has to be in a certain place, because it also shows there…there's a cupboard for S6, um… there's place for S5, I know where to go and I know what to start by doing before doing what so it also stipulate that. [E:536-543]

There was also appreciation expressed for the high level of realistic simulation contained in MyDispense.

> And the program also actually, is made... that is... like that shelving is literally in like A to Z which is most pharmacies, and schedule 5's are separate, schedule 6's are locked away. [C:548-549]

> Fridge items were literally in a little fridge .... so it actually makes you feel like you're in a pharmacy. [C:553-561]

As mentioned in the literature review, a high-fidelity simulation environment allows students to successfully engage with the simulation environment and gain exposure to the complex nature of the tasks and multiple skills needed to be competently performed (see Subsection 2.6.1.1)(Fernandez et al., 2007). The MyDispense program was therefore experienced by students to be a realistic experiential dispensing environment, allowing them to feel as if they were "in a pharmacy" [C:561].

Participant C further explained how the MyDispense scenarios encouraged full awareness or recognition of each step of the dispensing process and the logical order in which these would be completed:

> I think it was a good thing to try and learn the order of how you would help a patient, like...you wouldn't just randomly go to a patient, then go do something, go back to the patient, go do something, it made you start to try and grasp of how to actually... which way you would...which, however you prefer, if you prefer asking the patient- well I think you should ask the patient first, obviously but beyond that, it teaches you how to work efficiently. [C:232-236]

This emphasises what McDowell et al. (2016, p. 2) and Ferrone et al. (2017) described as a "conscious selections" process whereby there is no linear navigation through the MyDispense scenarios, and students are expected to advance through the scenarios with no prompts or reminders (see Section 2.7.5).

Students also recognised the value that the computer-generated simulated environment of MyDispense has in providing practice experience. For example, Participant C stated:

> I find it difficult to sometimes correlate what we actually learn at varsity and what you would apply in practice, and the MyDispense system is very nice, because you actually get practical experience as what you would do when you get a script, how would you analyse it, and how would you apply your actual knowledge that you gain at varsity. [C:168-171]

As Participant E previously highlighted, when stating that "…it kinda really helped me…" the MyDispense scenarios assisted in preparing the student for experiential practice which students are expected to complete during the BPharm programme. Hall et al. (2012), McDowell et al. (2016), and Weller et al. (2012) explain the relevance and necessity for experiential learning. However, Labuschagne et al. (2014) report the lack of placement opportunities due to increased student numbers at higher education institutions and the lack of variety of patient cases in academic and public sector health care facilities in South Africa (see Section 2.4). Participant B recognises that students require experiential practice to learn effectively and some students even seek practical experience in pharmacies outside of the pre-arranged placements. However, not all students have the opportunity or availability to do so, thus causing a deficit in students' experiential exposure: "…I think it's[5] a very nice thing to

[5] The MyDispense programme

have while doing this, especially since not everyone is able to work part time as a student…" [B:1122-1123].

The student participants were able to not only identify the benefit of increasing the students' exposure to the pharmacy environment, but also the availability of feedback immediately after completing the dispensing scenarios which assisted them in identifying errors and corrected their practice.

#### 4.4.4.2. MyDispense feedback received while completing scenarios

Another central benefit, mentioned by several of participants, suggests that during the research, once students had completed the scenarios on the MyDispense program, they received immediate feedback on the success of their attempt, together with full explanations of what was actually required. Several authors including McGaghie et al. (2010), Regan et al. (2014), and Weller et al. (2012) have described the ability of SBE to provide a platform for feedback to assist students to learn and then to be able to apply learning in the workplace (see Section 2.5.2.). During the focus group several participants were able to recognize the unique contribution that the access to feedback had made to their learning experience:

> Yeah it also helped because afterwards, after the scenario it gives you guidelines on what you did wrong, or what you missed and 'ahh maybe I should have asked that' or 'oh maybe I forgot that' and then you have that in your mind so the next time you have a scenario you know, okay you should ask this. [A: 182-185]

> …you know when they give you the answers then you know what you need to focus on when you get to encounter the scenario, or a script, you know… [D: 471-472]

> And if you don't call a doctor, and you were supposed to call a doctor, at the end it will give you feedback that you're supposed to contact the doctor based on this and that. [F: 608-610]

> …if you're incorrect, you get the re- uh- okay you should have phoned a doctor or referred, you should of asked this question, you should of taken note maybe of their age, even. [C: 641-650]

Ambroziak et al. (2018), McDowell et al. (2016), and Shin et al. (2017) also explain how the MyDispense program has benefited students as a self-study tool by providing immediate feedback, allowing them to gauge the amount of practice necessary to gain the required dispensing skills (see Section 2.5.2.). This benefit of MyDispense was described by some of the participants:

> …so you get the solution to your problem. [F: 423]

> …and it's instant, you don't have to wait … you can like instantly tell if you're right or wrong. [A: 431-440]

Furthermore, Participant A explained that practicing scenarios consecutively, after receiving feedback, became rewarding as it enabled students to learn from previous experience and potentially become more successful in the subsequent scenarios:

> Especially, like after the first scenario I did a few things wrong *laughter* and I forgot like a lot of things, and then they said, oh maybe you should have asked this, or maybe this, or maybe this. And I started thinking and as you go, went to like the third scenario, you did very, very well, you did, you asked most of the questions…. So even if I went there, I would have gotten even better and better and better and that would have helped even more. [A: 1018-1037]

Immediate feedback of students' work can therefore encourage students to amend their errors by practicing the scenarios. This benefit will be discussed in the following paragraphs.

#### 4.4.4.3. Repeatable practice of MyDispense scenarios

A major benefit of a simulation environment is the ability to repeat tasks and practice them as frequently as is required. Learning of technical skills and even cognitive skills can be enhanced by practicing and becoming competent in the tasks required. Pharmacy students are expected to demonstrate competency in dispensing skills before they qualify to practice as pharmacists. Several authors including Ericsson (2004), McGaghie et al. (2010), and Weller et al. (2012) have described the benefits of repetitive or "deliberate practice", suggesting that it is a manner by which students can refine their dispensing skills (see Section 2.5.2).

As Participant A mentions, the reference materials available in the scenarios were from Australian sources because the original MyDispense program displayed direct links to the Monash University website.

> Even with- thingy- the references as well, like when you had you go click. [D: 256]

> The references were from Australia or some other country, so you had to have your own references with you, you can't use the ones from the program. [A: 258-259]

Within the study, the researcher was unable to alter the setting on the MyDispense program before the scenarios were implemented. However, the participants were able to use all their regular online or physical references which they were familiar with, such as Micromedex, ACCESSPharmacy, or any recommended textbook or their lecturer notes; which they would have had access to as registered students of the BPharm programme. Participant A confirms below that they benefited from having the alternative resources available and refers to one of the prescribed textbooks for ZCP311, the South African Medicines Formulary (SAMF), as listed in Table 6 (page 64).

> But you can take your time…you have your resources, you have your books, you have your notes, you have your SAMF, you have everything with you. [A:1131-1132]

MyDispense can therefore be useful in providing clinical exposure, feedback, and practice but if the program is not fully integrated into a curriculum it would be difficult for students to fully engage themselves into the learning process and will be discussed in the following section.

#### 4.4.4.4. Future assimilation of MyDispense in the BPharm program

The MyDispense scenarios completed by the participants were designed for this research study and currently do not form any formal part of the BPharm programme or its assessments. Furthermore, the researcher only selected the third-year BPharm students to participate as the MyDispense scenarios were specifically based on the third-year module, ZCP311. During the focus group discussion participants gave feedback on how the use of the computer-generated scenarios could be adjusted for further integration into the BPharm curriculum, and how training for the use of the MyDispense could be adjusted from the training they received during the study.

Topics raised in the focus group discussion ranged from ideas suggesting that the scope of the MyDispense scenarios be widened across the entire program as mentioned previously in Subsection 4.4.2., to the fact that students' experiences in the study revealed conflicting constraints on their available time. Participants experienced tensions in this study between time spent on My Dispense versus time spent on their formal assessments. Participant A encouraged wider use of the MyDispense program across the BPharm curriculum and emphasized that the scenarios could provide a way of revising knowledge from previous years of study in their curriculum. The participants therefore encouraged the formal integration of MyDispense scenarios into the curriculum in the future.

Although they perceived great benefit to using MyDispense when it was offered as an optional extra, students in the study felt caught between giving time to MyDispense scenarios and having to complete other formal activities that contributed toward their assessment marks. This could also provide a possible reasoning for the low amount of MyDispense scenarios completed by the participating students as mentioned in Subsection 4.3.4. It would therefore appear from the inputs quoted below, that the limitation of time available for practicing the MyDispense scenarios could have been an influencing factor: "… like I didn't do much before the exams, I didn't have time" [B: 175-176]; "… and even if I didn't get to the last scenarios because there's no time" [A: 1035]. With hindsight, this participant goes on to express regret that they had not chosen to give the scenarios more prominence in their learning:

> I would just say, it's a really, really nice program. I mean, it really helped, if it wasn't part of the um… the syllabus because, on the sideline you don't really have time to do the simulations and to do your work …. So it's quite, quite hard to actually get time to actually do the scenarios. 'Cause it was really there and you could have used it but I didn't utilize it as, as much, because it was limiting 'cause you want to learn and you want to do good in your pharmacy and not focus on a program that really doesn't count for anything. [A: 997-1010]

Authors Labuschagne et al. (2014), McGaghie et al. (2010), and Weller et al. (2012) all agree that curriculum integration is important and readily allows for the alignment of SBE with learning outcomes. The learning outcomes applicable in this case would be from the BPharm curriculum and the competency standards for pharmacists practicing in South Africa as outlined by the SAPC, as stated in the literature review (see Subsection 2.5.5.).

However, given the circumstances of this study, where the MyDispense scenarios which students had experienced were voluntary and did not form any formal part of the requirements

of the BPharm curriculum, it would be expected that participants experienced conflict within themselves when faced with time constraints in their preparation for summative assessments. Thus, participants reported that they did see the value of having MyDispense scenarios as an optional adjunct to the module. For example, Participant D expressed the view that the MyDispense scenarios were of benefit to the students because the scenarios were low-risk academic activities that were not high-stake assessments: “there are no marks allocations” [D: 1134]. This again highlights what was mentioned in Subsection 4.4.3.2, that, as suggested by Fernandez et al. (2007) and Vyas et al. (2011), “safe” learning environments can lead to more meta-cognitive awareness, as the students are able to frequently practice scenarios in a “high-stress, low-risk” environment (see Subsection 2.6.1.1.). In this context, the “low-risk” mentioned in Subsection 4.4.3.2. is shown to have benefits for enhancing problem-solving and meta-cognition. Here, however, scenarios were voluntary and not part of any high stakes assessment and students report a different benefit on the notion of “low-risk”.

The success of the integration largely depends on the resources available, such as sufficient time and faculty staff (see Section 2.5). In this regard, the experience of the researcher was that the Pharmacy Department were able to supply a venue for the MyDispense information session, and students were able to attend the information sessions during a time which was convenient to them without experiencing any timetable clashes with lectures, practicals, or tests. Students were also able to use computers on any Nelson Mandela University campus, and also to use the university’s wireless local area network (WLAN) to connect to the internet, as an internet connection was necessary to access the MyDispense program.

#### 4.4.4.5. Initial training for MyDispense

In Section 4.3 of this chapter, the researcher explained how the third-year pharmacy students were prepared, while attending information and demonstration sessions, on how to use the MyDispense program. The researcher made it known to all the students that she was available for any queries and frequently encouraged the student participants to contact her if they experienced any problems.

When the focus group participants were asked what their general experience of MyDispense was, Participant A noted that she experienced the training as follows:

> She lectured about the, how to use the program, but we didn’t have it in front of us. So we had to just listen and then go home and then try it and .... figure it out. [A:306-309]

The rest of the participants agreed that the program was difficult to use initially, referring particularly to the technical skills required when in the initial phase of the dispensing process, which needed to be performed using the MyDispense program.

There was wide reporting by participants of difficulties which were experienced, which occurred when they first began to use MyDispense. Participant F gave input on how the MyDispense program was initially perceived to be a complicated program to use but later was perceived to be easier with practice: “Well, at first the program, I found it a little bit, uh, confusing, but the more I do it, the easier it got and .... even checking the medication” [F:244-245]. Similarly, Participant A mentioned the struggle that they had with familiarization with using MyDispense: “…yeah take your time to figure it out, which buttons are where do you go to, takes a while” [A:249]. Participant E, C and D elaborated on the particular technical difficulties they experienced: “…cos even selecting the medication ... yeah it was tricky” [E:252-253]: “the labelling it” [C:254], “in between the sticker and writing directions” [D:261] and “uploading the patient’s data” [F:273]. In these inputs, the students report details of how the nature of their training did not enable ease of use of MyDispense at an entry level, and named some barriers that they had to learn to overcome before they had achieved easy use of the computer-generated scenarios.

In this part of the discussion the participants spontaneously began to give suggestions how these difficulties could be overcome. Participant A, D and F gave input advocating “you need more training” [A, D: 292, 294] and “have the program there” [F:331]. Participant C gave an input of how they had successfully begun to use MyDispense; “it’s more the practice, that the more you do something it becomes easier” [C:300]. In the discussion, participants also reported that there was a video link that was provided, which aimed to assist them when they came across difficulties, but did they not comment on whether or not this was used to assist themselves in familiarising themselves with the software of the program.

The above inputs relate to how, in an exploratory study, students may also not have experienced the full potential of the organisational or administrative support of the MyDispense program from all the faculty staff, as it was only the researcher who was able to assist and instruct the students. As mentioned in Subsection 4.3.2., the researcher had envisaged that it would be better for students to pay careful attention to specific tasks that the researcher was completing on the MyDispense program before they attempted the tasks themselves. The researcher also notes that hardly any students consulted her for assistance after the information session, which could be ascribed to the voluntary nature of participation in the study. However, if all third year BPharm students were expected to complete the scenarios,

the support of more faculty staff would have been guaranteed and potentially peer support from fellow students could have been organised.

### 4.4.5. Trustworthiness of data

To ensure accurate representation of the student participants' contributions during the focus group and correct interpretation of their perspectives, the researcher asked one of the participants to review the transcript and this section (Section 4.4) of the interpretation of the data, to which the following was received via email:

"I absolutely agree with the conclusions you made in the analysis. I do not have anything to add, I think you interpreted our feelings perfectly." [Participant]

The researcher also employed an independent reviewer to evaluate the thematic analysis and to verify that the themes identified reflected the data transcribed from the focus group. The independent reviewer sent confirmation of the review by stating:

"This serves to confirm that after reading the transcript of the focus group I reviewed the themes and sub-themes which you described as emerging from this. I verify that the themes and the description of these gives a full and true reflection of the data from the focus group." [Independent Reviewer]

This provides evidence that the analysis of data was verified on two accounts and the data can be seen to be trustworthy.

### 4.4.6. Summary

In conclusion, MyDispense is acknowledged by the student participants to integrate the application of clinical knowledge and cognitive skills into the more technical aspects of the dispensing process, in order to successfully complete the designed clinical scenarios. Each theme identified by the researcher effectively represents the student participants' experiences of using the MyDispense program. The first theme identified was the use of MyDispense for student learning, particularly regarding the application of clinical knowledge into the dispensing process. Following this theme was the students' experience of using MyDispense scenarios as an adjunct to the ZCP311 module which further developed into the next theme

of the suitability of MyDispense to integrate clinical knowledge into the dispensing process. Sub-themes within this main theme were identified in terms of blending in of cognitive skills while practicing dispensing skills as the student participants reported practicing clinical decision-making and problem-solving during the completion of the scenarios and, in doing so, also made comparisons of cognitive difficulty related to prescription and non-prescription scenarios. Lastly, the researcher identified the students' reported ideas that described how MyDispense increased student exposure opportunities to dispensing practice, provided feedback while completing scenarios, and allowed for repeatable practice of MyDispense scenarios. The student participants also made recommendations for future assimilation of MyDispense in the BPharm program and improvements on the initial training required for MyDispense which the researcher included towards the end of the theme.

Subsection 4.4. has determined the students' experiences of using MyDispense scenarios and has aided in accomplishing the study's aim of determining whether the use of simulation, in particular MyDispense, could assist in the integration of clinical knowledge-based cognitive skills into the dispensing process. This will be further concluded in Chapter 5.

### 4.5. Summary

This chapter of the study has discussed the outcomes of each of the research objectives which collectively address the main research aim, which was to explore ways in which MyDispense can be used to facilitate the integration of clinical knowledge-based cognitive skills into the dispensing process.

The first part of the chapter describes how MyDispense-based scenarios were developed after a content analysis was conducted of the module learning outcomes, clinical knowledge underpinning the learning outcomes, and the minimum requirements for dispensing. The simulated scenarios were designed to integrate a hierarchy of cognitive skills required of students while completing the dispensing process. During the second phase of the research, the lecturer participants reported that the clinical scenarios required students to use a range of cognitive skills, varying from the lowest to highest level of Bloom's Revised Taxonomy. In addition, a connection was made between the clinical decision-making process as described by Wright et al. (2018), illustrating the cognitive processes required during the dispensing process; with the level of cognitive skills the lecturer participants perceived to be required of the students according to Bloom's Revised Taxonomy.

The MyDispense scenarios were piloted as an adjunct to the ZCP311 module by third year pharmacy students, who used the program to practice the scenarios designed in Phase One of the study. This section of the chapter reports that more than half of the students who volunteered to participate did not complete or submit any scenarios. The perceived reasons for this related to insufficient time available to students and the lack of program support available to students, due to MyDispense only being used in the capacity of an adjunct to the module.

The student participants who did complete the scenarios acknowledged that MyDispense facilitated integration of their clinical knowledge and the practice of clinical decision-making into the dispensing process. MyDispense was recognized to assist the students in preparing for ZCP311 assessments and was recommended by the students that it be used in all BPharm clinical modules in the future.

# CHAPTER 5: CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

This chapter will discuss the findings of each of the four phases of the study in the context of the literature reviewed in Chapter 2, focusing mainly on the study aim and objectives as outlined in the beginning of the study. The researcher will draw conclusions based on findings and reasons for conducting the research. Thereafter study limitations and implications are discussed, followed by recommendations for future research and practical implications for further use of the MyDispense simulation program.

## 5.1. Summary of findings

The first objective of the study was to develop patient-based scenarios using MyDispense, which was performed as the first phase of the study involving the content analysis of the module's learning outcomes and identified the clinical knowledge and minimum requirements for dispensing. This was necessary to provide a basis for the creation of the MyDispense scenarios.

Addressing the second objective of the study, the lecturer participants reported that each of the MyDispense scenarios required students to use a range of cognitive skills, varying from the lowest to highest level of Bloom's Revised Taxonomy. It became evident that the stages in the clinical decision-making process during dispensing, as described by Wright and colleagues (2018), aligned with the levels of cognitive skills the lecturer identified to be required of the students during completion of the scenarios.

MyDispense scenarios were successfully piloted as a voluntary adjunct to the ZCP311 module. Student participants reported that MyDispense assisted students in preparation for ZCP311 assessments and recommended that the program be incorporated into the BPharm curriculum in the future.

The student participants acknowledged that MyDispense facilitated the integration of their clinical knowledge and decision-making skills into the dispensing process.

## 5.2. Conclusions

As an exploratory study, the use of the virtual dispensing program, MyDispense, in the South African pharmacy education setting was the first of its kind. Therefore, the study's ability to gauge the successful capability of MyDispense to facilitate the integration of clinical knowledge-based cognitive skills into the dispensing process contributes to the search for educational tools effective in teaching large classes and providing work integrated learning opportunities for undergraduate students. Due to the large class numbers experienced in the researcher's working environment at Nelson Mandela University, and the reduced opportunities for experiential learning platforms, the use of MyDispense has proved to provide an effective simulated educational tool for the South African pharmacy education setting. The study also demonstrated the manner in which MyDispense scenarios could be easily created and adapted for the South African clinical setting, thus providing students with a more realistic virtual experience of the South African pharmacy workplace.

The MyDispense scenarios, including prescription and non-prescription exercises, were reported by lecturer participants to require higher levels of cognitive skills, according to Bloom's Revised Taxonomy. This taxonomy provides a basis for educators to determine the cognitive requirements of student assessments and has been adopted by the SAPC during its accreditation process as an approach to evaluate and promote the incorporation of the entire range of cognitive levels of knowledge into pharmacy education in South Africa. Therefore, pharmacy lecturers across the country, and particularly in this study, are familiar with Bloom's Revised Taxonomy and are able to understand the significance of the cognitive challenges faced during MyDispense scenarios. It is important to note that even though the lecturers had limited exposure to MyDispense and were unfamiliar with the program, it was possible for them, after a brief introduction, to assess the scenarios according to Bloom's Revised Taxonomy.

The implementation of MyDispense was successfully contextualised for South Africa and the scenario content was appropriate to the ZCP311 module learning outcomes. However, although students were able to complete the MyDispense scenarios with minimal training, making it fairly accessible, students would have preferred more training when using the program for the first time.

The exposure to MyDispense granted students the opportunity to integrate clinical knowledge into the dispensing process while completing both prescription and non-prescription scenarios.

Moreover, students recognized the difference in cognitive skills required by prescription and non-prescription scenarios, noting that non-prescription scenarios actually required a higher level of cognitive thinking when providing OTC medicine and advice.

Students were also able to identify the similarities between the simulated environment provided by MyDispense and their actual experience of the pharmacy workplace during WBL placements, thus confirming the WIL experience which MyDispense was able to provide. In addition, MyDispense prepared students for assessments such as OSCEs and written exams, by allowing for the practice of the integration of higher levels of clinical knowledge-based cognitive thinking while completing high fidelity simulated scenarios.

As the international shift of pharmacy practice is moving towards pharmacy technicians performing most, if not all, of technical tasks; this frees the pharmacist to give greater attention to cognitive tasks. Hence, pharmacy education is expected to provide effective teaching environments for potential pharmacists to practice applying their clinical knowledge-based cognitive skills before they begin to practice in the workplace. Therefore, the move towards SBE and the contribution that MyDispense, a simulation-based dispensing program, can have on educating proficient pharmacists should be seriously considered by all pharmacy schools.

### 5.3. Discussion of problems

In light of these conclusions, the following limitations need to be noted. The MyDispense scenarios were only based on one clinical module from the BPharm curriculum, creating a narrow scope of clinical topics for which MyDispense could be used in this study. Furthermore, participation in the study was voluntary, reducing the study sample size and reducing the pressure on the students to complete MyDispense scenarios. Participating students, although provided with all the scenarios, could choose not to complete them all, thus, making it difficult to gauge the full benefit of the program. Due to time pressures, participants reported a conflict between practicing the MyDispense scenarios which didn't count towards marks and studying for the module assessments which did count towards their class marks.

Some of the minor technical attributes of the MyDispense program, for example the availability of online references within the program, had not yet been fully adapted by the time the students piloted the scenarios. However, relative to the objective of the use of the MyDispense scenarios, this did not deter from the results of the study.

With regards to the data analysis in this study, the qualitative data analysis software program, Atlas.ti®, was not available and the transcripts had to be coded and analysed manually. Although the computer-based coding software would have been preferable in the management of codes and the grouping of themes, and would have further assisted in the audit trail and review process, the themes and sub-themes were identified and confirmed by the independent reviewer and lack of the program did not reduce the richness of data or the final thematic analysis.

The final limitation of the study was the use of the MyDispense scenarios as an adjunct to the ZCP311 module, rather than as an integrated component. At Nelson Mandela University, in terms of research, students are considered a highly vulnerable population and, therefore, student participation in educational studies is limited. The Research and Ethics Committee for Human Research at the university require that lecturers who are in the position of assessing students cannot be concurrently researching the students within the same module. Therefore, to avoid any influence on, or bias towards the students, MyDispense was offered as an adjunct to a module which I, as the researcher, was not involved in lecturing or assessing. This limited the students' exposure to MyDispense and reduced the level of potential support for using the program from the staff and fellow students.

### 5.4. Recommendations

Notwithstanding the limitations described in the previous subsection, the MyDispense program, if it is integrated and applied practically and is included in future potential research, has the potential to benefit pharmacy education in South Africa as well as internationally.

Arising from this study I would, therefore, like to make the following recommendations for the practical use of MyDispense:

- The practice and completion of MyDispense scenarios should be integrated into the BPharm curriculum since it provides a reliable platform for simulated learning. Furthermore, MyDispense allows a broad scope of cognitive and technical tasks to be practiced in order for pharmacy students to gain competence in performing the dispensing process. The clinical scenarios should also preferably be low stakes in relation to the module as this allows for a higher rate of deliberate practice.
- The use of MyDispense should be integrated across all relevant modules, preventing limitations on the scope of content integrated into the scenarios. Furthermore, consideration should be given to the inclusion of content from all four years of study in

the MyDispense scenarios, thereby providing familiarisation with the program and ongoing revision of all the content. In addition, prescription, non-prescription, and combination scenarios should all be offered to students within the simulated MyDispense environment.

- Pharmacy lecturers should be adequately trained to use and administrate MyDispense so that students are able to gain the support from staff members. Trained staff can also convert existing clinical scenarios into simulated versions of the same scenarios using MyDispense.
- Monash University should be affirmed and encouraged to continue to allow MyDispense to be made freely available on an international level so that the benefits of the program can be experienced throughout the pharmacy profession. Particularly in South Africa, where WBL opportunities are often limited and BPharm classes are large, the positive implications of MyDispense for WIL opportunities should be considered across the country. I would also highly recommend that pharmacy schools across the country consider collaboration in the adaptation of MyDispense for the South African pharmacy context. This could include the sharing of materials, scenarios and resources so that the benefits of the program can be widely experienced.
- Students should be adequately trained during the initial use of MyDispense by affording them access to the program during an instructor guided session, so that students are able to see and follow the various tasks required in completing a scenario. Furthermore, students should be provided with multiple information sessions on the use of the program and technical support should be freely and continuously available to students.

During this study, areas lending themselves to further research have also been identified and I offer the following suggestions for future research in this area. Firstly, the implementation of MyDispense across multiple clinical modules and years of study could lend itself towards further research. This would contribute to the understanding of the teaching of cognitive thinking and application of clinical skills as an integrated component of the dispensing process in all aspects of clinical pharmacy education, and at varying levels of complexity. Secondly, the potential benefits of using MyDispense to expose students to WIL environments prior to work-based placements could be explored as a longitudinal study. Lastly, the cognitive skills required during non-prescription or OTC-based scenarios in comparison to prescription scenarios could be investigated. This would provide further insights into the preparation of students to address both these aspects of dispensing practice, and could assist students to recognise, at an early stage, the positive cognitive-based contribution pharmacists can make to the dispensing of non-prescription medicines.

### 5.5. Personal response

As a pharmacy lecturer, comparing my years of undergraduate studies to those of the current pharmacy students, I feel that WIL, in combination with guided practicals focusing on the dispensing process, is of great benefit in preparing students for the workplace. I recall the only work-based practical experience that I considered to be beneficial as an undergraduate student was what was completed during the hours that I worked at a local pharmacy. From this perspective, I view the beneficial aspects of simulated learning to be transformational in the current age of technology and envisage that computer based SBE, which is still in the relatively early stages of development, will to come to the fore in a much larger capacity in future years.

The MyDispense scenarios I designed are currently being used by the third-year students at Nelson Mandela University, but it is my hope that all the clinical modules in the curriculum will adopt the simulated learning program and that the collaboration with pharmacy schools as proposed in the recommendations will come to fruition.

Lastly, pharmacy education owes a tremendous thanks to Monash University, and in particular the MyDispense Team, for designing this program and making it freely available to all pharmacy schools across the world. I hope that they are able to recognize the positive contribution that their work and generosity has made toward pharmacy education and ultimately the practice of pharmacy.

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# APPENDICES

## APPENDIX A: Letter of Permission for the Use of MyDispense

Faculty of Pharmacy and Pharmaceutical Sciences

7 August 2017

Miss Monique Klitsie
Pharmacy Department South Campus
Room 028, Building 12
Nelson Mandela University
University Way
Summerstrand, Port Elizabeth 6001
SOUTH AFRICA

Email: monique.klitsie@nmmu.ac.za

Dear Miss Klitsie

**Permission for the Use of MyDispense for Research Purposes**

We have received your request for permission as an MPharm student at Nelson Mandela University, to use MyDispense as a basis for conducting an explorative qualitative study.

MyDispense is an open source virtual computer programme developed by Monash University. Monash University has granted free use and customisation of the programme to its official partner universities, of which Nelson Mandela University is one.

Therefore, we hereby grant full permission for Miss Monique Klitsie to use MyDispense to conduct her research study.

Monash University looks forward to being provided with feedback on the outcome of the research, following completion of the study.

Yours sincerely,

Marian Costelloe
**General Manager**

**Faculty of Pharmacy and Pharmaceutical Sciences**
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ABN 12 377 614 012 CRICOS provider number 00008C

# APPENDIX B: Participant Consent Form for Purposive-Designed Assessment Form

South Campus
Department of Pharmacy
Tel: +27 (0)41 504 4910
Cell: +27 (0)71 364 6086
monique.klitsie@mandela.ac.za

Date: _____

Contact person: Miss Monique Klitsie

**INFORMED CONSENT FORM**

I**, .....,** confirm that I have been requested and am hereby willing to participate in a purposive-designed assessment form that will be part of a research study, entitled: “Simulated Learning: Integrating Clinical Knowledge into the Dispensing Process”, conducted by Miss Monique Klitsie (primary researcher) of the Department of Pharmacy in the Faculty of Health Sciences at Nelson Mandela University.

The following aspects of the study have been explained to me, the participant:

1. The primary aim of this study is to explore ways in which a virtual dispensing program, MyDispense, can be used to facilitate the integration of clinical knowledge-based cognitive skills into the dispensing process.
2. In participating in this study, I will be complete a purposive-designed assessment form where the responses will be documented.
3. I have a choice to participate, as the study is voluntary and I have the right to willingly withdraw from the study at any time.
4. My confidentiality will be ensured, no names or other identifying attributes will be published.
5. Participation in the study will not result in any cost to me.

I, hereby voluntarily consent to participate in this study.

Signed and confirmed at …… on the ……..... 20….

_____ _____
(Interviewee) (Principal investigator)

_____
(Witness)

## APPENDIX C: Participant Consent Form for Implementation of Clinical Scenarios

NELSON MANDELA UNIVERSITY

South Campus
Department of Pharmacy
Tel: +27 (0)41 504 4910
Cell: +27 (0)71 364 6086
monique.klitsie@mandela.ac.za

Date: _____

Contact person: Miss Monique Klitsie

**INFORMED CONSENT FORM**

I, **……,** confirm that I have been requested and am hereby willing to participate in the implementation of clinical scenarios that will be part of a research study, entitled: "Simulated Learning: Integrating Clinical Knowledge into the Dispensing Process", conducted by Miss Monique Klitsie (primary researcher) of the Department of Pharmacy in the Faculty of Health Sciences at Nelson Mandela University.

The following aspects of the study have been explained to me, the participant:

1. The primary aim of this study is to explore ways in which a virtual dispensing program, MyDispense, can be used to facilitate the integration of clinical knowledge-based cognitive skills into the dispensing process.
2. In participating in this study, I will complete clinical scenarios using MyDispense.
3. I have a choice to participate, as the study is voluntary and I have the right to willingly withdraw from the study at any time.
4. My confidentiality will be ensured, no names or other identifying attributes will be published.
5. Participation in the study will not result in any cost to me.

I, hereby voluntarily consent to participate in this study.

Signed and confirmed at …… on the ……..... 20….

_____ _____

(Interviewee) (Principal investigator)

_____

(Witness)

## APPENDIX D: Participant Consent Form for Focus Groups

NELSON MANDELA UNIVERSITY

South Campus
Department of Pharmacy
Tel: +27 (0)41 504 4910
Cell: +27 (0)71 364 6086
monique.klitsie@mandela.ac.za

Date: _____

Contact person: Miss Monique Klitsie

**INFORMED CONSENT FORM**

I**, .....,** confirm that I have been requested and am hereby willing to participate in the implementation of clinical scenarios that will be part of a research study, entitled: "Simulated Learning: Integrating Clinical Knowledge into the Dispensing Process", conducted by Miss Monique Klitsie (primary researcher) of the Department of Pharmacy in the Faculty of Health Sciences at Nelson Mandela University.

The following aspects of the study have been explained to me, the participant:

1. The primary aim of this study is to explore ways in which a virtual dispensing program, MyDispense, can be used to facilitate the integration of clinical knowledge-based cognitive skills into the dispensing process.
2. I have a choice to participate, as it is voluntary and I have the right to willingly withdraw from the study at any time.
3. I may be invited to view the transcripts, analysis, interpretations, and descriptions obtained from the interview; so as to validate the accuracy and transparency of the transcripts, field notes and interpretations of the researcher.
4. I have the freedom to suggest the removal of information that may lead to the exposure of the participants of the focus group.
5. My confidentiality will be ensured, no names or other identifying n attributes will be published.
6. Participation in the study will not result in any cost to me.

I, hereby voluntarily consent to participate in this study.

Signed and confirmed at …… on the ……..... 20….

_____ _____

(Interviewee) (Principal investigator)

_____

(Witness)

## APPENDIX E: Research Information for Student Participants

Dear Students

You are hereby invited to participate in a research study as part of a voluntary adjunct to the selected clinical module.

This research study aims to explore ways in which a virtual dispensing program, MyDispense, can be used to facilitate the integration of clinical knowledge-based cognitive skills into the dispensing process.

You will be asked to complete clinical scenarios on a virtual dispensing program called MyDispense where you will use the clinical knowledge gained in the selected clinical module and your skill of dispensing to complete these scenarios. These clinical scenarios are only adjuncts to the chosen clinical module and will not form any part of the course work or assessment for the clinical module. Your success in completing the clinical scenarios will not be scored and will in no way have any effect on your academic result for the chosen clinical module.

You will need to attend a two-hour face-to-face introduction and information session regarding the use of MyDispense and thereafter you will be able to complete the clinical scenarios in your own environment within a particular timeframe. You will need to have access to a computer with internet access to complete the clinical scenarios.

Your participation in this research study is voluntary and you may withdraw from the study if necessary. Your personal details will remain confidential and anonymous throughout the study.

Please notify Monique Klitsie if you are interested in participating in this research study.

## APPENDIX F: Research Information for Pharmacy Staff Participants

Dear Pharmacy Staff

You are hereby invited to participate in a research study which focuses on the ways in which a virtual dispensing program, MyDispense, can be used to facilitate the integration of clinical knowledge-based cognitive skills into the dispensing process.

The researcher has designed clinical scenarios pertaining to a chosen clinical module which participating students will need to complete. You will be asked to assess the provided clinical scenarios and evaluate them on a purposive-designed assessment form. The assessment will primarily focus on the alignment of the clinical scenarios with Bloom's Revised Taxonomy level descriptors, and will seek feedback on the appropriateness of the clinical knowledge required.

Based on feedback received from the assessment, the scenarios will be revised to ensure the fullest integration of clinical knowledge with clinical skills at increasing levels of complexity.

Students will then be asked to complete clinical scenarios on a virtual dispensing program called MyDispense where they will use the clinical knowledge gained in the selected clinical module and their skill of dispensing to complete these scenarios. These clinical scenarios are only adjuncts to the chosen clinical module and will not form any part of the course work or assessment for the clinical module. Their success in completing the clinical scenarios will not be scored and will in no way have any effect on your academic result for the chosen clinical module.

Your participation in this research study is voluntary and you may withdraw from the study if necessary. Your personal details will remain confidential and anonymous throughout the study.

Please notify Monique Klitsie if you are interested in participating in this research study.

## APPENDIX G: Purposive-Designed Assessment Form of Clinical Scenarios

# Purposive-Designed Assessment Form of Clinical Scenarios

**For each scenario, please select the descriptive word/s provided which you feel could best describe or categorise the cognitive skill/s required of the student to successfully complete the scenario. Re-write the word/s in the same column which you have selected them from.**

| Clinical Scenarios Analysis According to Level Descriptors of Bloom's Taxonomy | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Remembering** | **Understanding** | **Applying** | **Analysing** | **Evaluating** | **Creating** | | |
| **Number & Scenario Title** | recognising, identifying, recalling | interpreting, clarifying, representing, classifying, categorising, summarising, interpolating, comparing, explaining | executing, implementing, using, carrying out | differentiate, distinguish, focusing, integrating, structuring, finding coherence | checking, co-ordinating, detecting, monitoring, testing, judging | generating, planning, designing, producing, constructing | **Describe the clinical knowledge which the student would need to identify while completing this scenario.** | **Provide any recommendations which you think could improve the scenario as a tool to assist the integration of clinical knowledge-based skills into the dispensing process.** |
| **1** | | | | | | | | |
| **2** | | | | | | | | |
| **3** | | | | | | | | |
| **4** | | | | | | | | |
| **5** | | | | | | | | |

## APPENDIX H: Proposed Focus Group Questions

These questions will be finalised once the clinical scenarios are developed.

**Questions:**

1. What was your experience of using the MyDispense simulation-based program?
2. What would you have considered to be beneficial in your exposure to a simulated-based learning program?
3. Can you describe ways, if any, in which your experience with a simulated-based program required problem-solving thinking?
4. What was your experience in terms of the integration of clinical knowledge gained in the clinical module with the clinical scenarios presented in MyDispense?
5. Are there ways in which MyDispense created an awareness for the use of clinical knowledge alongside the technical skills of the dispensing process?
6. Can you describe some of the difficulties you experienced in using a simulation-based program?
7. What was your experience of the differences or similarities between pharmacist-initiated therapy scenarios and prescription driven clinical scenarios?

## APPENDIX I: An Example of MyDispense Scenario for Review by the Lecturer Participants

# ZCP311 MyDispense Clinical Scenarios

| | |
|---|---|
| TOPIC: | Hypothyroidism |
| TITLE: | Thyroid Case 1 |
| AUTHOR: | Monique Klitsie |

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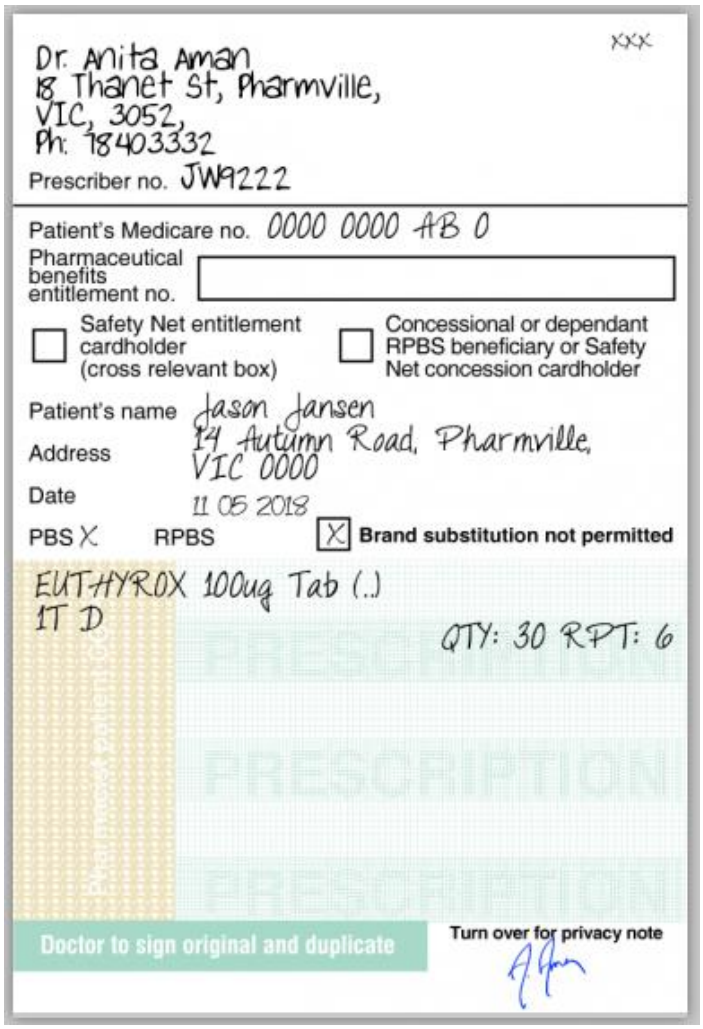
**Exercise Introduction:**

Dispense the prescription for Mr Jansen

**Patient's Introduction:**

Hi, can you please fill this prescription for me. The doctor did some tests and said I should start with this medicine.

**Patient's Prescription:**



**Patient's Attached Document:**

| MediHelp Centre | | |
|---|---|---|
| Dr Fiona Jones | Practice number: 47790 | 295 The Avenue Pharmville Tel: 78409555 |
| Dr Finn Johnson | | |
| Dr Roger Lamont | | |

PATIENT NAME: Mr Jason Jansen
PATIENT AGE: 37
PATIENT GENDER: Male

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## LABORATORY TEST RESULTS

| Test: | Result: | Norm: |
|---|---|---|
| BP | 128/79mmHg | >130/80mmHg to <140/90mmHg |
| TSH | 6.11 µIU/mL | 0.45 – 4.12 µIU/mL |
| T4 | 2.6 mcg/dL | 4.8 – 10.4 mcg/dL |
| Free T4 | 0.3 ng/dL | 0.8 - 1.4 ng/dL |

**Patient Fact Finding:**

| QUESTION: | ANSWER: |
|---|---|
| Age | 37 years old |
| Alcohol Consumption | I am a social drinker; I drink heavily during braais or when catching up with friends |
| Allergies | I am allergic to bee stings and I get hay fever |
| Breastfeeding | Are you joking? |
| Other Medication | I use antihistamine tablets for my hay fever |
| Pregnant | Seriously, are you kidding me? |
| Previous use of medicine | I have never used this medicine on the prescription before. |
| Purpose of medicine | The doctor said it will fix the tiredness and weakness I have been feeling lately |
| Smoking status | I have never smoked before. |
| Symptoms | I'm tired all the time, I feel weak, I get cold easily, my muscles cramp and as soon as I try to exercise, I feel out of breath. I also feel really down all the time. |
| Other symptoms | Just what I said above. |
| Aggravating/relieving factors | Nothing seems to help. |

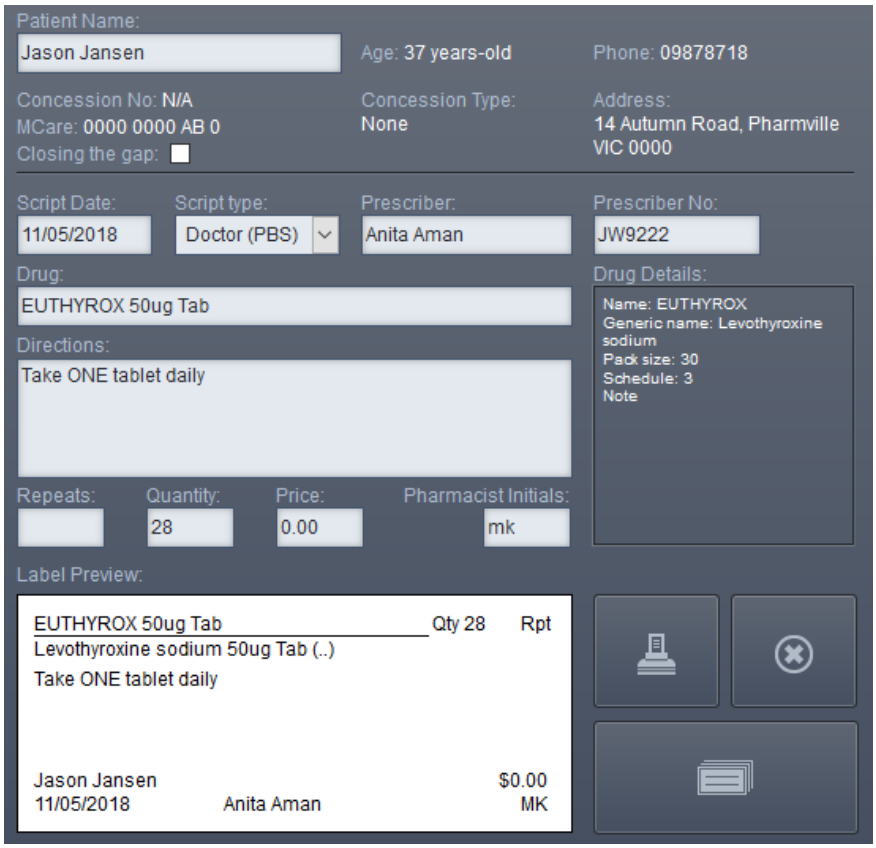
**Consulting the Doctor:**

| QUESTION | ANSWER |
|---|---|
| Doctor's Plan of action | I plan on letting the patient use the medicine for a while and then I will test their thyroid hormone levels again. |
| Dosing Query | I forgot that I needed to start the patient on lower levels of levothyroxine. Please start the patient on 50 micrograms for four weeks and tell them to come and see me to have their levels tested. |

**Loading of Medicine onto Computer System:**

EUTHYROX 100ug Tab
Replaced with: EUTHYROX 50ug Tab
No fields have been changed.

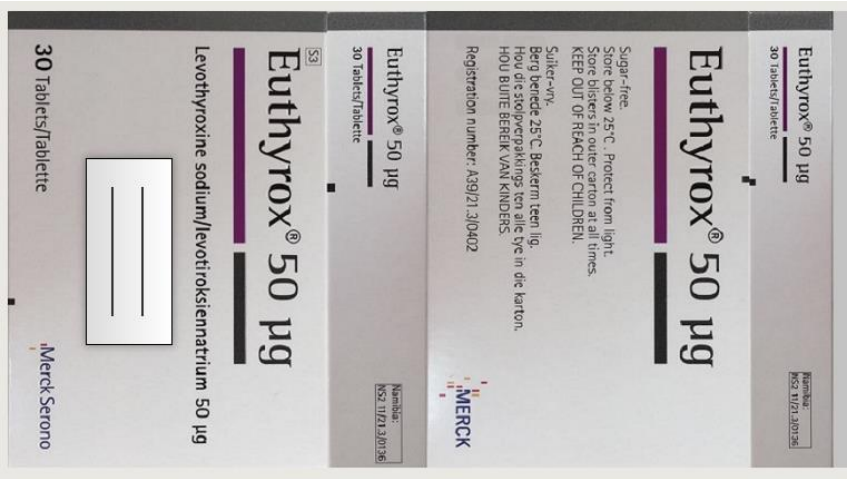
Student should be able to identify that Euthyrox® 50mcg should be dispensed instead of Euthyrox® 100mcg and that there should be no repeats for Euthyrox® 50mcg as the patient needs to see the doctor after four weeks, as requested.



**Professional Note-taking:**

- [Date of dispense]: patient experiencing hypothyroidism
- Phoned Dr Aman – discuss patient initiated on Euthyrox® 50mcg and not Euthyrox® 100mcg
- Dr Aman confirmed – patient to see Dr after 4 weeks of therapy - Rx with 50mcg to be sent in next 7 days
- Dispensed Euthyrox® 50mcg with NO REPEATS – Patient to see Dr first

**Selection and Label Placement:**




**Patient Counselling:**

-Patient should take Euthyrox® 50mcg once daily.

-Patient must notify you as the pharmacist or the doctor if he experiences any side-effects which bother him.

-The patient may experience a raised heart rate, feelings of anxiety and flushing, but these should go away as the body adapts. If they do not go away within four weeks the patient should consult you as the pharmacist, or the doctor.

-Patient must be encouraged to adhere to a healthy lifestyle:

- limit drinking as far as possible

- eat healthily, eat regular meals, regular exercise

-The patient must take the medication as directed for four weeks, then return to the doctor to have their thyroid hormone levels tested.

**Patient is handed their medicine.**

## APPENDIX J: An Illustration of the Navigation Through a MyDispense Scenario

# Introduction to the Exercise

1

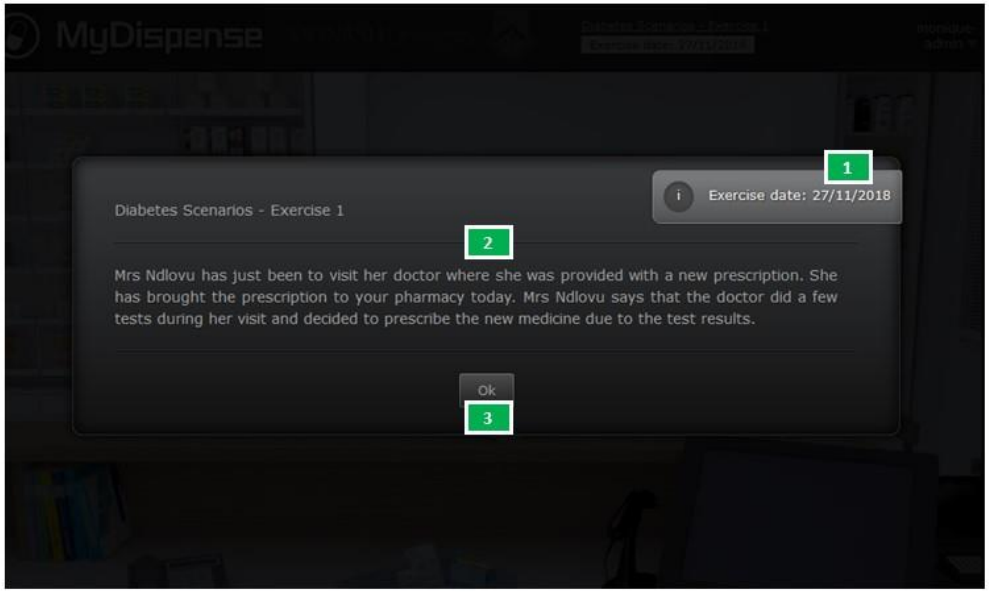
**Key:**

1 - Date Accessed
2 - Exercise Introduction
3 - "OK" icon

**Dispensing Phase:** ONE

**Descriptions:**

- [1] The date upon which the student accessed the exercise.
- [2] The introduction the student needs to read before attempting the exercise.
- [3] The button to be pressed to proceed to the exercise.



# MyDispense Dispensary



**Key:**

1 - Prescription
2 - Pharmacy Computer
3 - Medicine Holding Basket
4 - Telephone
5 - Patient
6 - Information Resource Icon
7 - Professional Note-taking Icon
8 - Label and Medicine Count
9 - Pharmacy Medicine Storeroom
10 - Exercise Date and Exercise Title
11 - Username

**Description:**

- Icons at the bottom of the image duplicate the option of selecting and opening an item (for example, the prescription)
- [6] – Resources – not in-use
- [7] – A professional note-taking page appears on screen when selected
- [9] – Also illustrated on slide 13

# Prescription



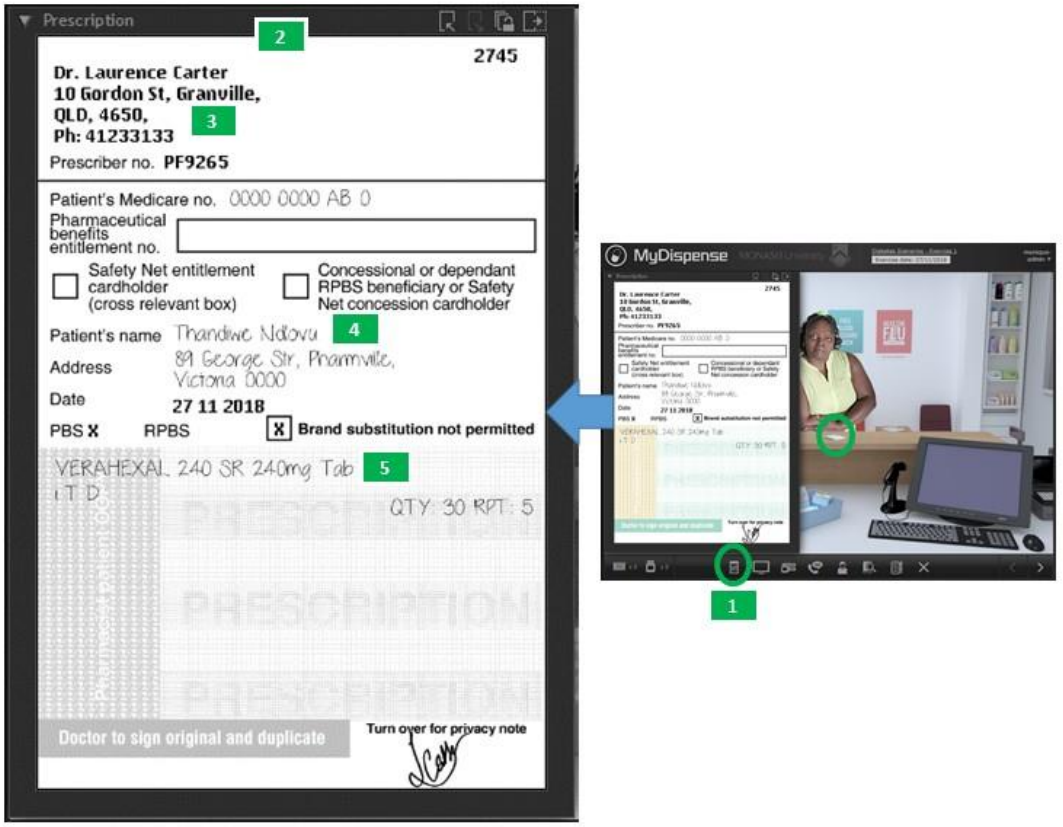
**Key:**

1 - Prescription Icon
2 - Prescription
3 - Prescriber's Details
4 - Patient's Details
5 - Medicine Prescribed

**Dispensing Phase:** ONE

**Description:**

- By selecting the prescription icon [1], the prescription [2] will appear into view.



# Attachment



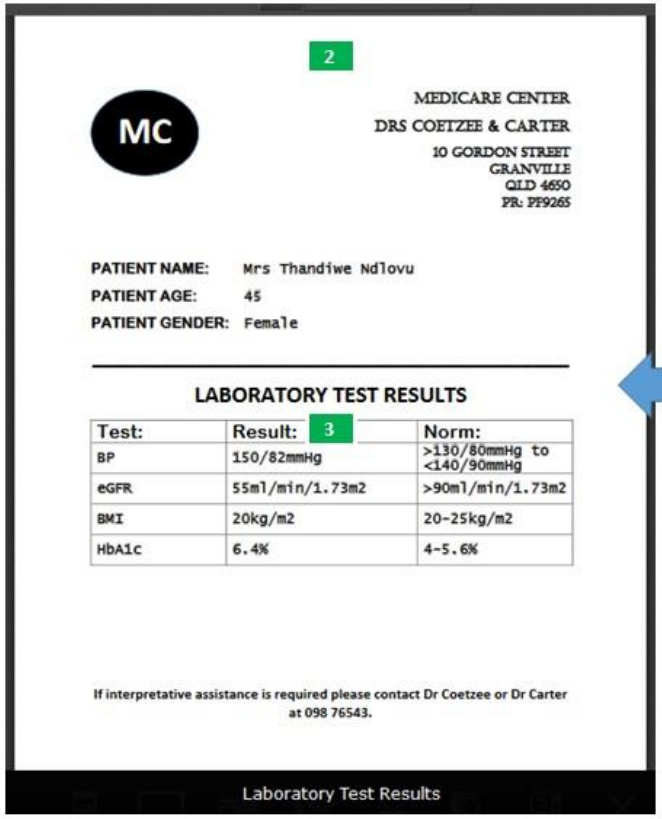
**Key:**

1 - Attachment icon
2 - Opened Attachment
3 - Laboratory Test Results

**Dispensing Phase:** ONE

**Description:**

- By selecting the attachment icon [1], the attachment [2] will appear into view.




# Dispensary Computer



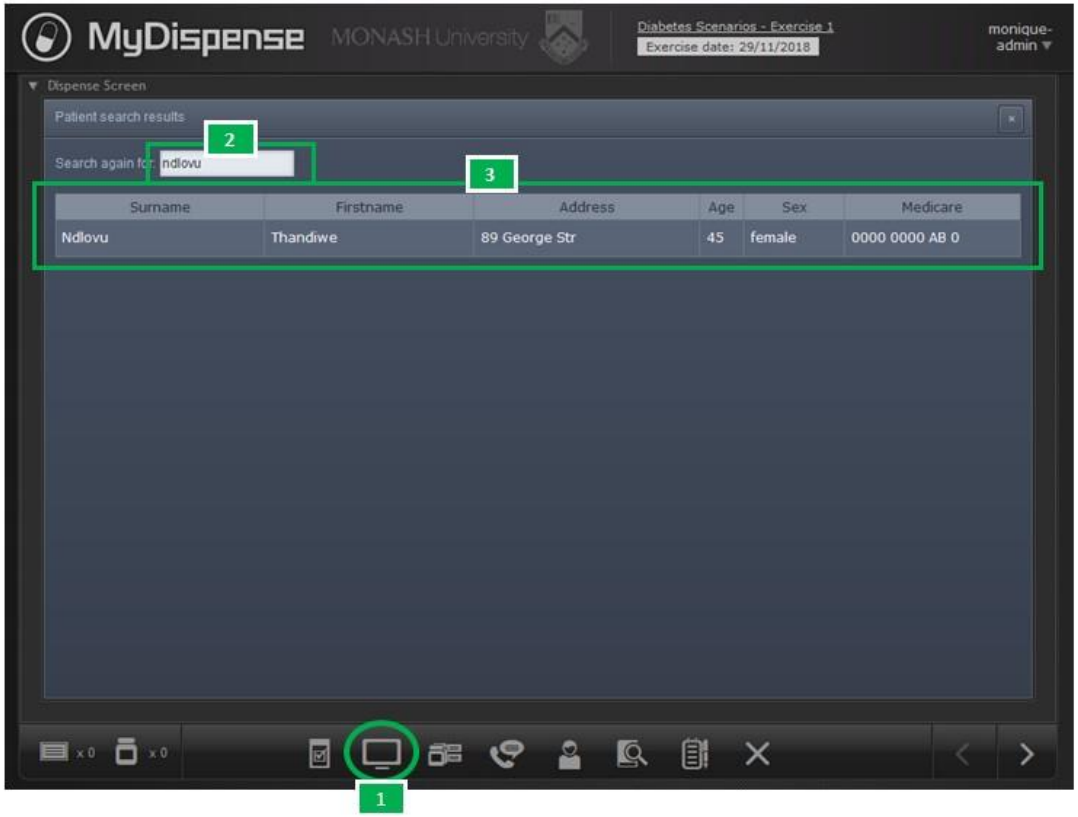
**Key:**

1 - Computer Icon
2 - Patient Profile Search
3 - Patient Profile List

**Dispensing Phase:** ONE

**Description:**

- By selecting the dispensary computer icon [1], the computer screen will appear into view.
- The patient's surname is used to search for the patient's profile [2].
- A list of patient profiles will appear to be selected from.



# Patient's Medicine History



**Key:**

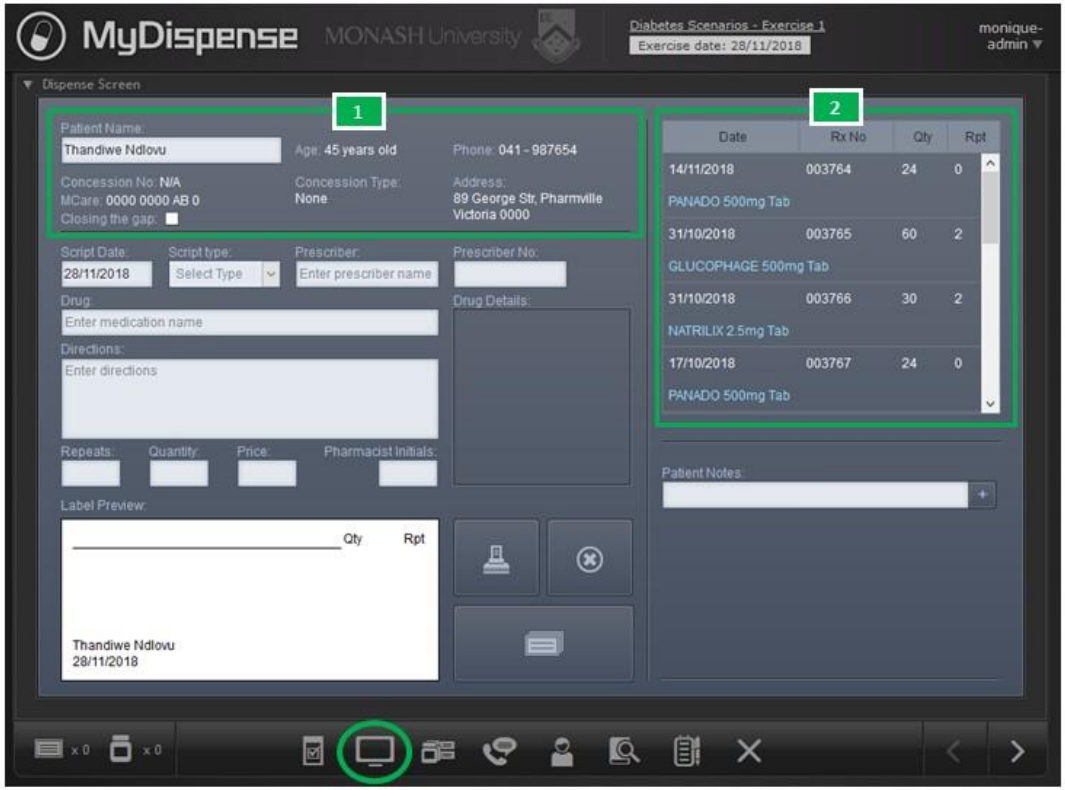
1 - Patient's Details

2 - Patient's Medicine History

**Dispensing Phase:** ONE

**Description:**

- [1] – Patient's details which were previously loaded onto the dispensary computer
- [2] – Medicine history of the patient with the following information:
  - Name of medicine, strength, dosage form
  - Date dispensed
  - Quantity dispensed
  - Number of repeats remaining
- If one of the medicine histories is selected, the label will appear with the directions for use and prescriber of the medicine
- Scroll down option on the right allows user to scroll through all past medicine history



# Patient Fact Finding



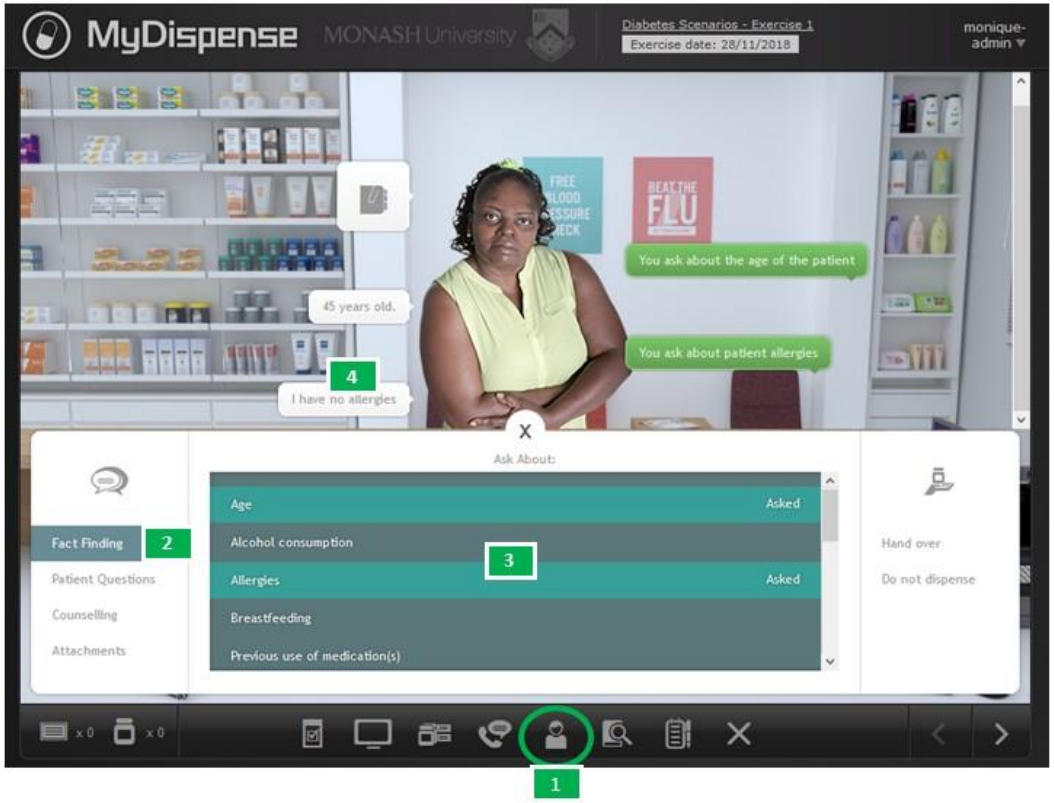
**Key:**

1 - Patient Icon
2 - Patient Fact Finding Questions
3 - List of Questions
4 - Patient's Answers

**Dispensing Phase:** ONE

**Description:**

- By selecting the patient icon [1], the patient menu will appear into view. Fact Finding is selected [2].
- A list of questions [3] which the patient could be asked is presented (scroll down option for the full list of questions).
- The question appears on the right-hand side of the patient and the answer appears on the left-hand side of the patient [4].
- There is no limitation on number of questions allowed to be asked.



# Patient Questions



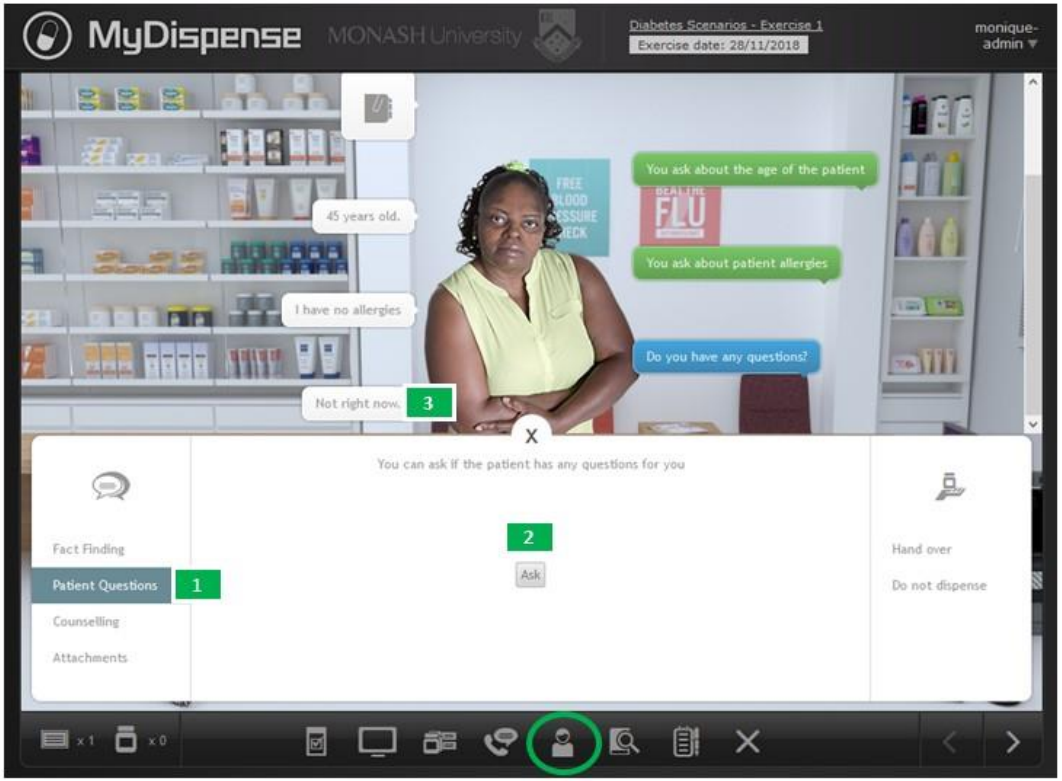
**Key:**

1 - Patient's Questions
2 - "Ask" Icon
3 - Patient's Answers

**Dispensing Phase:** ONE and THREE

**Description:**

- By clicking the "Ask" icon, the student can check if the patient has any questions for them.
- The patient's reply, whether it is a question or response, will appear on the left-hand side of the patient [3].
- If the patient has a question, the student will have the opportunity to respond in a text block which appears at no.[2].



# Professional Notes



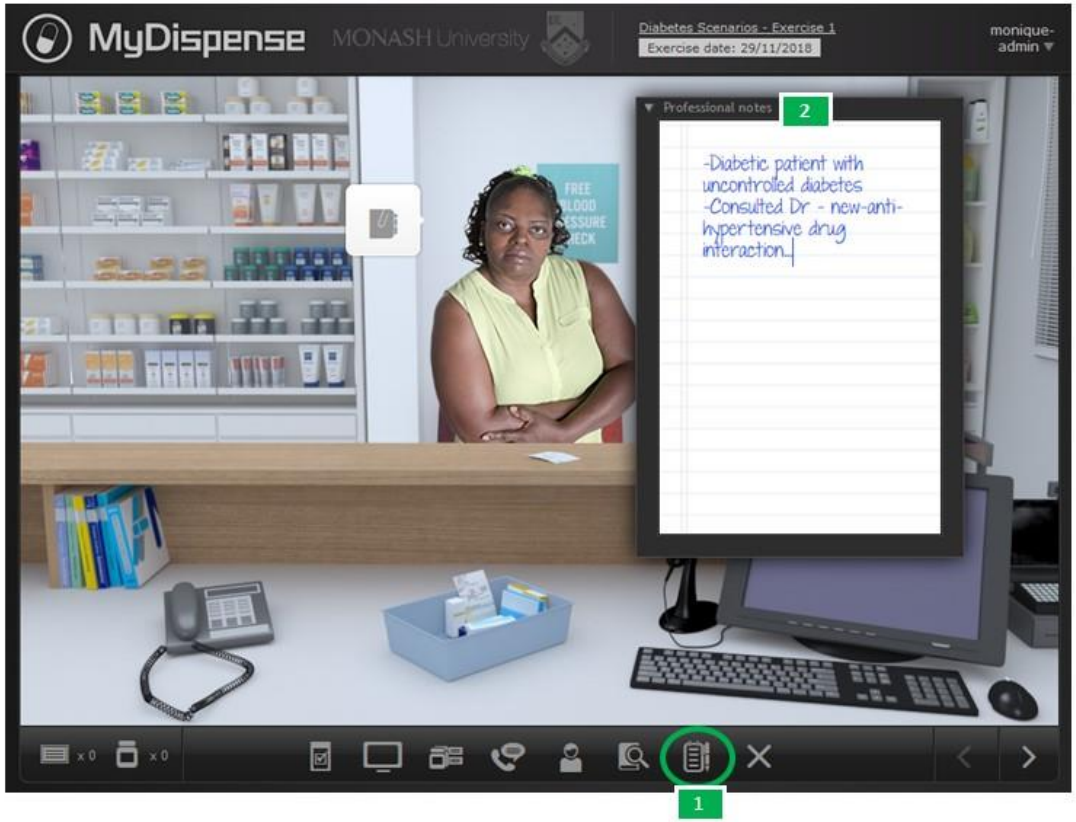
**Key:**

1 - Professional Note-taking Icon
2 - Professional Note-taking pad

**Dispensing Phase:** ONE or THREE

**Description:**

- By selecting the professional note-taking icon [1], the professional note-taking pad [2] will appear.
- Professional notes concerning the exercise are documented.



# Consulting the Prescriber



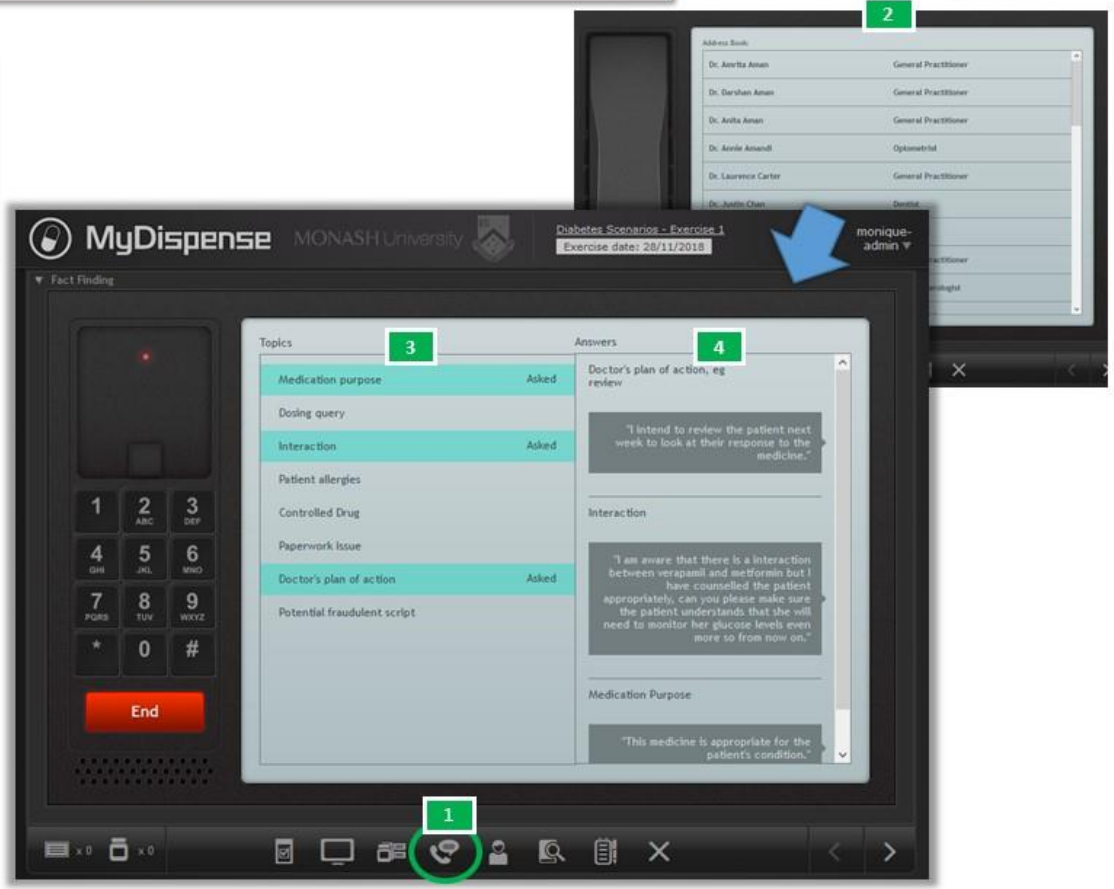
**Key:**

1 - Telephone Icon
2 - List of Contactable Prescribers
3 - Pharmacist's Questions to the Prescriber
4 - Prescriber's Responses

**Dispensing Phase:** ONE

**Description:**

- By selecting the telephone icon [1], the list of contactable prescribers [2] appears into view.
- After the student selects the question to be asked of the prescriber on the left [3], the prescriber's response appears on the right [4].



# Entering Prescription Details



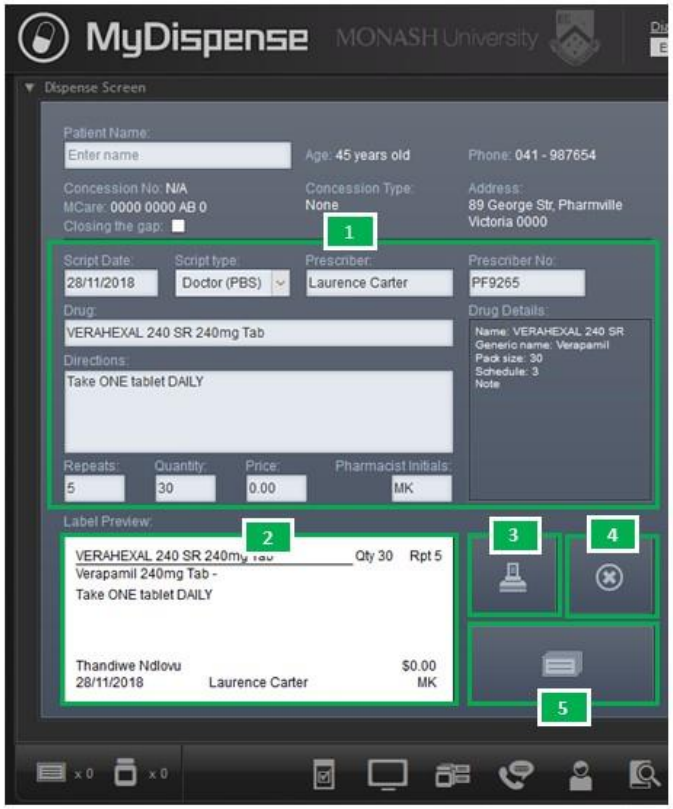
**Key:**

1 - Prescription Information
2 - Label Preview
3 - Print Label Icon
4 - Clear Screen Icon
5 - Label Manager Icon

**Dispensing Phase:** ONE

**Description:**

- Information of the prescription is entered into the various required fields [1].
- Relevant information appears on the label preview [2].
- The print label button [3] is selected to print the label.
- To dispense another prescription, the clear screen icon [4] is selected.
- To open the label manager, the label manager icon is selected [5].



# Label Management



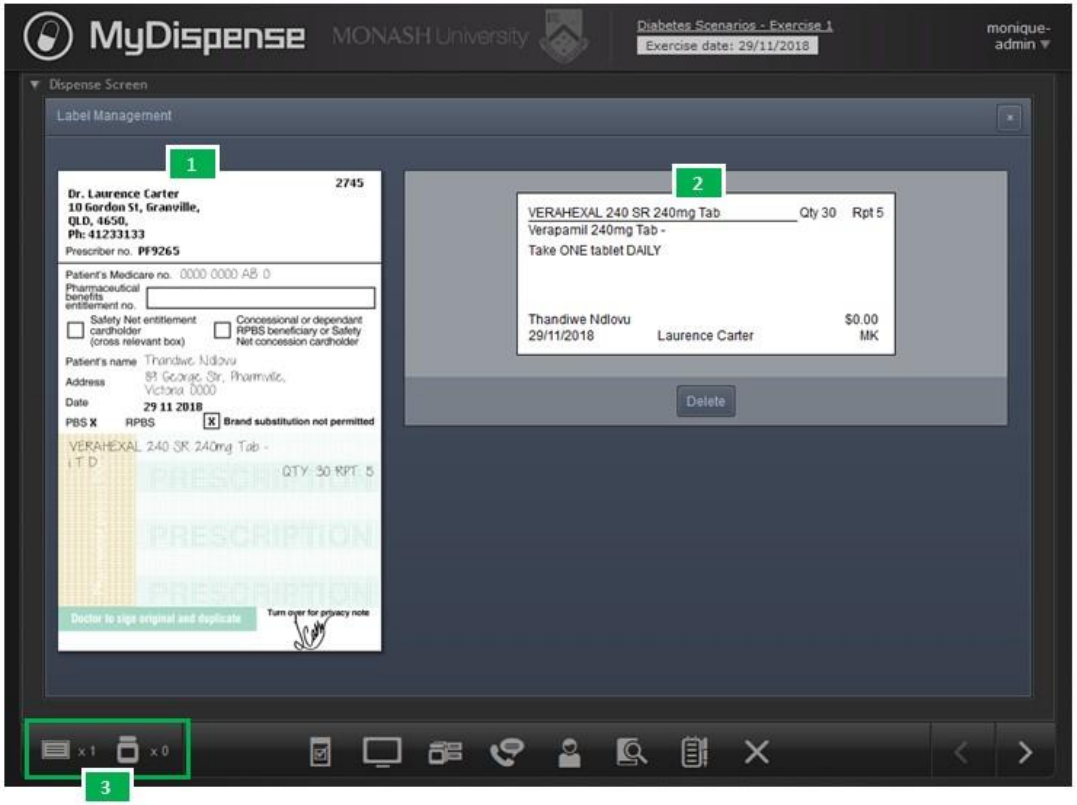
**Key:**

1 - Prescription
2 - Label
3 - Label and Medicine Count

**Dispensing Phase:** TWO

**Description:**

- Once the label is printed, the label and medicine count [3] will match the number of labels printed and medicines picked.
- The information on the label [2] is compared to the prescription information [1] for accuracy.
- If there are multiple items on a prescription, the student is asked to confirm which label has been printed for which item on the prescription.



# Pharmacy Medicine Storeroom



**Key:**

1 - Shelves
2 - Fridge
3 - Return to Dispensary

**Dispensing Phase:** TWO

**Description:**

- Students are navigated to this screen when they select the side-arrow [9] on slide 2.
- By selecting the shelves [1], the medicine stored on the shelves will appear.
- By selecting the fridge [2], the medicine stored in the fridge will appear.

# Medicine Selection



**Key:**

1 - Shelf Icon
2 - Alphabetical Arrangement
3 - Medicine Available for Selection

**Dispensing Phase:** TWO

**Description:**

- By selecting the shelf or the shelf icon [1], the presented image will appear.
- By selecting the first letter of the medicine "V" in the alphabet list [2], the medicine corresponding to the letter selected will appear.
- By selecting the correct medicine on the shelf [3], the medicine will be selected (see the next slide).

# Medicine Selection



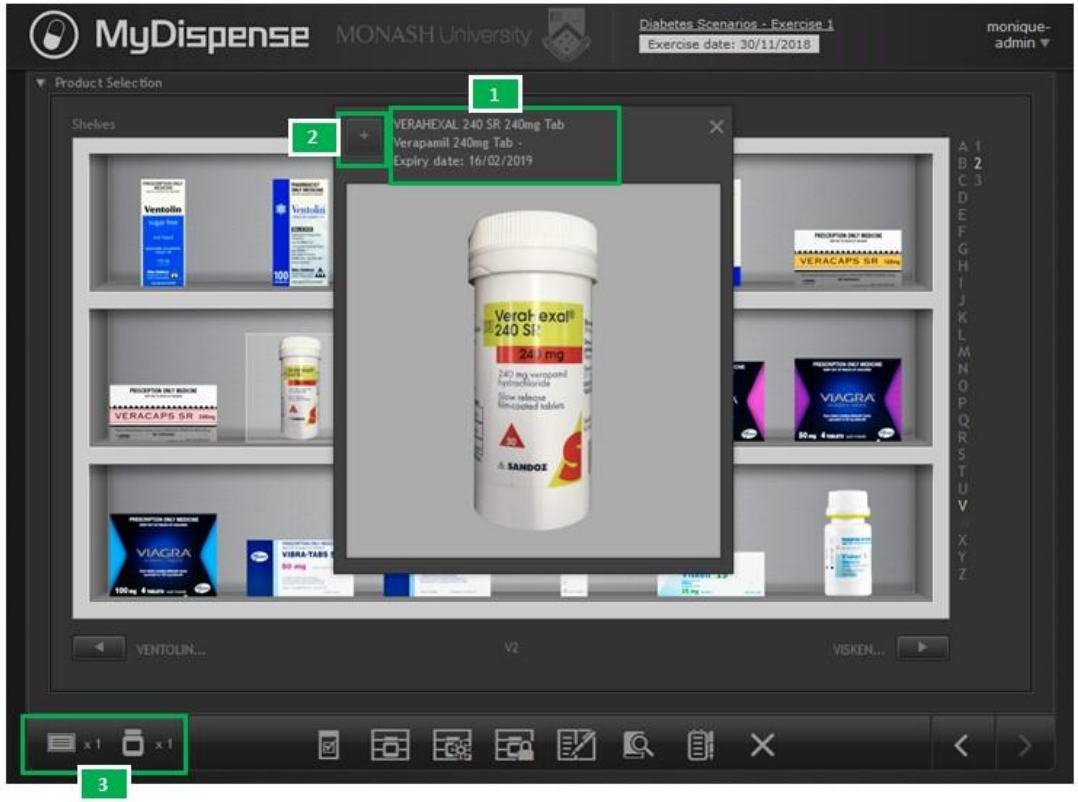
**Key:**

1 - Medicine Description
2 - Add Button
3 - Label and Medicine Count

**Dispensing Phase:** TWO

**Description:**

- By selecting the medicine off the shelf (see previous slide), the user can view the medicine descriptions [1].
- The medicine can be selected for dispensing by selecting the add button [2].
- Once the medicine is added, the label and medicine count will be updated [3].



# Medicine Preparation



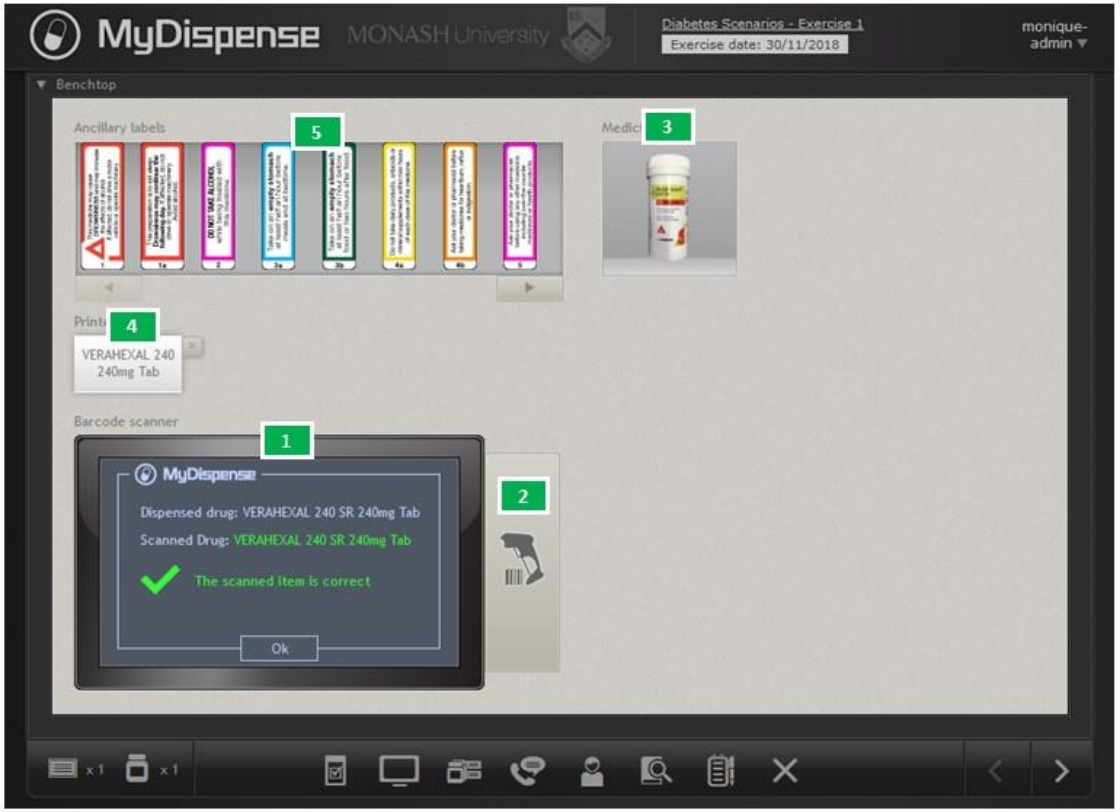
**Key:**

1 - Scanner Screen
2 - Scanner
3 - Medicine Selected
4 - Printed Label
5 - Ancillary Labels

**Dispensing Phase:** TWO

**Description:**

- The medicines loaded from the prescription should appear on the scanner screen [1] and are selected to verify the medicine selected off the shelf.
- The scanner button is pressed to "pick" up the scanner [2].
- The scanner is dragged and dropped on the medicine selected [3] to actively "scan" the medicine.
- The scanner screen [1] verifies the correct/incorrect selection of the medicine.
- The printed label [4] is also dragged and dropped on the medicine selected [3].
- The ancillary labels [5] were not used in the study



# Label Placement



**Key:**

1 - Label Placement Image
2 - Label
3 - Options for the Label
4 - Stick Label

**Dispensing Phase:** TWO

**Description:**

- The medicine selected is laid out as an image [1].
- The label [2] can be dragged to where the student decides to place it.
- The label can be halved in size, made smaller into a quarter of its size or rotated [3].
- Once the label is placed, the stick label [4] can be pressed to apply the label.

# Counselling



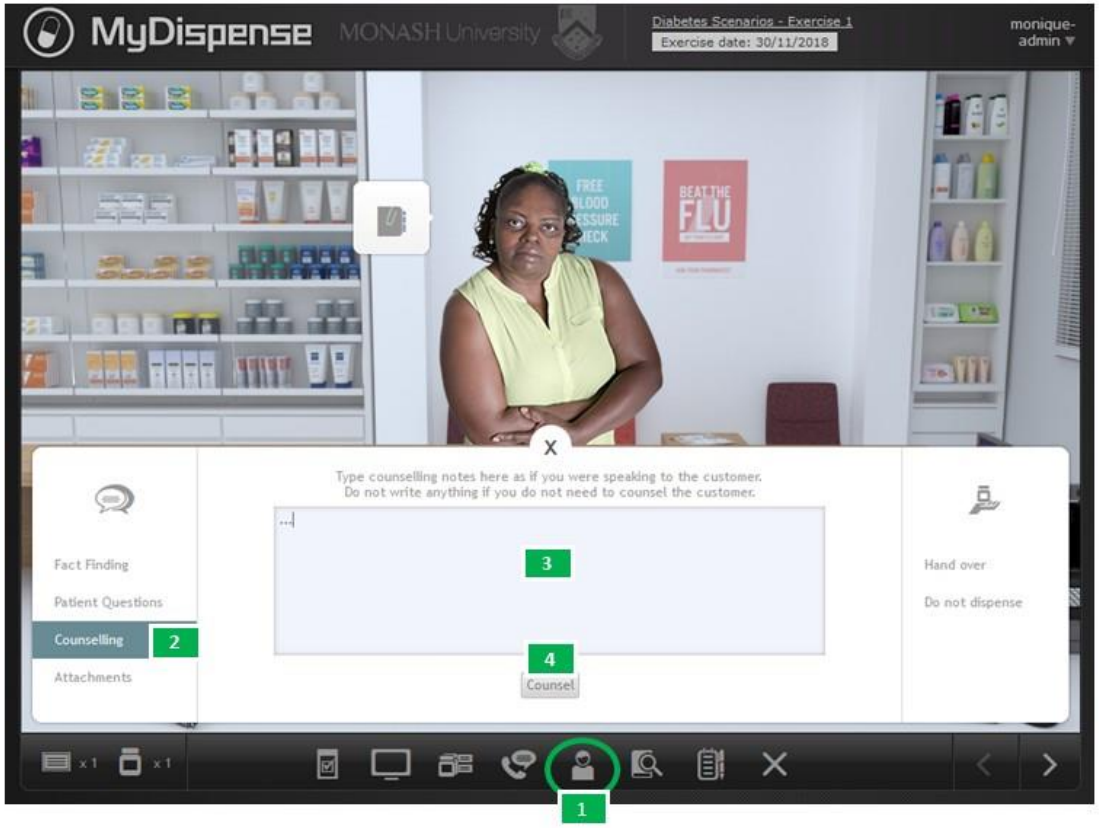
**Key:**

1 - Patient Icon
2 - Counselling Option
3 - Counselling Text Block
4 - Counsel Submit Button

**Dispensing Phase:** THREE

**Description:**

- By selecting the patient icon [1], the patient menu will appear.
- By selecting the counselling option [2], the counselling text block will appear [3].
- Once the counselling paragraph has been entered [3], the "counsel" button [4] can be pressed to submit the counselling.



# Handing Over



**Key:**

1 - Dispensed Medicine
2 - Hand Over Option
3 - Finish Submit Button

**Dispensing Phase:** THREE

**Description:**

- To give the patient the medicine, the "hand over" option [1] must be selected.
- The medicine prepared for the patient will appear on the screen [2] for the student to recheck.
- After checking, the student can press the "finish" button to submit the scenario for feedback.