

**Assessment of Medication Knowledge of Community-Based Licensed Practical
Nurses Based on an Educational Session Using Kolb's (1981)
Experiential Learning Model**

by

Janet A. Sinclair

A thesis presented to the
Faculty of Graduate Studies, University of Manitoba
in partial fulfillment of the requirements for the degree of
Master of Education
in
Educational Administration and Foundations

April 18, 2001



National Library
of Canada

Acquisitions and
Bibliographic Services

395 Wellington Street
Ottawa ON K1A 0N4
Canada

Bibliothèque nationale
du Canada

Acquisitions et
services bibliographiques

395, rue Wellington
Ottawa ON K1A 0N4
Canada

Your file Votre référence

Our file Notre référence

The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

L'auteur conserve la propriété du droit d'auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

0-612-80029-6

Canada

**THE UNIVERSITY OF MANITOBA
FACULTY OF GRADUATE STUDIES

COPYRIGHT PERMISSION**

**ASSESSMENT OF MEDICATION KNOWLEDGE OF COMMUNITY-BASED LICENSED
PRACTICAL NURSES BASED ON AN EDUCATIONAL SESSION USING KOLB'S (1981)
EXPERIENTIAL LEARNING MODEL**

BY

JANET A. SINCLAIR

**A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University of
Manitoba in partial fulfillment of the requirement of the degree
of
MASTER OF EDUCATION**

JANET A. SINCLAIR © 2001

Permission has been granted to the Library of the University of Manitoba to lend or sell copies of this thesis/practicum, to the National Library of Canada to microfilm this thesis and to lend or sell copies of the film, and to University Microfilms Inc. to publish an abstract of this thesis/practicum.

This reproduction or copy of this thesis has been made available by authority of the copyright owner solely for the purpose of private study and research, and may only be reproduced and copied as permitted by copyright laws or with express written authorization from the copyright owner.

ABSTRACT

The purpose of this study is to assess the medication administration knowledge of community-based Licensed Practical Nurses (LPNs) employed by a regional health authority. This study was conducted because an increase in the submission of medication error reports by the LPNs was noted to occur from 1997 to 1998. This researcher, with consent from the supervisor of the nursing unit, examined these reports and found that 14 separate medication errors were reported for 1997, and 43 separate medication errors were reported for 1998. The reason for the increase in reporting of the errors is not known. To address this issue, this researcher developed a medication administration review module (see Appendix A), which was later presented to the LPNs in an educational session. The knowledge level of the LPNs regarding medication administration was to be measured both before and after they attended the session. The variable of knowledge was selected for this study because the literature indicates that this is one factor that is associated with the making of medication errors.

The medication review module was based on a review of the literature. Several studies found in the literature indicate that there are many factors associated with the making of medication errors. Various strategies have been employed to reduce the incidence of medication errors. Since not all the strategies can be realistically applied to community based LPNs, only one strategy, an educational strategy, was selected for the purpose of this study. To implement this strategy, an educational session on medication administration was designed using the Experiential Learning Model (Kolb, 1981).

A quasi-experimental one-group pre-test and post-test design (Campbell & Stanley, 1966) was used for this study. The sample consisted of 19 community-based LPNs

employed by a regional health authority in the province of Manitoba who consented to participate in the study. Once consent was obtained from the participants, two separate dates were established for presenting the medication administration review module. Part 1 of the module was presented in the first half of each session, and Part 2 was presented in the second half of each session. Some of the limitations in this study include small sample size, voluntary participation, and testing effects.

The main finding obtained from the data collection for this study was that the overall scores of the participants for both the pre-test and the post-test increased by 9.6% from the writing of the pre-test to the writing of the post-test. Results of each of the sub-tests contained in both the pre-test and the post-test, which reflected specific areas of medication administration, indicated that the subjects' scores were lowest in the areas of the transcription of physician orders, and calculations of medication dosages.

It is difficult to generalize the results of this study to the community based LPN population because the sample size was small, and no random assignment was included in its design. Testing effects are also another factor to consider when interpreting the post-test scores. Based on the results that were obtained from this study, however, it is obvious that the knowledge level of LPNs in regard to medication administration is not as high as it could be. It is therefore recommended that future educational sessions in the area of medication administration be conducted for this group of nurses. It is also recommended that this study be replicated using a larger sample, and a Solomon Four Group design.

ACKNOWLEDGEMENTS

I would like to thank Ms. Louise Friesen, supervisor of the nursing unit of the Winnipeg Regional Health Authority, and Ms. Sue MacKenzie, Director of Planning and Special Projects of the Winnipeg Regional Health Authority, for their permission in allowing me to conduct this study. I would also like to thank all the supervisors of the LPNs in the nursing unit who assisted me with the scheduling of the educational sessions and assistance in encouraging their LPNs to participate in this study. This study could also not have been conducted without the participation of the 19 LPNs who consented to be involved in the study; these LPNs are also thanked by this researcher. And finally, I owe much thanks to my advisory committee, Dr. Rodney Clifton, Dr. Lynn Taylor, and Dr. Lynn Scruby who guided me throughout this entire process. I thank them for their time, understanding of my concerns, and patience involved in my writing of the thesis for this study. This has been, without a doubt, my most memorable and challenging experience as a student in the Master of Education program at the University of Manitoba.

LIST OF FIGURES

Figure	Page
1. The Experiential Learning Model	29
2. Instructional Activities for Different Aspects of the Learning Cycle	32

LIST OF TABLES

TABLE	Page
1. Summary of Individual and Systemic Factors that Contribute to Medication Errors	19
2. Participant Scores – Overview	54
3. Scores for Part 1 of Pre-test and Post-test	56
4. Scores for Part 2 of Pre-test and Post-test	57
5. Sub-test – Steps of Medication Administration	61
6. Specific Responses – Three Checks Identification Sub-test	64
7. Sub-test – Five Rights	67
8. Specific Responses – Identification of the Five Rights Sub-test	70
9. Sub-test – Transcription of Physician’s Orders	72
10. Sub-test – Medication Calculations	76
11. Specific Responses – Medication Calculations Sub-test	79
12. Sub-test – Glyburide/Glucophage/Insulin	82
13. Specific Responses - Glyburide/Glucophage/Insulin	85
14. Sub-test – Steps of Insulin Administration	87
15. Specific Responses – Three Steps of Actual Insulin Administration Sub-test	90

TABLE OF CONTENTS

	Page
ABSTRACT	ii
ACKNOWLEDGEMENTS	iv
LIST OF FIGURES	v
LIST OF TABLES	vi
CHAPTER	
1. INTRODUCTION	1
Licensed Practical Nurses (LPNs) as Community-Based Nurses	3
Five Rights of Medication Administration	4
Purpose of the Study	7
Operational Definitions	7
Overview of the Study	8
2. LITERATURE REVIEW	
Medication Errors	11
Factors Associated with Medication Errors	14
Educational Strategies	24
Effectiveness of Strategies	27
Experiential Learning Model	28

CHAPTER	Page
3. METHOD	35
Medication Administration Review Module	35
Pre-test and Post-test Questions	37
Ethical Considerations	42
Design of Study	44
Session Format	48
4. RESULTS	51
Overview of Scores	51
Pre-test and Post-test Scores: Part 1 and Part 2	55
Sub-test Scores – Part 1	61
Sub-test Scores – Part 2	82
5. CONCLUSION	92
Summary	92
Discussion	96
Recommendations	104
REFERENCES	111

APPENDIX A	Medication Review Module	118
APPENDIX B	Letter of Support	152
APPENDIX C	Pre-tests/Post-tests	153
APPENDIX D	Participant Consent Letter	158

CHAPTER 1

INTRODUCTION

Unlike previous years, the 1999-2000 provincial budget for Manitoba, announced on April 29, 1999 (Manitoba Government, 1999), provided a much-needed boost to the province's ailing health care system. After several years of fiscal restraint on part of both the provincial and federal governments, Manitoba Finance Minister, Harold Gilleshammer, announced that health care would receive a 10 % increase in funding over the next year. Already comprising 35 % of provincial expenditures (Manitoba Health, 1999), funds allocated for health care would now increase from \$1.9 billion to \$2.1 billion (Manitoba Government, 1999, p. 1).

Part of the reason why the Province was able to increase funding to the health care system is because it received a one-time injection of \$131 million in the form of a transfer payment from the federal government (Manitoba Government, 1999). This supplement was to be used in any way the province saw fit over a period of three years (Government of Canada, 1999). Although Gilleshammer acknowledges that the federal government is replacing some of the money it withheld from the province in the form of transfer payments, he stated it still left Manitoba with a loss of \$347 million for health care since 1994 (Manitoba Government, 1999). The federal government is, however, trying to rectify this situation and has committed to increasing health care funding to the provinces and territories by \$11.5 billion over the next five years (Government of Canada, 1999, p. 8).

The main benefactor of health care dollars has traditionally been hospitals. In the 1999-2000 provincial budget for Manitoba, however, the Home Care program also

benefited from increased funding. In this program, people are cared for in their own homes by members of a community health care team. The amount of money allocated to this program constitutes a 16% increase, or \$20.5 million (Manitoba Government, 1999). This is significant because reduced funding to the health care system in both the United States and Canada has led to shorter hospital stays for clients (Atack & Kenny, 1998; Murray, 1998). As a result, clients are now being sent home to convalesce while receiving care from nurses, health care aides, and other members of the health care team who provide care in client's homes.

One effect of sending more people home from hospital to convalesce sooner than they would have several years ago is that there is a greater need for community-based care providers. The need for these providers will increase even more as the population ages. For instance, there are currently at least 3.6 million people in Canada who are over the age of 65 (Hollander Analytical Services, 2000, p. 3). This number will increase by the year 2016, when it is predicted that there will be at least 5.9 million Canadians over the age of 70. Since the aging process and years of wear and tear on the body predisposes individuals to chronic illnesses such as arthritis, and heart and lung conditions, it can be expected that, if the prediction of our future population demographics is correct, more people will require medical and at-home assistance in the future. Some people will be able to depend upon their significant others for assistance; others, however, will require help from the Home Care program.

Home Care will even be a more significant care option in the future because it currently costs an average of \$5,413 per person per year to provide minimal Home Care services to people in Canada (Picard, 2000, p. 3), whereas it costs an average of \$12,504

per person per year if they are in an institution. When the cost of providing care at home and the shortage of health care dollars is taken into consideration, the increased funding to the Home Care program by the Manitoba government to provide for more community-based care providers seems more than justified.

Licensed Practical Nurses (LPNs) as Community-Based Nurses

Licensed practical nurses are one component of the community health care team. Unlike registered nurses (RNs), who possess a minimum of two years of nurses' training, LPNs only require 14 months of training in order to practice as nurses (Assiniboine Community College, 1999). These nurses work under the supervision of RNs (Manitoba Association of Licensed Practical Nurses, 1998) and, depending upon where they work, are limited to the types of tasks they can perform. For instance, LPNs employed in a hospital setting can insert catheters and give intramuscular injections (injections of medication into muscle), whereas LPNs employed in the community are not permitted to perform these tasks. In view of the current nursing shortage and increased number of skills the practical nursing students are currently learning, however, it is possible that community-based LPNs may be required to do these tasks in the future.

One of the tasks community-based LPNs often perform is that of administering medications. The majority of medications LPNs administer consist of pills, liquids, eye/ear drops, and subcutaneous injections (injection of medication such as insulin into subcutaneous tissue). Medications that LPNs do not administer include those of intramuscular or intravenous injections.

Five Rights of Medication Administration

One of the most important factors for LPNs to consider when they are administering medications to their clients is that they follow the “five rights” guidelines. These rights consist of administering the *right dose* of the *right medication* to the *right client* by the *right route* at the *right time* (Nursing81, 1981, p. 12). A violation of any of these five rights constitutes a medication error. The significance of the error depends upon which one of the five rights is violated. For instance, in a situation involving a registered nurse, a medication known as Digoxin, which regulates the heart beat, was administered by the wrong route and, as a result, the baby who received it, died (Andreoli, 2000). The reason this medication was administered by the *wrong route* is because the nurse, who was the Assistant Director of Nursing Services in a hospital in Arkansas at the time, did not clarify the route by which the medication was to be administered. This happened in spite of the fact that she knew the medication order was not clear when she read it, and instead of going to the physician who wrote the order, she tried to clarify it by consulting with a student nurse and two other physicians, who all told her to give the medication as it was ordered.

In another situation, a registered nurse who was very busy on medical-surgical unit in a large hospital in the United States inadvertently gave the wrong medication to two different patients on the unit (Ahmed & Fecik, 1999). What happened in this instance was that the nurse mixed up two intravenous antibiotics and each patient received the other’s medication. It was fortunate that there were no allergic reactions on part of either patient; however, the danger of administering the *wrong medication* to the *wrong patient* is certainly a factor to consider when performing the task of medication administration.

Medication administration at the *wrong time* can also pose danger to patients. For instance, in a hospital in Illinois, a nurse gave a post-heart surgery patient Phenobarb, which is a drug used to control seizures, three hours after he had had a seizure (Calfee, 1997). The outcome of this action was that the patient died because he did not receive the medication after he had had the first seizure and, as a result, he incurred several more seizures that could not be stopped because he did not have the medication he needed until much later. The nurse, in this case, had misinterpreted the physician's order for the client. Thus, not only was administering medications at the correct time important in this situation, but clarifying the physician's order was also of importance.

Although the foregoing situations do not involve community-based LPNs, they have implications for the nurses because they could encounter similar situations. For example, insulin is a medication used to control blood sugar levels in clients who have diabetes. If a LPN administered too much, or too little, insulin (*wrong dose*) to a client who has diabetes, the client could become comatose. In fact, the potential consequences of this medication error could be life-threatening. Had the LPN administered the correct dose of this medication, which is one of the "five rights", this medication error would not have occurred. Once discovering that a medication error has been made, however, the LPN is not only required to verbally report the error and monitor the client, but he or she is also required to complete an incident report indicating that a medication error has been made.

Medication error incident reports submitted by community-based LPNs employed by a health authority in the Province of Manitoba, in the Manitoba Home Care program, were reviewed and analyzed by this researcher over two years, 1997 and 1998. Results indicated that 14 separate medication errors were reported in 1997, and 43 were reported

in 1998. Out of the 43 incidents reported in 1998, 15 medication errors involved administering the incorrect dose of medication. These errors resulted from LPNs administering the incorrect dose either in person, or via a medication set-up, which is where the nurses set out medications in a dosette (pill container) for a specified number of days. Another 15 incidents were attributed to omission of medications in the form of missed visits, neglecting to include all the prescribed medications in the client's dosette, or neglecting to perform a medication set-up while visiting the client. The remainder of the incidents were due to LPNs not following the physicians' orders correctly, dispensing medications when they were discontinued, and administering the wrong medication. Data determining types of medication errors made by the LPNs during 1997 were not reviewed by the researcher because there was no documentation on the type of errors that were made.

When one considers that there are 26 LPNs working each day of the week, with the number of client visits per LPN ranging from 7 to 46 per day, the reported frequencies of medication errors is relatively low. It is notable, however, that the number of medication error incidents almost tripled from 1997 to 1998. Part of the reason for this could be due to better documentation by the LPNs and/or by their supervisors, or it could result from the fact that the number of clients served by the LPNs increased substantially from 1997 to 1998. As well, since the reporting of most medication errors is dependent upon self-disclosure, it is possible that the LPNs were more attentive to their errors in 1998 than in 1997.

Purpose of the Study

To address the issue of medication errors being made in the community, a medication review module for LPNs was developed by this writer in collaboration with the Nursing Unit of the health authority. This module was presented to the LPNs in two parts during one educational session. The outcome assessed as a result of the LPNs attending this educational session was the knowledge level of the LPNs in relation to medication administration. A quasi-experimental one-group pre-test/post-test design (Campbell & Stanley, 1966; Polit & Hungler, 1991) with a retention post-test was developed to assess this outcome. Research questions to be answered as a result of this proposed study are:

1. What will the knowledge level of community-based LPNs be in regard to medication administration before attending two educational sessions on medication administration?
2. What will the knowledge level of community-based LPNs be in regard to medication administration after attending two educational sessions on medication administration?
3. How much knowledge about medication administration will be retained by the LPNs eight weeks after the second educational session ended?

Operational Definitions

Community-based Licensed Practical Nurses (LPNs): LPNs employed as nurses by a health authority in the Province of Manitoba, in the Manitoba Home Care program.

Medication error: Any violation of the five rights as well as omission of medication(s), and/or administering a medication to a client with an allergy to the medication(s), and/or administering medications not prescribed for the client.

Educational sessions: One, two and one-half hour instructional session consisting of the presentation of a medication review module developed by the writer. Group discussion,

material presented in lecture format with use of transparencies, and case study analysis was used.

Medication Review Module: An information package consisting of two parts. Part 1 consists of a definition of medication errors, five rights, three checks, factors associated with medication errors, and parts of a medication order. Part 2 consists of hypoglycemic agents, insulin administration, drawing up and mixing insulins, including a return-demonstration, and insulin storage. Each part of the module contains learning outcomes to be achieved at the end of the educational session.

Pre-test/post-test Part 1: Two separate, but identical, tests administered before, and immediately following, the presentation of the educational session. Each test consisted of: Steps of medication administration (ordering of steps) – 10 parts; List the five rights; Medical calculations – 5 questions; Transcribing physician's orders – 4 orders - **TOTAL** number of questions = 24. The questions pertained to Part 1 of the module presented in the educational session.

Pre-test/post-test Part 2: Two separate, but identical tests administered before, and immediately following, the presentation of the educational session. Each test consisted of: Oral hypoglycemic agents and insulin – 18 true/false questions; Steps of administering insulin – 11 steps **TOTAL** number of questions = 29. The questions pertained to Part 2 of the module presented in the educational session.

Overview of the Study

This thesis consists of five chapters. The first chapter introduced the background and the purpose of the study, which was to assess the knowledge level of LPNs in regard to medication administration both before and after they attended an educational session on

this topic. The background to the study was discussed in terms of how the need for Home Care has increased, and along with it, the need for more community health providers. The type of community health provider that is the basis for this study is the LPNs who work for Home Care. One of the tasks LPNs perform is to administer medications, and although infrequent, medication errors do occur. A brief discussion about medication error incident reports submitted by the LPNs, and what constitutes a medication error was then presented. How the study was to be conducted, along with the operational definitions to be used for it, was then discussed. The chapter concluded with an overview of this thesis.

Chapter 2 of this thesis consists of a review of the pertinent research literature used to develop and conduct this study. A brief definition of what constitutes medication errors is presented first, which is followed by a synopsis of studies that determine some of the factors related to medication errors. Several studies that relate to educational strategies used to reduce the risk of making medication errors are then presented. The educational strategy that is used as the design for the educational session in this study, which is Kolb's Experiential Learning Model (Kolb, 1981), is then discussed. Included in this discussion is an illustration of how the model can be applied to educational situations. Justification for the use of this model and a brief analysis of the studies reviewed for this study then concludes the chapter.

The third chapter describes how the study was conducted. The chapter begins with what was involved in obtaining support for this study, and the time commitment that would be required on part of the participants. Ethical considerations related to the participants are then reviewed. The sample, and design of the study, which is a quasi-

experimental one-group pre-test/post-test design, follows. Limitations related to the design of the study, including generalizability and volunteer bias, are then presented. The chapter concludes with a description of the format of the educational sessions, and how the data were to be analyzed.

The results obtained from the data collection for the study are presented in the fourth chapter. To begin the reporting of these results, an overview of all the scores obtained from the participants' writing of the pre-tests and post-tests are presented. All results are initially presented as original scores, which is then followed by their conversion to a percentage form. This is followed by the presentation of several tables of data that display the results obtained for each sub-test, or component, of the pre-tests and the post-tests. The questions in both the pre-tests and the post-tests are the same. Discussion related to the data that are displayed, as well as an examination of scores of specific participants is also included in this chapter.

The fifth, and last, chapter of this thesis includes a discussion of the implications of the results obtained in this study. Also included in this discussion is how the educational intervention, described in the second chapter, was designed to meet the participants' learning needs. Recommendations based on the results obtained from the data, which relate to future educational sessions in the area of medication administration, and using the learning model incorporated into this study, conclude the chapter.

CHAPTER II

LITERATURE REVIEW

As previously stated, the purpose of this study is to assess the level of medication administration knowledge of community-based LPNs both before and after they attended an educational session on this topic. A review of the literature related to this purpose was performed by the researcher and is presented in this chapter. This begins with a definition of what constitutes a medication error. This is followed by summaries of several studies that were conducted to determine possible factors related to the occurrence of medication errors; these summaries also address the lack of knowledge that nurses have about medications. Studies conducted to determine the effectiveness of a variety of educational strategies designed to increase knowledge related to the prevention of medication errors are then presented. Rationale for selecting the Experiential Learning Model (Kolb, 1981), and how it can be applied as an educational strategy for this study, is provided. A brief analysis of the studies reviewed and how they relate to the present study is presented at the end of the chapter.

Medication Errors

Medication errors are defined as "...unintentional mistakes associated with drugs and intravenous solutions that involve patients and are made during the prescription, transcription, dispensing, and administration phases of drug preparation and distribution" (Wolf, 1989, p. 8). In an analysis of medication error reports submitted by pharmacists in various health care settings throughout the United States over the past 20 years, it was noted that "...one out of every five doses (20%) of medication administered may be given to the wrong patient, in the wrong dose, by the wrong route, at the wrong time, or

even as the wrong drug” (Cohen, 1991, p. iii). Based on this analysis, it is possible that of all medications being administered, approximately 20% of them are being administered in error.

The most common type of medication error made by nurses, documented in several studies cited in the literature, is that of administering an incorrect dose of medication. For instance, in an analysis of 334 reported medication errors examined by Leape et al. (1995), it was found that administering the incorrect dose was the cause of 27% of the errors that were reported. In their analysis of 75 reported medication errors, Long and Johnson (1981) found that about 33% of the errors made were due to incorrect dose. Similarly, Gladstone (1995) found that of the 79 medication error reports she reviewed, about 47% of them were due to the wrong dose being administered to the client. McGovern (1981) also found that the most common cause of medication errors made were due to administration of an incorrect dose. However, the number of medication error reports and the number of errors due to an incorrect dose were not specified in this study.

The actual number of medication errors made in hospitals may actually be higher than the number reported. For instance, Ludwig-Beymer, Czurylo, Gattuso, Hennessy, and Ryan (1990) found that the number of medication errors reported on anonymous questionnaires outnumbered the actual number of incident reports that were completed by about 57%. Similarly, Walters (1992) found that when a sample of 238 RNs completed a questionnaire related to the reporting of medication errors over a 12-month period, the report of errors made by RNs was an average of .95 errors per RN. In contrast, the number of incident reports completed by the RNs indicated that the medication error rate

was .60 per RN. These results are further obscured by how nurses perceived what type of medication errors should be reported. For instance, it was noted that about 97% of the respondents who completed the questionnaire stated that they would report a life-threatening error, while only about 12% of them stated that they would complete an incident report for administering a daily medication 30 minutes late.

One of the reasons why nurses may not complete medication incident forms is because they fear retribution for making errors (Wolf, 1994). In a medication error perception survey study by Osborne, Blais, and Hayes (1999), for instance, 86% of the RNs responded that medication errors are not reported because nurses are afraid to do so, and 25% of the RNs responded that they did not report medication errors because of fear of repercussion. This may be due to the fact that these reports were formerly used for disciplinary action than for education (Fuqua & Stevens, 1988). When given disciplinary action, the opposite effects of its purpose may occur (Booth, 1994). For instance, instead of viewing the corrective action as an educational experience in helping to prevent nurses from making medication errors in the future, they may experience a decreased level of self-confidence in the administration of medications. This in turn may cause them to be more ineffective in their role of administering medications and, as a result, put them at risk of making even more errors. In an interview with 34 nurses, Arndt (1994), for example, found that after receiving disciplinary action, some of the nurses indicated that they would hesitate before reporting medication errors again if they occurred. Gladstone (1995) also noted similar findings.

Many studies and anecdotal reports regarding medication error rates and educational strategies designed to reduce the incidence of medication errors can be found in the

literature. Most of these studies examined medication errors made by RNs, and not LPNs. Studies related to medication errors made by LPNs in a community-based setting were not, however, noted to be present in the literature by this researcher.

Factors Associated with Medication Errors

Various factors associated with medication errors are cited in the literature. These factors can be divided into two categories. The first category is individual factors, which involves the actions of specific individuals who make the errors. Neglecting to administer a medication to a client is an example of an individual factor. The second category is systemic factors, which involves factors that cannot be controlled by an individual in the making of medication errors. For instance, the manner in which medications are dispensed from hospital pharmacies is an example of a systemic factor, even though an individual pharmacist may have made the error.

In terms of individual factors, Long and Johnson (1981) found that 72% out of 75 medication errors they analyzed were due to nurses not following policies and procedures. The improper checking of medication labels against the corresponding medication cards, incorrect transcription of physician orders, and the improper monitoring of intravenous therapy (IV's) were all included in this category.

Several factors perceived to cause medication errors were identified in a study by Conklin, MacFarland, Kinnie-Steeves, and Chenger (1990). In this study, the investigators analyzed 150 questionnaires that were voluntarily completed by registered nurses working in two hospitals in Calgary, Alberta. The purpose of the questionnaires completed by the participants in this study was to determine factors associated with medication errors. Results indicated that personal factors were perceived to be the most common causes of errors. Examples of factors in this category include failing to check a

client's identification band, neglecting to check for new orders, leaving medications at a patient's bedside, and lacking knowledge about some prescription medications.

With regard to lack of knowledge about medications, Markowitz, Pearson, Kay and Loewenstein (1980) found that nurses' scores were lower than physicians' and pharmacists' scores when a medication test was administered to them. The test consisted of 25 questions related to commonly administered medications in the participants' hospital. Pharmacists scored highest with a mean score of 85%, physicians scored slightly lower with a mean score of 81%, and nurses scored lowest with a mean score of 72%. It should be noted that of the sample size of 216 participants, only 14 were pharmacists, while there were 102 physicians, and 100 nurses.

Lack of knowledge about medications was also noted in a medication test administered to 166 registered nurses and 16 licensed practical nurses in a study by Boggs, Brown-Molnar, and DeLapp (1988). Overall, the nurses scored highest in the area of using three commonly administered medications, and scored lowest in the areas of dosage, mechanism of action, and drug interactions. The range of scores was between 8% and 75%. Interestingly, the mean score of the LPNs was below 50%, and the mean score of the RNs was above 50%. Based on these results, the researchers recommend that there should be ongoing education in medication administration for the nurses, and that LPNs not be allowed to administer medications at all. The latter recommendation should be considered very carefully because the number of LPNs who participated in this study was very small. This, in turn, makes it difficult to generalize the results to the LPN population. As well, it is quite possible that the LPNs' test scores may have been higher if they had previously received ongoing education in the administration of medication.

To recommend that LPNs be excluded from administering medications without providing them with the opportunity to upgrade themselves is, to this researcher, a very harsh and unfounded recommendation.

In their analysis of 334 reported medication errors made over a period of six months at two American hospitals, Leape et al. (1995) found that lack of medication knowledge contributed to the occurrence of about 22% of the errors. In a qualitative study involving 29 nurses, Cheek (1997) found that some of the nurses (number not disclosed) commonly identified lack of knowledge about medications to be a factor related to medication errors. In some instances, however, nurses did not have access to the most current written resources about the medications they administered. This, in turn, could have accounted for some of the errors that were made.

Calculation errors are also noted to be a cause of medication errors in several studies (Conklin et al., 1990; Gladstone, 1995; Long & Johnson, 1981). The fact that nurses are frequently deficient in mathematical skills is well documented in the literature. For example, the investigators of one study noted that only about 35% of 62 nurses obtained a score of 90% or higher (a level that was considered to be acceptable) when given a medication calculation test (Bayne & Bindler, 1988).

The fact that nurses have difficulty with calculations could be related to their training. For instance, Worrell and Hodson (1989) report that of 223 baccalaureate, associate, and diploma programs in the U. S.A., about 41% of the programs reported that between 11%-30% of their students lacked basic mathematical concept skills, and 41% reported this skill to be lacking in 31% or more of their students. The authors also noticed that administration of medication tests to the students was not consistent. In one instance,

there were 48 variations of one problem that was set up as a test question; this reflects a lack of standardization for this calculation question, which, in turn, could affect interpretation of the question and thereby make it more difficult to answer in some instances.

The foregoing discussion on the factors associated with medication errors indicates that there is a range of factors that contribute to medication errors that can be addressed through professional development educational strategies. Individual factors as they relate to medication errors are, however, compounded by the characteristics of the work environment. In essence, individual factors do not occur in isolation; systemic factors contributing to medication errors must also be considered.

One systemic factor associated with medication errors, identified by Long and Johnson (1981), was that of communication problems. For example, when verbal orders were not documented, nurses working subsequent shifts were unaware that any new medication(s) had been prescribed. Another type of communication problem found in other studies is the inability to read physician's orders adequately due to illegible writing (Bechtel, Vertrees, & Swartzberg; 1993; Conklin et al., 1990; Gladstone, 1995).

Staff workload as a systemic factor has been noted in several studies related to medication errors (Cheek, 1997; Conklin et al., 1990; Leape et al. 1995; Roseman & Booker, 1995). This factor can include working short-staffed, providing patient care that is very acute, and working with inexperienced or temporary staff who may not know the patients' histories. Distraction and/or frequent interruptions may also occur because of increased workload (Conklin et al., 1990; Gladstone, 1995; Walters, 1992). It is also

possible that nurses become tired as a result of increased workloads and, as a result, are more prone to making medication errors (Osborne, Blais, & Hayes, 1999).

Staff mix on a unit has also been associated with medication errors. For instance, in their analysis of outcomes of 42 units in one hospital, Blegan, Goode, and Reed (1998) noted that medication error rates were reduced when there was a higher proportion of registered nurses (RNs) than licensed practical nurses (LPNs) and/or nursing assistants on the units. Blegen and Vaughn (1998) also found this to be true in a study they conducted involving 39 units in 11 hospitals. One unexpected finding in this study was that on units where RNs comprised more than 85% of the staff mix, medication errors were found to increase. The authors postulate that this occurrence may have resulted from an increased awareness among the nurses for the need to report medication errors, fewer staff members on units staffed with more RNs, and/or more acutely ill patients on units staffed with a higher proportion of RNs.

It is difficult to discern all the factors that may contribute to medication errors because often, more than one factor may be involved in each occurrence. The individual and systemic factors cited in this literature review (see Table 1 for summary) are not exclusive but do provide a representative sampling of the factors found in the literature. Although the literature did not pertain to community-based LPNs, it is quite plausible that some of these factors also explain why LPNs make medication errors. With the exception of correctly monitoring IVs, for instance, all of the other individual factors cited in Table 1 could be associated with the making of medication errors by LPNs.

Table 1

Summary of Individual and Systemic Factors that Contribute to Medication Errors

<i>Individual Factors</i>	<i>Systemic Factors</i>
Policy and Procedure	Communication Problems
- Improper checking of medication labels	- Orders not relayed to oncoming shift
- Incorrect transcription of orders	- No documentation of verbal orders
- Failure to properly monitor IV's	- Illegible physician orders
Personal Factors	Staff Workload
- Failure to check identification bands	- Lack of staff
- Failure to check for new orders	- Acute patient care
- Leaving medications at bedside	- Inexperienced/temporary staff
- Lack of knowledge about medications	Distraction/frequent interruptions
Calculation Errors	Staff Mix

The reason why LPNs would not make a medication error in relation to monitoring IVs is because they do not work with them in the community. The LPNs do, however, administer pills and are responsible for ensuring that they are administering the correct medication. One way to ensure that medications are administered correctly is to check the labels on medication containers before medications are taken from them. It is possible that labels are not consistently checked by community-based LPNs; this may be especially the case if the LPNs are used to finding a client's medications in one place all the time, in the same types of containers. As a result, the LPNs may assume no changes

have been made to the client's medication orders. The individual factor of failing to check new orders would also apply to the LPNs in this instance.

Community-based LPNs do not obtain physician's orders; however, they are often responsible for transcribing the orders onto clients' medication sheets. The individual factor of incorrect transcription of physician's orders, cited in Table 1, could then apply to the community-based LPNs if they did not do this task correctly. This, in turn, would predispose the LPNs to making medication errors. In fact, when this researcher reviewed the medication error reports submitted by the community-based LPNs, it was noted that some of the errors occurred because they had transcribed the orders incorrectly. A lack of knowledge regarding prescribed medications could also be an individual factor (also cited in Table 1) that could have contributed to the making of these errors because the LPNs may not have been aware of proper dosages or actions of the medications ordered when they transcribed the physician's order(s) onto the appropriate medication sheets.

Although Home Care clients do not wear identification bracelets, there is still a slight possibility that medications could be administered to the wrong client. For instance, it is not uncommon for two or more elderly siblings to live together in the same dwelling; this has certainly been this researcher's experience when she worked in Home Care. If the clients also have cognitive impairment, it may be difficult for the LPN, especially if this is his or her first visit to the home, to correctly identify the clients. Similar to the individual factor of improper checking of an identification band, as is listed in Table 1, improper identification of the client by community-based LPNs could be a factor associated with medication errors.

Another individual factor associated with medication errors listed in Table 1 that can be applied to community-based LPNs is that of leaving medication at the bedside. This practice occurs quite frequently in the community in the form of LPNs leaving dosettes filled with pills for the clients to take at later times. There are also times, however, when a LPN must administer medications to a client during a visit in the client's home. If the client does not wish to take his or her medication during the time of the nursing visit, then the nurse might, due to time constraints, leave the medication for the client to take at a later time. This, in turn, could lead to a medication error because the LPN would not have actually administered the medication(s) and, as a result, it is possible that the client may not take the pill(s), or may only take a portion of the pill(s). Although the fact that a client's refusal to take medication(s) is not considered to be a medication error, the fact that the medication(s) may not have been administered at the correct time could be an error. In order to avoid this situation from occurring, the LPN should administer the medication(s) in question if specific times have been prescribed, or the LPN should leave the client's home and return at a later time to administer the medication. Due to the number of clients visited during one shift, however, the suggestion of returning to the client's home is not always possible.

The final individual factor associated with medication errors that is listed in Table 1 that can be applied to community-based LPNs is that of calculation errors. This factor is, in fact, noted to be associated with about 35% of the 43 medication error reports that were reviewed by this researcher for 1998. In all of these instances, the LPNs administered the incorrect dose of medication.

In addition to illegible physician orders contributing to medication errors, all of the other systemic factors listed in Table 1 can be directly or indirectly applied to community-based LPNs. It is quite possible, for instance, that an LPN who works the day shift may not relay new orders to an LPN coming onto the evening shift. The reason for this is because LPNs are responsible for picking up new orders for their clients from a district nursing office. While the orders may be picked up, and medications administered as ordered, it is possible for the LPNs to misplace the orders in the client's home, or forget to leave them in the home because of distraction during the visit. Thus, the evening nurse may not be aware of new orders and, as a result, may make a medication error. It is also possible that the supervisors of the LPNs may not document verbal orders obtained over the telephone and, as a result, may not pass the order(s) in question on to the appropriate LPN(s).

In most instances, clients have 'regular' LPNs who visit them. There are times, however, when casual LPNs must be employed. When this occurs, it is possible that the potential for making medication errors is increased because the casual LPNs may not be familiar with their clients or the clients' medications. Thus, although the systemic factor of temporary, or casual, staff listed in Table 1 actually pertains to hospital nurses, it can also be applied to the community setting.

Another systemic factor that is listed in Table 1 that can be applied to community-based LPNs is that of staff mix. Although the LPNs do not work together with health care aides (HCAs) to provide care for clients in their homes, they do set up medications in dosettes so that in some instances, HCAs can ensure clients take their medications at specific times. If the HCAs forget to assist clients in taking their medications, the clients

will not receive the entire complement of medications as prescribed and, as a result, a medication error will occur. Conversely, if a LPN misses a visit which results in the client's dosette being filled with medication, the HCA will not be able to administer any medications to the client. The fact that LPNs do miss some visits is also noted to be a factor in some of the medication error reports that were reviewed by this researcher.

The last systemic factor that can be associated with the making of a medication error by community-based LPNs is that of acuity of client care. Although community-based LPNs do not generally visit clients who are acutely ill, it is possible that their medical condition may have worsened between the time of the LPN's last and present visit. For instance, a client may have become ill with the flu, or the client may have had a fall. In tending to the needs of their client, the LPN may forget to fill the dosette or administer all the client's required medications because he or she is distracted from this task, which is also a factor that was addressed earlier in this thesis. Regardless of the cause, medications to be given as ordered would not be set up or administered as directed and, as a result, a medication error would occur.

In spite of the fact that medication errors may occur due to the systemic factor of client acuity, which is listed in Table 1, it is significant to note that both the individual and systemic factors associated with medication errors that were discussed in the literature review of this chapter can be applied to both hospital and community nurses. Without a doubt, it is in the best interest of all clients, health care professionals, and all citizens, to reduce the number of medication errors. Various strategies addressing both types of factors have been employed to reduce the incidence of these errors. For the purpose of this study, only educational strategies will be discussed.

Educational Strategies

One type of educational strategy designed to reduce medication errors involves administering tests related to medication knowledge. The results of testing nurses in this area are not, however, conclusive. For instance, in a study reported by Callieri (1995), results of a medication calculation test administered to 274 RNs new to an Atlantic coastal institution from May 1987 to December, 1991 were analyzed to determine if there was a direct relationship between nurses who failed the test and those found to make medication errors. Of the 48 RNs who failed the test, two-thirds of them were noted to have made medication errors. In contrast, half of the 226 RNs who passed the test made medication errors. Based on these results, it was decided to continue administering the test to RNs during their orientation period. The fact that a large number of RNs who passed the test also made medication errors was not addressed. As well, no mention of a follow-up assessment of the RNs who made medication errors was discussed. The investigators did, however, acknowledge that these RNs may need closer supervision, perhaps by their supervisor, or staff development educator, when they are administering their medications in the future.

Ludwig-Beymer et al. (1990) noted that the overall medication error rate did not decrease significantly once a yearly medication test was discontinued at a large mid-western city in the United States. When the test was discontinued, the administration of medications to the wrong patient did, however, increase. Based on these results, RNs new to this hospital were required to write a medication test, and a mandatory educational session for RNs on the prevention of medication errors was also implemented in 1988. A videotape regarding medication error prevention was also purchased for the RNs to

review on their own time. Nevertheless, neither of these strategies had been evaluated at the time the article was written (1990), and it is not indicated whether the educational session was offered again, or whether or not it was effective.

Two medication modules developed as corrective action for nurses who had made medication errors were evaluated by Werab, Alexander, Brunt, and Wester (1994). One module was to be completed by both LPNs and RNs, and the other was to be completed by RNs only. One LPN and 11 RNs were involved in this study. Each nurse met with a staff development educator to write a pre-test, and to be provided with the modules he or she was to complete. The nurses then met with the educator upon completion of the module(s) to discuss the material learned, and to view a videotape related to medication errors. A post-test was also administered at that time. Results indicated that the nurses' knowledge level increased in the administration of medications. As well, eight out of the 12 nurses did not make another medication error after completing the educational module(s) during the time the study was conducted. The time period from completing the education module to the assessment of medication errors is not reported. The investigators did, however, state that they planned to monitor future results over a period of six months, both prior to and after the module was completed by the nurses.

In contrast to an individualized modular approach, Flynn, Wolf, McGoldrick, Jablonski, Dean and McKee (1996) evaluated three teaching strategies designed to increase RNs and LPNs knowledge about preventing medication errors. The three teaching strategies consisted of an instructional booklet, a videotape, and a lecture. A pre-test/post-test design was used to compare the knowledge of risk reduction strategies between the RNs and LPNs involved in the study. The results indicated that the RNs'

post-test scores improved in all areas of medication error prevention strategies and in calculating medication dosages, and that the LPNs' scores decreased in all areas of medication error prevention strategies. The LPNs did, however, exhibit increased scores on the calculation component of the test. The type of teaching strategy employed did not appear to make a difference on the overall impact of knowledge for the nurses. The mean score of about 84% was, however, slightly higher for those who used the instruction booklet than the mean scores of about 80% for those who were given a lecture, or for those who viewed the videotape. The authors suggest that it may be beneficial to use instructional booklets in education programs for nurses because they can be read at times that are convenient to them. No mention was made regarding why the nurses could not view the video on their own time as well.

Similarly, Flynn et al. (1996), Bayne and Bindler (1997) implemented and evaluated three teaching strategies designed to help RNs become more proficient in performing medication calculations. These strategies consisted of classroom instruction, a self-instruction workbook, and a computer assisted instructional (CAI) package. A pre-test/post-test design was used to assess the knowledge levels of the nurses who participated in the study. Although the nurses' scores increased most with the classroom method, the self-study workbook was the method that the nurses preferred the most. Scores were highest with the CAI method but the level of satisfaction was lower for the nurses who used this method of instruction.

Another educational approach designed to reduce medication errors is cited in the study by McGovern (1986). Based on the results of an analysis of an undisclosed number of medication errors made by nurses, physicians, and pharmacists over one year, a 10

step program designed to improve interdisciplinary communication and increase responsibility for medication administration was established. Three of the ten steps had been implemented at the time the author wrote the article. These included revision of medication administration record sheets, publishing a newsletter, and implementing educational sessions related to "Medication Awareness" month. Results obtained after three months of implementing the three steps indicated that the incidence of medication errors decreased by about 10 %. The investigator did not, however, address the types of medication errors that were found to decrease the most.

Effectiveness of Strategies

It is often difficult to determine whether implementation of educational strategies would truly reduce the incidence of medication errors. For instance, Flynn et al. (1996), and Bayne and Bindler (1997) did not study whether there was any change in the medication error rate at either of their institutions once they had implemented their educational strategies. The fact that nurses increased their knowledge about medication administration as a result of these educational interventions is a positive indicator. Whether application of this knowledge would decrease medication error rates in hospitals or community settings is impossible to say with the results that are available to date.

An evaluation of educational strategies employed in the studies cited by McGovern (1986) and Werab et al. (1994) indicated that there was a slight decrease in the occurrence of medication errors after educational programs were implemented. Caution must be used in interpreting these results, however, because no information regarding the actual number of medication errors made before or after the implementation of the educational programs was provided by the investigators. It would also be difficult to

generalize these results as no sample size was provided by McGovern (1986), and the sample size in the Werab et al. (1994) study only consisted of 12 nurses. To obtain a more accurate assessment of the effectiveness of these types of educational programs, additional studies with larger samples would need to be conducted.

The fact that the reporting of medication errors depends primarily upon disclosure by the nurse who made the error makes it difficult to determine the actual error rate. As a result, self-reported medication error data are not likely to be accurate. As well, how medication errors, which is a term that is vague in its operational definition, are defined may differ among individual nurses. The literature also suggests that the medication error rate could be higher than the documented rate. Although it would have been interesting to assess whether there was a change in the error rate after the LPNs attended the educational sessions, the data collected would likely not reliably reflect the actual situation. Based on the research literature, it was decided not to study the effects of these sessions upon the incidence of the medication errors. Rather, the focus of this study is to assess the effectiveness of an education intervention upon the knowledge level of LPNs with respect to the administration of medications.

Experiential Learning Model

The educational intervention selected for this study is the Experiential Learning Model (ELM) by Kolb (1981). The major premise of this model is that experience is an important part of the learning process. As well, past experiences of learners determine how they will explain and interpret their learning situations. This, in turn, will provide learners with guidelines for future learning.

In order for learning to be optimized, Kolb (1981) contends that learners need to experience four different kinds of learning. These different learning experiences are all part of a learning cycle that optimizes full and lasting learning (see Figure 1). The four kinds of learning experiences consist of *concrete experience* whereby learners become involved in their learning situation, *reflective observation*, which involves learner reflection upon their learning experiences, *abstract conceptualization* where learners incorporate their observations into theory, and *active experimentation* whereby learners use their theories to solve problems. Kolb (1981) further divides these learning experiences into two dimensions that reflect the process of learning. The first dimension focuses on how learners receive information, and is comprised of a continuum from concrete experience to abstract conceptualization, which describes how learners receive information. The second dimension focuses on how learners prefer to use information and is comprised of a continuum from active experimentation to reflective observation, which describes how learners process information.

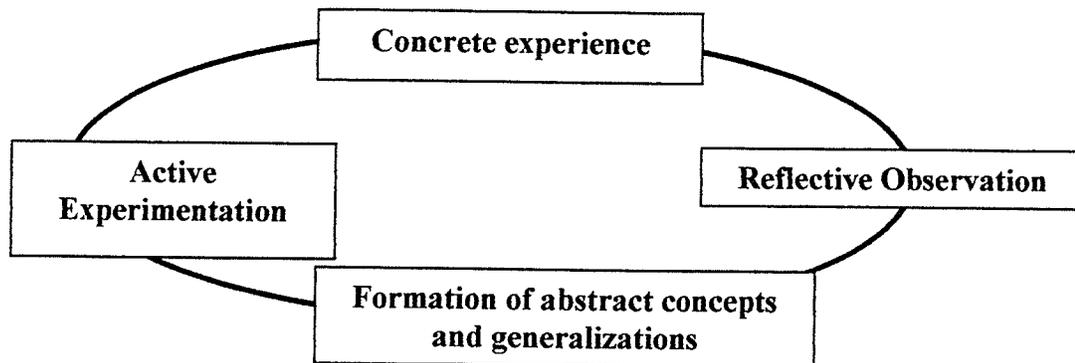


Figure 1. The Experiential Learning Model (Kolb, 1981, p. 235)

In addition to the four learning abilities cited above, Kolb (1981) also developed a Learning Styles Inventory (LSI) (cited in Linares, 1999) to assess differences in learning styles along the abstract-concrete and active-reflective dimensions. Four learning styles were identified as a result of his research with this tool. These learning styles are relevant to this study because they served as a guide for addressing learning styles in the development of the educational session for this study. Briefly, these learning styles are characterized in the following ways:

1. *Convergers* are not people oriented and mainly possess abstract conceptualization and active experimentation abilities,
2. *Divergers* are interested in people and primarily learn by concrete experience and reflective observation,
3. *Assimilators* are concerned with abstract concepts and use abstract conceptualization and reflective observation as learning styles,
4. *Accommodators* enjoy doing things, are at ease with people, and learn best by using concrete experience and active experimentation.

Although the learning style of diverger can definitely relate to nurses, some studies show other learning styles also exist in nursing profession. For instance, in a study involving 123 nursing students, Jambunathan (1995) found the predominant learning styles to be accommodator and assimilator. In contrast, Cavanagh, Hogan, and Ramgopal (1995) found all four types of learning styles to be present among the 192 nursing students they studied. Similar to Kolb's findings, Katz and Heimann (1991) found the diverger learning style to be predominant among 89 nursing students they studied; however, the converger style was more dominant among the 32 nurse practitioners they

also studied. White, Amos, and Kouzekanani (1991) found the accomodator style to be most prevalent among the 15 nursing students involved in their study.

In spite of the fact that validity and reliability has been established for the original (1976) and revised (1985) LSI (Laschinger & Boss, 1989; Romero, Tepper & Tetrault, 1992), there are, inconsistencies in reports on learning styles within the profession. By using the ELM by Kolb (1981) as a teaching tool rather than a categorizing/typing instrument, however, all of the learning abilities he has identified can be addressed. In fact, both Jambunathan (1995) and Cavanagh et al. (1995) recommend that the ELM be used in nursing education.

To successfully deliver an educational session, educators must ensure the activities included in the session address both the learning styles and learning abilities of the students. The fact that the Kolb (1981) model addresses these needs is the reason why it was selected for this study. As well, there are a variety of instructional activities that can be used for each part of the learning cycle; some of these, such as case studies, and lecture, were used in the educational session developed for this study. Examples of the types of instructional activities that can be employed are shown in the expansion of the Kolb (1981) model conceptualized by Svinicki and Dixon (1987) (see Figure 2).

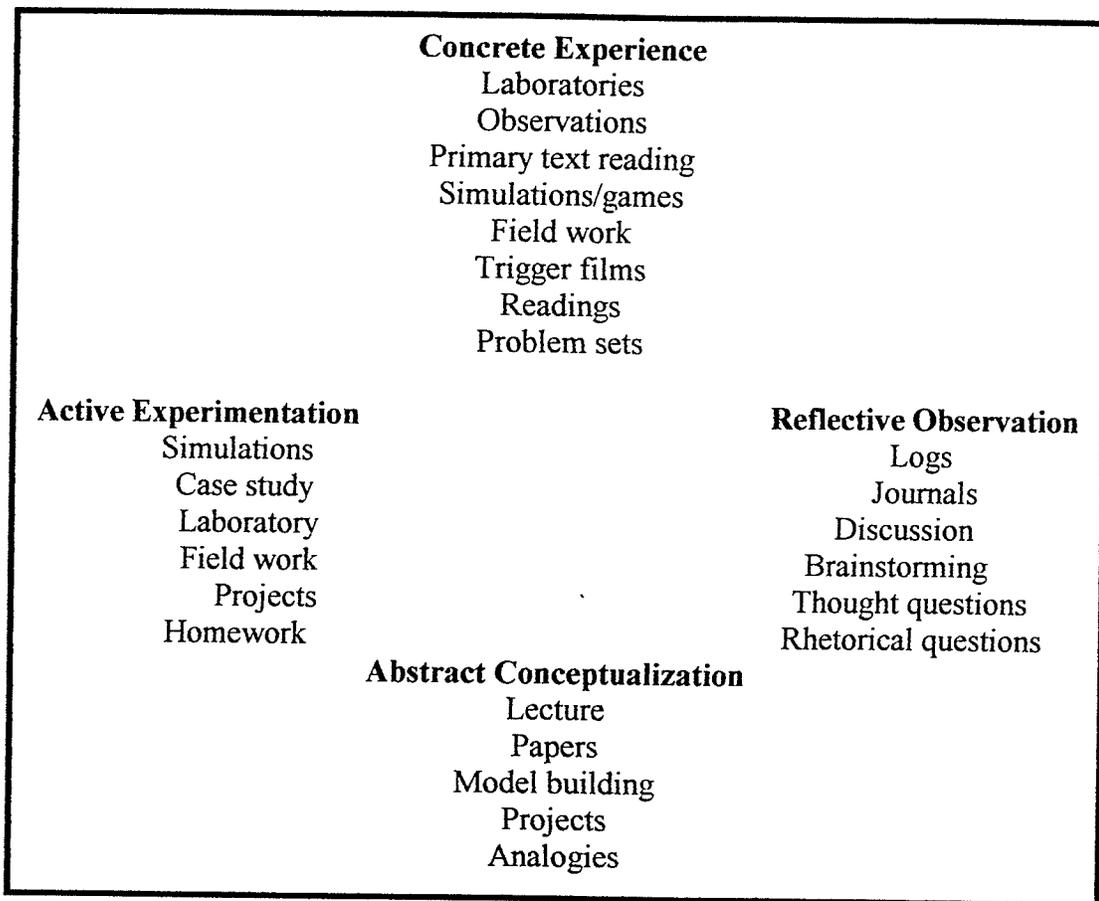


Figure 2. Instructional Activities for Different Aspects of the Learning Cycle

(Source: Svinicki & Dixon, 1987, p. 142)

Determination of specific teaching strategies is not the only factor that educators should consider when they are deciding how to develop and/or implement educational sessions. Learner needs must also be assessed. For instance, results of a survey of 24 nurses by White et al. (1998) indicate that educational sessions lasting over an hour do not seem to promote learning or its application to the clinical setting. Distraction caused by thinking about work that needs to be done upon return to the unit, and by not being asked for input into what is being taught were other factors noted to deter learning. As well, time between the sessions and clinical application were also identified as important

factors in determining how well knowledge from educational sessions would be implemented. Major barriers to attending workshops identified by Cullen (1998) consisted of priorities other than attending an educational session, time constraints, and sessions offered at inconvenient times. Responses from 347 nurses in a survey by Kersaitis (1997) indicated that cost and family commitments were major deterrents to pursuing continuing professional education that took place after working hours. Although the design of the present study does take these factors into consideration, time constraints could still pose a problem.

In summary, medication errors can be caused by systemic and/or individual factors. Both factors are interrelated to some degree. Although the studies reviewed thus far provide useful information regarding possible causes of medication errors, the generalizability of the results obtained in the studies involving the evaluation of selected educational interventions are questionable because most of them have poor research designs. As well, all the studies were conducted in hospitals. This, in turn, makes it difficult to generalize the results to community-based nurses. Furthermore, many of the participants in the survey samples were voluntary. This factor was identified as a limitation by the investigators in only two studies (Gladstone, 1995; Ludwig-Beymer et al., 1990).

Nevertheless, various degrees of success have been achieved in the implementation of strategies designed to assess and or increase knowledge about all aspects of medication administration. Based on the studies discussed in this chapter, the effect of reducing medication errors as a result of nurses receiving education seems to be minimal or, in many studies, it was not ever evaluated. The present study also has some of the same

weaknesses. For instance, the actual changes in the incidence of medication errors in the community setting both before and after delivering two educational sessions on medication administration was not evaluated in this study because, as was previously discussed, self-reported medication error data are not reliable. Instead, the knowledge level of LPNs regarding medication administration, their ability to calculate dosages, and their ability to transcribe physician orders both before and after the educational sessions was evaluated. The manner in which this evaluation occurred is discussed in the next chapter of this thesis.

CHAPTER III

METHOD

This chapter describes how this study was conducted. A discussion of the module that was presented in the educational sessions will be described first. This is followed by a presentation of the pre-test and post-test questions that the participants were asked to complete both before and after they attended the educational session. Ethical considerations related to this study and how they relate to the participants in the study are then discussed, which is followed by a description of the LPNs who participated in the study. The design of the study is then described, which is followed by a discussion on the limitations of the study. The format of the educational session and how the data were analyzed concludes the chapter.

Medication Administration Review Module

As previously discussed, the researcher developed a medication administration review module (see Appendix A) in December, 1999, for LPNs employed to work in the community by a health authority in a large city in the province of Manitoba. The content of the module was based on the literature, and was divided into two parts; each part was presented in one educational session.

Part One of the module consisted of five areas of content. The first area related to the definition of a medication error, and the second of which addressed the five rights of medication administration. The three label checks of checking medication labels before pouring the medication, after pouring the medication, and while putting the medication back to its original location before actually administering it to the client, comprised the third area of content. Factors associated with the occurrence of medication errors was the

fourth area of content. The last area addressed in the first part of the module was parts of a medication order; this was considered to be important because it involved the transcription of physician orders.

In contrast to the first part of the module, the second part addressed specific medications that are used in the treatment of diabetes. The first two medications discussed are those of Glyburide and Glucophage, which are both pills taken by clients who have diabetes. The other medication discussed is Insulin; included in this discussion is the technique involved in mixing two different types of Insulin, and how the mixture is administered once it is drawn up in the syringe. The side effects of all three medications are discussed, as well as their action upon the body.

Once the module was developed, it was reviewed by the supervisor of the nursing unit, the LPNs' nursing supervisors, and the Director of Planning and Special Projects for content. The feedback from these individuals was positive in that they all felt it reflected what the LPNs were doing in the community and that they needed knowledge in this area to ensure safe administration of medications. They also liked the format of the module, and the pictures that were included in all the content areas. It was agreed that the module could be presented in its current format and as a result, verbal permission to conduct a study evaluating LPNs' knowledge related to medication administration was given to this researcher. This verbal support was followed by a letter of support (see Appendix B) from the supervisor of the nursing unit. Based on this support, this researcher then developed a pre-test and a post-test to be administered in conjunction with the presentation, or educational session. An example of these tests is presented below.

Pre-test and Post-test Questions

Both the pre-test and the post-test were the same and were developed directly from the literature. The actual tests are included in this thesis in Appendix C; for a better understanding of how the questions related to the content of the module, however, the questions are presented below. The order in which these questions are presented are identical to the order they were in when they were administered to the LPNs in this study.

The purpose of the first set of questions presented below was to assess how well the LPNs could identify when they should check their medication labels. As a result, they were asked to correctly number 10 steps involved in medication administration. These steps are as follows:

- _____ Document the medication given
- _____ Obtain the medication from the client's supply
- _____ Identify the client
- _____ Check for allergies
- _____ Read the drug label
- _____ Read the drug label
- _____ Read the drug label and discard the empty package
- _____ Compare the drugs and doses available in the client's medication supply with information on the physician's order sheet and medication record
- _____ Administer the medication
- _____ If this is the first time you are administering this medication to your client, inform him or her of its name and purpose.

As is indicated in the foregoing questions, checking the label is cited three times. One of the participants brought this to the researcher's attention while writing the test to ensure that this was not an error in typing. This question alone indicated to the researcher that this participant lacked some knowledge in the area of checking medication labels.

In order to determine how well the participants knew the five rights of medication administration, they were asked to list them in the second sub-test of the test. Related to this question was a sub-test on transcribing physician's orders. In order to transcribe the orders correctly, the participants had to know the five rights of medication administration. They also had to know that the orders needed to be clarified if they could not read them; three of the orders actually are difficult to read and should not be transcribed by the participants until they are clarified. These orders were actual orders that were written by a physician who frequently wrote orders for the nurses to follow, and were taken from charts of Home Care clients. These orders, typed, are as follows (there may be errors in the typing of these orders because the researcher had difficulty reading them and would need to ask for clarification before actually transcribing them):

1. Imovane 7.5 ½ HS
2. Start Hydrochlorothiazide alone 12.5 mg. once daily
3. Increase Vitamin E to 800 IU O.D.
4. Zantac 150 I BID

Since the literature clearly indicates that calculation of medication doses by nurses have resulted in medication errors, five calculation questions were also included in the test. The participants were to calculate how much medication would need to be drawn up

from the medication that was on hand prior to its administration. These questions comprise the last sub-test of the first part of the pre-test and post-test, and are as follows:

1. Ordered: Ampicillin 1 gm. PO Q6H
Available: Ampicillin 250 mg. per capsule
2. Ordered: Digoxin 0.50 mg. PO OD
Available: Digoxin 0.125 mg. per tablet
3. Ordered: Metformin 750 mg. PO TID with meals
Available: Metformin 500 mg. per tablet
4. Ordered: Lasix 10 mg. PO OD
Available: Lasix 20 mg. per tablet
5. Ordered: 9 units of Regular acting Insulin to be mixed with 17 units of Intermediate acting Insulin to be administered subcutaneously AMAC OD
Available: One 10 ml. vial of Short acting Insulin, 100 units per ml., and one 10 ml. vial of Intermediate acting Insulin, 100 units per ml.

The second part of the pre-test and post-test consists of questions related to medications prescribed for clients who have diabetes. The reason these were included is because more people are developing diabetes, especially Aboriginal people, and as a result, more people are requiring treatment for this disease in Home Care. In order to ensure safe and effective administration of the medications used to treat this disease, it is essential that the LPNs have knowledge of the effects of the drugs and their side effects. The first set of questions asks the participants to indicate whether the statements they read about the oral anti-diabetic medications, Glucophage and Glyburide, and insulin, which is administered subcutaneously, are true or false. These questions are as follows:

- Glyburide is used for people who have Type I diabetes
- Glucophage can be helpful in treating obesity
- Hypoglycemia is a side effect of Glucophage when it is used alone
- Glucophage stimulates Insulin secretion from the beta cells of the pancreas
- One possible side effect from Glyburide is weight gain
- Glyburide is effective in the absence of functioning beta cells
- Glyburide is used to control hypoglycemia in people with Type II diabetes
- Glucophage works well with people who have unstable Type II diabetes
- Women should carry Insulin in their purse
- A vial of Insulin should not be used if there is discolouration or "white strings" present
- When mixing Insulin, the intermediate or long-acting Insulin is drawn up before the Regular Insulin
- A "body log" can serve as a guide for selecting Insulin administration sites
- A different site is to be used each time Insulin is administered
- Insulin can be injected at a 90 degree angle
- Insulin injection sites should be gently massaged after Insulin administration
- Insulin can be used after its expiration date as long as it has been kept in the refrigerator
- The combination of Lente and Regular Insulin does not have to be administered immediately after drawing it up from both vials
- Pre-mixed Insulin (ie- Novolin 30/70) can be drawn up and stored in the refrigerator for two weeks

Once the participants completed the true and false questions, they were then asked to order the steps involved in administering an Insulin injection. These questions are as follows:

_____ Pinch up a portion of the skin approximately 1-2 inches in height

_____ Release skin

_____ Wash hands

_____ Chart Insulin administration on medication record

_____ Select site where Insulin is to be injected

_____ Hold Insulin syringe like a pen and inject into skin

_____ Ensure Insulin site is free of bruises and abrasions

_____ Hold alcohol swab near the needle and pull needle out of skin

_____ Push plunger down

_____ Press alcohol swab against Insulin injection site for several seconds
and then remove

_____ Cleanse Insulin injection site with an alcohol swab and let dry

Once the participants completed the question on Insulin administration, they had, in essence, completed the entire test. As can be seen from the questions contained in the test, the major areas tested were those of the participants' level of knowledge the medications used to treat diabetes, and the steps that need to be taken to ensure proper administration of medications. This area was selected because, as is listed in Table 1, lack of knowledge about medications is one factor that contributes to medication errors. Other areas tested that include some of the other factors listed in Table 1 are those of calculations, transcription of physician orders, and checking of medication labels. If the

participants indicated that they had a good knowledge level of all these areas tested, then it is hoped they would apply this knowledge in the clinical setting and, hopefully, reduce the risk of making a medication error. It should also be noted that all the areas tested were included in the module on medication administration.

The original intent was to have the medication administration review module presented in two parts, on two separate days. Due to the fact that it would have put extra time constraints on the LPNs, a collective decision by the supervisor of the nursing unit, and the LPNs' supervisors was made to present both parts of the module in one session. In order to accommodate as many LPNs as possible, it was also decided that the session would be held on two separate days. By having the session on two different days, LPNs who ordinarily were off duty one day would be able to attend the session when they returned to work their next scheduled shift. The first session was held on December 20, 1999, and the second session was held the following day. Both sessions were held in the afternoon and at a location that housed the LPNs' supervisors, and the supervisor of the nursing unit. The LPNs also had to go to this location to hand in their time sheets.

Ethical Considerations

Attendance at the educational session was initially to be mandatory; however, this was never instituted by the supervisor of the nursing unit. Instead, the supervisors of the LPNs sent a notice to their staff to inform them that this researcher was conducting a study and would be present at their November, 1999, staff meeting to inform them of the details. The researcher held the first information session at the first LPN staff meeting on November 29, 1999. The second informational session was held the next day at another staff meeting held for the LPNs who ordinarily were off duty the previous day. The

number of LPNs who attended the first informational session totalled 19; 12 LPNs were at the second informational session. Both staff meetings incorporating the informational sessions were held during the nurses' regular work time.

Throughout both the information sessions, potential participants in the study were informed that an educational session on medication administration was being presented in conjunction with this research. They were also informed that there would be a pre-test before the session, and a post-test after the session ended.

The purpose of the educational session and how it related to the purpose of the study was explained to the potential participants. The format of the educational session was also explained by the researcher. The potential participants were also made aware that their participation in the proposed study was voluntary, and that non-participation would not affect the evaluation of their performance by their supervisors in any way. As well, potential participants were informed that all data obtained from the study was to be confidential, and that all those who participated in the study would receive a summary of the results of the study within six months of when the session they attended ended. The potential participants were also informed that they would be paid for their participation in the study. Once the information about the study was presented to the potential participants, those who wanted to participate were asked to sign a Letter of Consent (see Appendix D). The potential participants were also informed that the proposal for this study had been approved by an ethics review committee to ensure its integrity.

A total of 19 LPNs out of a workforce of 70 attended the educational sessions. No random assignment was involved in determining which session date they would attend. Twelve LPNs attended the session on the first day, and seven LPNs attended the session

on the subsequent day. All but one of the LPNs was female (based on this fact, all participants will be referred to as 'she,' or 'her,' throughout the rest of this thesis). Years of service among the group, as told to the researcher by one of the LPN supervisors, ranged from 6 months to 15 years. None of the LPNs had attended any similar educational sessions since being employed with the health authority (the researcher did not have access to any other biographical data about the participants). All the LPNs in both groups administered medications to their clients on a daily basis.

Design of the Study

A quasi-experimental one-group pre-test/post-test design (Campbell & Stanley, 1966; Polit & Hungler, 1991) was used for this study. No random assignment or control group was used with regard to attending the educational session as it was deemed by the supervisor of the nursing unit that all the LPNs required the knowledge to be presented in the session, and consequently, as many as possible should attend. Although the design of this study is one that is frequently used by nurse researchers, as was evident in the literature review in the last chapter, it does have some limitations.

One of the limitations of the design of this study, which is also a threat to its internal validity (Campbell & Stanley, 1966), is the effects of testing. Given that the LPNs wrote a pre-test before the educational session, they may have performed better on the post-test without even having attended the educational session (Gay, 1981). This is especially significant because the pre-test was the same as the post-test. As well, if the LPNs remembered some of the questions on the pre-test and then heard the answers for those questions during the educational session, they may have answered more questions correctly on the post-test.

The time between the pre-test and post-test is also another factor to consider because the threat of the effects of testing are increased if the time between the two tests is short (Gay, 1981). In the case of this study, the time factor was approximately two hours between the writing of the pre-test and the post-test, which is a very short period of time to test the effectiveness of an educational program.

A six-week retention post-test had also initially been part of the study design. The retention post-test was to be the same as the previous two tests the participants wrote. The reason for having the retention post-test was to test how much information the participants retained six weeks after they had attended the educational session on medication administration. Due to the fact that nursing schedules, client assignments, and some supervisors were changing their staffing assignments, it was impossible to do this test. This was unfortunate because it would have provided a better test of the effect of the educational session and, as well, would have enabled the researcher to answer the third research question originally developed for this study. The inability to answer the third research question became an additional limitation to the design of this study because it made it more difficult to evaluate the effectiveness of the educational intervention used in the educational session.

Another factor that affects the internal validity of this study is the selection of participants (Campbell & Stanley, 1966). Since the sample was voluntary, and only consisted of 19 out of 70 potential participants, it is quite possible that the participants in the study had different characteristics from the greater population. This, in turn, limits the generalizability of the results (Katzner, Cook, & Crouch, 1998). As well, it is difficult to know what motivated the participants to volunteer for the study (LeBiondo-Wood &

Haber, 1994). For instance, the LPNs were paid for their time; perhaps some of them needed extra money. Another explanation could be that some of the LPNs wanted to re-learn some of the information they had learned in nursing school. Perhaps the LPNs who did not volunteer felt uncomfortable about their knowledge base of the participant to be presented. Regardless of the motivation, it is questionable as to whether the results would reflect the characteristics of the LPNs who did not volunteer to attend the educational session.

A third limitation to this study design is that due to its small sample size, and lack of a control group, its generalizability, or external validity (Campbell & Stanley, 1966) is threatened. Since there were only 19 participants, it is not possible to generalize the results of the study to the rest of the LPN population working in a community setting in Winnipeg, or outside of the city. Although it would have been beneficial to use a more adequate research design, it was not possible to do so in this study.

Bias could be present as a result of this researcher's involvement in developing and delivering the proposed study's material. The reason for this is because the researcher did not use a standardized test that had been properly tested for reliability and validity. The researcher also developed the module based on the literature. It is possible that other important concepts may have been missed in the development of the module and the test because of the researcher's focus on specific areas. In essence, it is possible that the module and ensuing test did not represent all the main areas of the literature written about medication errors and how to reduce the risk of their occurrence.

Another potential source of bias could be the researcher's previous familiarity with the participants (Gay, 1981). The fact that some of the participants knew the researcher as a

case coordinator who could have had input into their workplace evaluations may have caused them to feel uncomfortable when it came time for them to write the pre-test and the post-test. Some of this bias was, however, reduced because at the time of this research, the researcher was no longer employed with the health authority. This, in turn, also reduced the power relationship between the LPNs and the researcher. For instance, the LPNs might have felt intimidated and thought that the researcher was evaluating them if she was still employed by the health authority during the time the sessions were held. Since the researcher was now an 'outsider,' and hence, had no involvement with the LPNs in the work environment, they may have felt more relaxed about participating in the study.

To further reduce bias and power between the researcher and participants in the study, a community-based RN volunteered to present the material for the educational session. Although the RN worked in Home Care, she did not work with any of the participants in the study. The RN was also had no knowledge of the questions that were on the pre-test and the post-test.

The combination of having the volunteer RN conduct the sessions, and the supervisors of the LPNs not being present throughout each session, may also have been helpful in promoting a more informal atmosphere in the classroom. In fact, it was the intent of this researcher to make the classroom environment as non-threatening as possible by not having any persons of authority present during each session, and by encouraging comments and questions on part of the potential participants throughout both sessions.

The medication review module was developed by the writer in collaboration with the nursing unit of the health authority. Its content was based on the research literature that

was available regarding medication errors. The pre-test and post-test was also developed by this researcher and was based on the literature and the module. The fact that there was no established reliability and validity estimates for the tests that were used in this study constitutes another limitation in its design (Gay, 1981; LoBiondo-Wood & Haber, 1994). To help determine content validity of the test, however, the writer asked the supervisor of the nursing unit and her five nursing resource coordinators to examine the tests. The directions for one question were changed as a result of this review. No other questions were changed because the supervisors thought that the items were clearly written and represented the areas of medication administration that the LPNs needed to know.

Session Format

The format for each of the sessions consisted of the researcher welcoming the participants to the session and then administering the pre-test (see Appendix C) to them. To ensure anonymity, and to allow for the collection of data, participants were asked to write an identification code consisting of their birthdate (the researcher has no access to this data) on the front of each test they wrote. The test took approximately 25 minutes to complete. The tests were collected by this researcher once the LPNs had completed them. The researcher then sat in a location away from the presentation area. The RN who had volunteered to teach the session on both days then began her presentation.

The presentation of the first part of the module began with a discussion of examples of medication errors their peers had made over the past two years. The group was then asked how the errors could have been avoided. A brief lecture addressing medication policies and administration which involved the use of coloured overhead transparencies was then performed (see Appendix A). The second part consisted of the same type of

presentation method with the exception that a 'hands on' component was also included. In this part of the presentation, the LPNs were asked to demonstrate the drawing up and mixing of two types of Insulin. They were also asked to demonstrate how they would inject Insulin into a client. Once this part of the presentation was completed, the LPNs were asked to read and discuss a case study related to a nurse making a medication error. The researcher then administered the post-test at the end of the session; this post-test was the same as the pre-test (see Appendix C). To ensure anonymity, and to allow for the collection of data, participants were asked to write an identification code consisting of their birthdate on the front of both the pre-test and the post-test. The total time commitment for each of the sessions was 2 1/2 hours. Informal feedback received from the LPNs was positive in that several of them stated it was a good review of the material for them.

The researcher analyzed the data obtained from the pretests and post-tests by first of all, matching the pre-tests and post-tests with the participants' birthdates. The scores for each of the participants were then added together to obtain an overall score. This score was then divided by the number of participants to obtain the mean score (Gay, 1981). This procedure was then performed again for each sub-test in both the pre-test and the posttest.

To determine whether an increase in knowledge, as indicated by test scores, had occurred, the scores were all converted to a percentage. The scores calculated as percentages in the pre-test were then subtracted from the post-test scores. All the scores were also assessed to determine if some participants performed consistently better or

worse than others. The results of this assessment, and the other assessments are presented in Chapter 4 of this thesis.

CHAPTER IV

RESULTS

This chapter includes a report on the results obtained on Part 1 and Part 2 of the pre-test and post-test, the details of which were presented in Chapter 3. Also included in this chapter are the results on all of the sub-tests contained within each part of the pre-test and post-test that each participant wrote for the purpose of this study. An overview of the participants' overall scores for Part 1 and Part 2 of the pre-test and post-test is presented first. This is followed by a series of tables presenting the results of each sub-test. All the scores are presented in tabular format in their raw, and then in percent, form in separate columns. An additional column is included to indicate the change in percent of each participant's score from the writing of the pre-test to the post-test.

Overview of Scores

The overview of scores presented in Table 2 suggests that with a pre-test mean of 68.4%, the participants possessed a satisfactory knowledge base of medication administration. With the range of scores noted to be between 45.3% to 83.0%, however, it can be seen that not all of the participants possessed a satisfactory knowledge base. For instance, participant #1 achieved a score of 45.3%, participant # 6 achieved a score of 47.2%, and participant #13 achieved a score of 49.1%. If an arbitrary pass mark of 50% had been established for this test, these three participants would have received failing marks. In contrast to the three participants who scored lowest on the test, three other participants achieved a score above 80%; this would suggest that they possessed a very good knowledge base of medication administration. The participants who scored above 80% were participant #2, who achieved a score of 81.1%, and participants #18 and #19,

who achieved a score of 83.0%. The remainder of the pre-test scores ranged from 58.5% to 77.4%. In spite of the fact that three participants scored very well on the pre-test, the fact that 16 participants scored below 80% suggests to this researcher that these participants lacked knowledge in one or more areas of the pre-test.

The post-test scores displayed in Table 2 show that the range was between 62.3% to 92.5%, with three participants scoring in the 60% range. The participants who achieved these scores were participant #7, who achieved a score of 64.2%, participant #8, who achieved a score of 67.9%, and participant # 13, who achieved a score of 62.3%. In contrast, two participants scored over 90% in the post-test. These participants were participant #2, who achieved a score of 90.6%, and participant #18, who achieved a score of 92.5%. None of the participants would be deemed to have failed the post-test if they had been required to achieve a mark of 50% in order to pass the post-test.

The increase in the post-test scores indicates that a higher knowledge base was present among the participants after, versus before, they attended the educational session on medication administration. The range of scores on the post-test was also higher than that of the pre-test scores. As well, 17 of the participants obtained post-test scores that were higher than their pre-test scores. The two participants who did not increase their scores on the post-test were participant #8, who obtained 67.9% both on the pre-test and the post-test, and participant #19, who obtained a score of 83.0% on the pre-test, and 79.2% on the post-test.

The highest score obtained on the pre-test was 83.0%; participants #18 and #19 attained this score. Participant #18 also attained the highest score of 92.5% on the post-test. In contrast, the lowest score on the pre-test was 45.3%, and the lowest score on the

post-test was 62.3%; both these scores belonged to different participants. It is notable that participant #6, who had the lowest pre-test score of 45.3%, achieved the highest increase in percent (37.7%) in her score from the pre-test to the post-test. Overall, the scores increased by an average of 9.64% from the pre-test to the post-test.

The post-test scores presented in Table 2 are similar to those obtained in the studies conducted by Bayne and Bindler (1997), and Flynn et al. (1996), because the participants' scores also increased after they wrote the post-test. The increase in results in these two studies were not, however, statistically significant. It should also be noted that the post-test written by the participants in the Bayne and Bindler (1997) study was done three to five months after they had written the pre-test. In contrast, the post-test written by the participants in the study by Flynn et al. (1996) was done immediately following the educational intervention used in their research. The scores, however, were based upon content presented using three different types of teaching strategies; namely, a lecture, a videotape, and an instructional booklet. With regard to this researcher's study, the teaching methods used consisted of a lecture, a case study, and a return demonstration of a skill. As well, although the post-test method used in this study was similar to the other two studies, the tests would have been different for each study.

Table 2**Participant Scores – Overview**

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
1	24	45.3	38	71.7	26.4
2	43	81.1	48	90.6	9.5
3	36	67.9	40	75.5	7.6
4	35	66.0	45	84.9	18.9
5	41	77.4	43	81.1	3.7
6	25	47.2	45	84.9	37.7
7	31	58.5	34	64.2	5.7
8	36	67.9	36	67.9	0.0
9	35	66.0	39	73.6	7.6
10	39	73.6	41	77.4	3.8
11	38	71.7	41	77.4	5.7
12	38	71.7	39	73.6	1.9
13	26	49.1	33	62.3	13.2
14	37	69.8	41	77.4	7.6

(table continues)

Table 2 (continued)

Participant Scores - Overview

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
15	41	77.4	42	79.2	1.8
16	39	73.6	45	84.9	11.3
17	37	69.8	45	84.9	15.1
18	44	83.0	49	92.5	9.5
19	44	83.0	42	79.2	-3.8
MEAN	36.3	68.4	41.4	78.1	9.6

Pre-test and Post-test Scores: Part 1 and Part 2

As discussed in Chapter 3, both the pre-test and post-test contained two parts. The maximum score for Part 1 was 24, and the maximum score for Part 2 was 29. Topics included in Part 1 of the tests included ordering of the steps of medication administration with three label checks incorporated into the steps, the five rights, transcribing physician's orders, and medication calculations. Part 2 consisted of a true and false test related to oral antidiabetic agents and insulin, and the ordering of steps involved in administering insulin. Tables 3 and 4 reflect the scores obtained for each of these parts and the corresponding increase or decrease in percentage.

Table 3**Scores for Part 1 of Pre-test and Post-test**

Participant	Pre-test Part 1	Percent	Post-test Part 1	Percent	Percent Change
1	15	62.5	16	66.7	4.2
2	22	91.7	23	95.8	4.1
3	17	70.8	21	88.0	17.2
4	17	70.8	22	91.7	20.9
5	24	100	24	100	0.0
6	11	45.8	19	79.2	33.4
7	12	50.0	15	62.5	12.5
8	15	62.5	16	66.7	4.2
9	15	62.5	16	66.7	4.2
10	14	58.3	16	66.7	4.2
11	19	79.2	17	70.8	8.4
12	16	66.7	18	75.0	8.3
13	14	58.3	18	75.0	8.3
14	17	70.8	18	75.0	8.3
15	18	75.0	20	83.3	8.3

(table continues)

Table 3 (continued)

Scores for Part 1 of Pre-test and Post-test

Participant	Pre-test Part 1	Percent	Post-test Part 1	Percent	Percent Change
16	19	79.2	21	88.0	8.8
17	18	75	20	83.3	8.3
18	24	100	23	95.8	-4.2
19	22	91.7	18	75.0	-16.7
MEAN	17	72.0	19	79.0	7.0

Table 4

Scores for Part 2 of Pre-test and Post-test

Participant	Pre-test Part 2	Percent	Post-test Part 2	Percent	Percent Change
1	9	31.0	22	75.9	44.9
2	21	72.4	25	86.2	13.8
3	19	65.5	19	65.5	0.0
4	18	62.1	23	79.3	17.2

(table continues)

Table 4 (continued)

Scores for Part 2 of Pre-test and Post-test

Participant	Pre-test Part 2	Percent	Post-test Part 2	Percent	Percent Change
5	17	58.6	19	65.5	6.9
6	14	48.3	26	89.7	41.4
7	19	65.5	19	65.5	3.0
8	21	72.4	20	69.0	2.3
9	20	69.0	23	79.3	12.6
10	25	86.2	25	86.2	0.0
11	19	65.5	24	82.8	17.3
12	22	75.9	21	72.4	-3.5
13	12	41.4	15	51.7	10.3
14	20	69.0	23	79.3	10.3
15	23	79.3	22	75.9	-3.4
16	20	69.0	24	82.8	13.8
17	19	65.5	25	86.2	20.7
18	20	69.0	26	89.7	20.7
19	22	75.9	24	82.8	6.9
MEAN	19	65.0	22	77.0	12.0

The pre-test results displayed in Table 3 show that the range of scores to be between 45.8% and 100%. The participant who obtained the lowest mark of 45.8% on the test was participant #6, and the participants who achieved the highest mark of 100% were participants #5, and #18. The overall mean obtained on this part of the test was 72%.

In contrast to the results displayed in Table 3, the results displayed in Table 4 show that the range of the pre-test scores for Part 2 of the pre-test ranged from 31.0% to 86.2%. The participant who obtained the lowest mark of 31.0% on this portion of the test was participant #1, and the participant who obtained the highest mark of 86.2% was participant # 10. The overall mean obtained on this part of the test was 65.0%.

The foregoing results are of interest to the researcher because the scores obtained for the first part of the pre-test are notably higher than those obtained in the second part of the pre-test. As well, two of the participants obtained a perfect score in the first part of the pre-test, whereas none of the participants achieved a perfect score on the second part. The mean for the first part of the pre-test was also higher than that of the second part. It is also interesting to note that the two participants who achieved perfect scores in the first part both obtained much lower scores in the second part of the test. The fact that there was such a variation in scores between the first and second parts of the pre-test suggests that the participants were more familiar with the procedures involved in administering medications than they were in terms of administering specific medications, which in this case, were anti-diabetic medications that are prescribed for some Home Care clients. This, in turn, represents cause for concern because although the participants may be able to safely administer their medications, some of them may not know the actions or the side effects of some of the medications they are giving to their clients.

The post-test scores displayed in Table 3 show that the range of scores was between 62.5% and 100%. The participant who obtained the lowest score of 62.5% on this part of the post-test was participant #7, and the participant who obtained the highest score of 100% was participant #5. It is notable that this participant also obtained the same mark on Part 1 of the pre-test.

Results of Part 2 of the post-test displayed in Table 4 show that the range was between 51.7% and 89.7%. The participant who obtained the lowest score of 51.7% on this part of the test was participant #13, and the participants who obtained the highest score of 89.7% were participants #6, and #18. Three participants, namely, participant #2, participant #10, and participant #17, obtained the second highest score 86.2% on Part 2 of the post-test. It is interesting to note that participant #5 obtained 100% on Part 1 of the post-test, but only obtained 65.5% on Part 2 of the post-test, which was the second lowest score on this part of the test.

The mean of the post-test scores increased over the pre-test for both parts of the test. In Part 1, the score increased from 72% to 79%, and in Part 2, the score increased from 65.0% to 77%. Thus, it can be seen that although there was an increase of mean scores on both parts of the test, the increase in percentages was higher on Part 2. The reason for the higher increase in the mean score on Part 2 may have been due to the fact that the participants may have found this part of the educational presentation more interesting to them because they had a limited knowledge base about anti-diabetic medications. As well, the answers to the questions they could not answer correctly when they first wrote this part of the pre-test may have been presented to them during the presentation, which, in turn, may have triggered their memory when it came time to write the test again.

In contrast to the increase in the mean scores for both parts of the test, some of the participants experienced a decrease in scores on both parts. For instance, participants #18, and #19 experienced a decrease in their scores on Part 1 of the post-test, and participants #12, and #15 experienced a decrease in their scores on Part 2 of the post-test. The greatest decrease in scores was obtained by participant #19, who scored 91.7% on Part 1 of the pre-test, but only scored 75% on Part 1 of the post-test. Although it is not known why these participants experienced a decline in their post-test scores, it is possible that they were tired when it came time to write the post-test, or became confused with the information that was presented to them and were not given sufficient time to absorb it. In effect, these participants may have been experiencing information overload.

Sub-test Scores – Part 1

To determine how scores were distributed throughout the separate components of the tests, a separate analysis was performed for each component. Table 5 displays the data obtained from the ordering of the steps involved in medication administration; this is the first component/sub-test in Part 1 of the test.

Table 5

Sub-test - Steps of Medication Administration

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
1	7	70.0	7	70.0	0.0
2	10	100	8	80.0	-20.0
3	8	80.0	10	100	20

(table continues)

Table 5 (continued)

Sub-test - Steps of Medication Administration

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
4	8	80.0	8	80.0	0.0
5	8	80.0	8	80.0	0.0
6	8	80.0	8	80.0	0.0
7	8	80.0	10	100	20.0
8	7	70.0	7	70	30.0
9	7	70.0	8	80.0	10.0
10	8	80.0	8	80.0	0.0
11	10	100	8	80	-20
12	6	60.0	8	80.0	20
13	8	80.0	8	80.0	0.0
14	8	80.0	10	100	20.0
15	8	80.0	8	80.0	0.0
16	6	60.0	8	80.0	20.0
17	8	80.0	8	80.0	0.0
18	10	100	8	80.0	0.0
19	10	100	10	100	0.0
MEAN	8.1	81.0	8.3	83.2	2.2

The pre-test results displayed in Table 5 show that the range of scores was between 60% to 100%. Participants #12, and #16 obtained the lowest score of 60%, and participants #2, #11, #18, and #19 obtained the highest score of 100%. All the participants would have passed this pre-test component if an arbitrary pass mark of 50% had been established. This result suggests, from my perspective, that the participants possessed a satisfactory base of knowledge on the steps involved in administering medications before they attended the educational session on this topic.

Similar to the pre-test on the steps involved in medication administration, all the participants obtained a satisfactory score on the post-test. The range of scores on the post-test was between 70% and 100%. Participants #1, and #8 obtained the lowest score of 70%, and participants #3, #7, #14, and #19 obtained the highest score of 100%.

Although the post-test scores were generally higher than those of the pre-test, the post-test mean did not reflect the overall increase as the increase in percentage was only 2.2%. This occurrence could be due to the fact that three of the participants, #2, #11, and #18, experienced a decrease of 20% from their pre-test to their post-test scores. The reason for this decrease could be attributed to fatigue because the nurses wanted to complete the test as soon as they could so they could leave for home.

It is interesting to note that participant #19's score remained the same for both the pre-test and the post-test. This participant also achieved the highest score for this portion of the test, which contrasts with her score in Table 3 whereby she experienced the greatest decrease in her post-test score for Part 1 of the test.

Table 5 reflects the overall steps of medication administration. Within this component of the pre-test and post-test is the correct identification of the order in which medication

labels need to be checked before medications are administered. To determine how many participants correctly identified these steps, the data were extrapolated from the scores of the medication component of the test and are displayed in Table 6.

Table 6

Specific Responses -Three Checks Identification Sub-test

Participant	Pre-test			Post-test		
	O	B	R	O	B	R
1			X		X	X
2						
3						
4			X			X
5						
6			X			X
7			X			
8			X		X	X
9			X			X
10			X			X
11						X
12						X
13				X		
14			X			X
15			X			X

(table continues)

Table 6 (continued)

Specific Responses - Three Checks Identification Sub-test

Participant	Pre-test			Post-test		
	O	B	R	O	B	R
16			X			X
17			X			X
18						
19						X
Participants incorrect	1	0	11	0	2	13

Note. X = incorrect; O = check label while obtaining medication; B = check label before pouring medication; R = check label while returning medication to original location.

The pre-test results displayed in Table 6 show that 18 of the participants correctly indicated that they would check the medication label(s) while obtaining medication; only one participant scored this part incorrectly. In contrast, all of the participants correctly indicated that they would check their medication label(s) before they poured the medication. More than half of the participants did, however, indicated that they would not check the medication label(s) for a third time before the medication was returned to its original location. This is significant, because if the participants were to go ahead and administer the medication before they performed the third check, they may realize that they administered the wrong medication when it came time to return the container to its appropriate location. The performance of the third check of medication label(s) constitutes a safety measure to aid in the prevention of medication errors; by neglecting

this check, 11 of the participants who wrote the pre-test on this topic indicated that they increased their potential for making an error. Furthermore, these results are comparable to the findings in the literature, whereby improper checking of medication labels, as is listed in Table 1, is a factor associated with the occurrence of medication errors.

The post-test results related to the specific responses to the checking of medication labels show that all the participants correctly identified that they would check the label(s) while obtaining their medication. Two participants indicated that they would not check the medication label(s) before pouring their medication, and 13 participants indicated they would not check the medication label(s) before returning the medication container to its original location.

With the exception of the first step in checking medication labels, more incorrect responses were cited for the second and third steps of the procedure on the post-test than on the pre-test. Three participants; namely, #11, #12, and #19 correctly identified the order of all three checks on the pre-test, but on the post-test, incorrectly indicated that they would administer their medication before performing the third label check. In two instances, participants #1 and #8, correctly identified the second and third check on the pre-test, but on the post-test, incorrectly identified the first check. It is hoped that this was just an oversight on part of the participants as this material was presented during the educational session. As well, all of the participants should have obtained 100% on both the pre-test and post-test because checking medication labels three times before administering medication is a procedure that has been learned, and should be being performed on a routine basis, by the community-based LPNs.

In addition to performing three label checks before administering medications, nurses are also taught to perform the “five rights” rule, which includes administering the right dose of medication to the right client, at the right time, by the right route, in the right dose. Table 7 reflects the test scores achieved by the participants in this sub-test.

Table 7

Sub-Test - Five Rights

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
1	5	100	5	100	0.0
2	5	100	5	100	0.0
3	3	60.0	5	100	40.0
4	5	100	5	100	0.0
5	5	100	5	100	0.0
6	0	0.0	4	80.0	80.0
7	3	60.0	3	60.0	0.0
8	4	80.0	5	100	20.0
9	4	80.0	5	100	20.0
10	2	40.0	4	80.0	40.0
11	4	80.0	5	100	20.0
12	4	80.0	5	100	20.0

(table continues)

Table 7 (continued)**Sub-test - Five Rights**

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
13	4	80.0	5	100	20.0
14	5	100	5	100	0.0
15	5	100	5	100	0.0
16	5	100	5	100	0.0
17	5	100	5	100	0.0
18	5	100	5	100	0.0
19	5	100	4	80	-20.0
MEAN	4.2	82.0	4.7	95.0	13.0

The pre-test results displayed in Table 7 show that the range of scores was between 0.0%, and 100%. The lowest score of 0.0% was obtained by participant #6, and the second lowest score of 40% was obtained by participant #10. In contrast, 10 participants obtained the highest score of 100%. In spite of the fact that slightly more than 50% of the participants attained a perfect score on this portion of the pre-test, about 47% of the participants would have failed this aspect of the pre-test. By not being able to correctly identify all of the "five rights" the participants are indicating that they potentially would have made at least one medication error.

The results of the post-test displayed in Table 7 show an improvement over the pre-test scores as 15 of the participants obtained 100%. As well, the lowest score obtained on

this portion of the post-test was 60%. In spite of the higher scores, however, four of the participants actually failed this part of the post-test because they did not obtain a perfect score.

Upon further examination of the data cited in Table 7, it can be seen that all the participants except for participant #19 either increased their post-test score or obtained 100 % on both the pre-test and post-test. As well, participant #6, who had the lowest score on the pre-test, obtained the highest increase in the percentage of her score on the post-test. The fact that the scores improved is also reflected in the post-test mean of 95%; which is an increase of 13% from the pre-test mean. One possible reason for the improvement in the participants' results could be due to the fact that they were able to refresh their memory of the "five rights" during the educational session. This could, however, also constitute testing effects because the information may have triggered the participants' memory regarding the rights they were unable to identify on the pre-test. Regardless of the reason for the increase in scores, it would appear that the participants were attentive during this part of the educational session.

To determine which of the "five rights" that were not correctly identified by the participants, the data were further analyzed and are presented in Table 8. Codes that describe each of the "five rights" are presented below the table.

Table 8

Specific Responses - Identification of the Five Rights Sub-test

Pre-test						Post-test				
Participant	D	M	T	P	R	D	M	T	P	R
1										
2										
3			X		X					
4										
5										
6	X	X	X	X	X		X			
7			X		X			X	X	
8			X							
9		X								
10		X	X	X				X		
11			X							
12		X								
13	X									
14										
15										
16										
17										

(table continues)

Table 8 (continued)

Specific Responses - Identification of the Five Rights Sub-test

Pre-test					Post-test					
Participant	D	M	T	P	R	D	M	T	P	R
18								X		
19										
Participants incorrect	1	4	6	2	2	0	1	3	1	0

Note. D = right dose M = right medication T = right time P = right patient R = right route X = wrong

The data in Table 8 indicate that the identification of administering medications at the correct time was the right that was most frequently missed on both the pre-test and the post-test. This is significant because if some medications, such as insulin, are administered at the wrong time, they could have an unfavourable impact upon clients. Three participants who provided the incorrect response on the pre-test for the right time, namely, participants #3, #8, and #11, provided the correct answer on the post-test. Participants #7 and #10, however, provided the incorrect response on both the pre-test and the post-test. As well, although participant #18 provided all the correct answers on the pre-test, she experienced a decreased post-test score in this area when she did not identify the right time as being one of the five rights.

In addition to being able to identify the five rights when administering medications, nurses must also ensure these rights are present in physician's orders before they are transcribed and implemented. To determine whether the participants could identify

orders that should be clarified before transcribing them, they were asked to transcribe five physician's orders. The results of this component of the pre-test and post-test are presented in Table 9.

Table 9

Sub-test - Transcription of Physician's Orders

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
1	1	25.0	1	25.0	0.0
2	4	100	4	100	0.0
3	2	50.0	2	50.0	0.0
4	0	0.0	4	100	100
5	4	100	4	100	0.0
6	1	25.0	4	100	75
7	0	0.0	0	0.0	0.0
8	0	0.0	0	0.0	0.0
9	1	25.0	0	0.0	-25.0
10	1	25.0	0	0.0	-25.0
11	0	0.0	0	0.0	0.0
12	2	50.0	2	50.0	0.0
13	0	0.0	0	0.0	0.0

(table continues)

Table 9 (continued)

Sub-test - Transcription of Physician's Orders

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
14	2	50.0	0	0.0	-50.0
15	0	0.0	2	50.0	50.0
16	4	100	4	100	0.0
17	1	25.0	2	50.0	25.0
18	4	100	4	100	0.0
19	2	50.0	0	0.0	-50.0
MEAN	1.5	38.2	1.7	43.4	5.3

The pre-test results displayed in Table 9 show that the range of scores was between 0.0% and 100%. Six participants, namely, participants #4, #7, #8, #11, #13, and #15, obtained the lowest score of 0.0%. The second lowest score of 25% was obtained by participants #6, #9, #10, and #15. In contrast, the participants who obtained the highest score of 100% were participants #2, #5, #16, and #18. In spite of the fact that some participants obtained a perfect score on this component of the pre-test, however, the mean was only 38.2%.

In order to obtain a perfect score on the pre-test discussed above, participants had to indicate that the route of medication administration was missing from all four orders. As was previously discussed, knowledge of the route of medication administration is one of the "five rights." Given that the ability to transcribe physician's orders correctly involves

knowing all of the “five rights,” it is disconcerting to note that the majority of the participants did not notice that the route of medication administration was missing in all the orders on the pre-test. Furthermore, the fact that so many participants scored 0.0% is perplexing because, with the exception of participant #7, participants #4, #8, #11, #13, and #15 scored 80% or higher in the “five rights” pre-test. These results are not, however, reflected in the transcription of physician’s orders component of the pre-test. This, in turn, is cause for concern for this researcher because although it may appear that the participants know the “five rights,” it is questionable as to whether they are able to apply them to specific situations, such as transcribing physician’s orders. The level of knowledge of the participants regarding the transcription of physician’s orders is further questioned when the post-test scores are examined.

Similar to the pre-test scores, the range of the post-test scores displayed in Table 9 was between 0.0% and 100%. Eight participants, participants #7, #8, #9, #10, #11, #13, #14, and #19, obtained the lowest score of 0.0%. In contrast, six participants obtained the highest mark of 100%; these participants were #2, #4, #5, #6, #16, and #18. Although more participants obtained a perfect score in this portion of the post-test, the mean still remained low at 43.4%. The reason for this occurrence is most likely due to the fact that more participants obtained a score of 0.0% on the post-test.

It is interesting to note that participants #7, #8, #11, and #13 obtained a score of 0.0% on both the pre-test and the post-test discussed above. As well, the scores for participants #9, and #10 decreased from 25.0% to 0.0%, and the scores for participants #14, and #19 decreased from 50.0% to 0.0%.

The reason for the low scores cited above are not known; however, it is possible that these participants did not entirely understand the question and, as a result, provided answers that were incorrect. Since the question asked the participants to transcribe the physician's orders, and to indicate why they would or would not give the medication(s), some participants may have read more into the question than what was needed, thereby overlooking the obvious answer. Another reason for the low scores could have been due to the fact that the orders were hard to read and, as a result, the participants could not identify what was, or was not, missing from each order. A third reason for the low scores could be the fact that LPNs traditionally have not transcribed physician's orders per se; they have only been required to re-copy medication sheets which are based on physician's orders. Combined with the fact that the orders were difficult to read, and the unfamiliarity with the task, it is quite possible the LPNs who scored 0.0% did not know how to transcribe the orders properly. As well, similar to the discussion regarding the pre-test, the LPNs may have been aware of the "five rights," but were unable to apply them to this situation. Regardless of the reason for the low scores, the fact that the scores were so low has implications. The reason for this is because it is a goal of Home Care to have LPNs transcribe physician's orders. If the LPNs are not able to perform this task correctly, then, as is indicated in the literature, and listed in Table 1, there is a potential for medication errors being made. This could be serious if, for example, a dose of a medication that slows the heart was transcribed as being higher than what was ordered.

Related to the ability to properly transcribe physician orders is the ability to correctly calculate how much medication must be poured so that the dose that is being administered is actually what was ordered. To determine how well the participants could

calculate dosages of medications they commonly administered, five calculation questions were included in the pre-test and post-test. The results of this sub-test are presented in Table 10. The first four questions involved calculations related to tablets and capsules; the fifth question involved calculating the total amount of insulin that needed to be drawn up prior to its administration.

Table 10

Sub-test - Medication Calculations

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
1	2	40.0	3	60.0	20.0
2	3	60.0	4	80.0	20.0
3	4	80.0	4	80.0	0.0
4	4	80.0	5	100	20.0
5	5	100	5	100	0.0
6	2	40.0	3	60.0	20.0
7	2	40.0	2	40.0	0.0
8	4	80.0	4	80.0	0.0
9	3	60.0	3	60.0	0.0
10	3	60.0	4	80.0	0.0
11	5	100	4	80.0	-20.0
12	3	60.0	3	60.0	0.0

(table continues)

Table 10 (continued)

Sub-test - Medication Calculations

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
13	2	40.0	3	60.0	20.0
14	4	80.0	5	100	20.0
15	5	100	5	100	0.0
16	4	80.0	4	80.0	0.0
17	4	80.0	5	100	20.0
18	5	100	5	100	0.0
19	5	100	5	100	0.0
MEAN	3.6	72.6	4.0	78.9	6.3

The pre-test results displayed in Table 10 show that the range of scores was between 40% and 100%. Four participants, namely, participants #1, #6, #7, and #13, obtained the lowest score of 40%. Participants #5, #11, #15, #18, and #19, on the other hand, obtained the highest score of 100%. The overall mean obtained on the pre-test was 72.6%. Given the fact that schools of nursing establish a rate of 80% or more as a pass mark for students writing a calculation test, the results obtained in this study indicate that eight participants essentially failed the test on medication calculations. Although there would be different questions on a test administered by a school of nursing, these results have implications because the calculation questions in the pre-test were very basic. This, in turn, makes the researcher question the ability of some of the participants to properly

calculate the dose(s) of medications when they are administering medications to their clients. It is quite possible that some of the participants are increasing their potential to make medication errors based on the medication calculations they perform.

Similar to the pre-test scores displayed in Table 10, the range of the post-test scores was between 40% and 100%. The participant who obtained the lowest score of 40% was participant #7. In contrast, several participants, #4, #5, #14, #15, #17, #18, and #19, obtained a score of 100%. The post-test mean was 78.9%.

As can be seen from the results cited above, three of the participants, namely participants #1, #6, and #13, increased their scores to 60% on the post-test. Participant #7, however, maintained a score of 40% on both the pre-test and the post-test. In contrast, participants #5, #15, #18, and #19 maintained a score of 100% on both the pre-test and post-test. Participant #11, however, obtained a lower score of 80% on the post-test, which is a 20% decrease from her pre-test score. This participant also experienced a decreased score in the "Three Checks" component of the post-test.

In spite of the fact that several participants increased their score on the post-test, six participants basically failed the medication calculation portion of the post-test because they did not achieve a score of at least 80%. The reason why some of the participants did not do well in this component of the post-test is unknown; however, it could be due to the fact that they may not possess the skills that are needed to perform the calculations correctly. Conversely, some participants may have found it difficult to do calculations on paper without actually having access to the medication(s) requiring dosage calculations. Length of time allotted to complete the calculations may also have been a factor that contributed to the low scores. Regardless of the reason for some of the low scores on this

post-test, the results do indicate that there is a need for intervention in this area. To determine which calculations may have posed the most difficulty, and therefore help guide future intervention in this area, the data were further analyzed according to the responses for each question. These results are displayed in Table 11.

Table 11

Specific Responses - Medication Calculations Sub-test

Participant	Pretest					Post-test				
	1	2	3	4	5	1	2	3	4	5
1	X	X			X	X	X			
2		X			X		X			
3		X			X		X			
4					X					
5										
6	X	X			X		X			X
7	X	X			X	X	X			X
8					X					
9		X			X		X			X
10			X		X			X		
11										X
12	X	X				X	X			
13	X	X			X		X			X
14					X					

(table continues)

Table 11 (continued)

Specific Responses - Medication Calculations Sub-test

Participant	Pre-test					Post-test				
	1	2	3	4	5	1	2	3	4	5
15										
16					X					X
17					X					
18										
19										
Participants incorrect	5	8	1	0	13	3	8	1	0	7

Note: X = incorrect response

The pre-test results displayed in Table 11 show the question that the participants had the least difficulty with was question #4 (see Chapter 3 or Appendix C); all of the participants answered this question correctly. The calculation involved in this question required the participants to determine how much of a tablet should be administered when the dose ordered was half of the tablet dosage. The participants did not score as well on question #2, however, which also involved the calculation of determining calculating tablet dosage. The tablet involved in this question was Digoxin, which is a widely prescribed medication that lowers the heart rate. The fact that 8 of the participants answered this question incorrectly is cause for concern because this is a medication that LPNs administer quite often. It is quite possible that the participants found this question

to be difficult because it involved decimals, which would have been more difficult to calculate than dosages in the form of whole numbers.

A second question on the pre-test that participants experienced difficulty with was question #5 (see Chapter 3 or Appendix C); 13 of the participants answered this question incorrectly. The calculation involved in this question required the participants to add the doses of two different types of insulin together. The reason why so many participants answered this question incorrectly could have been due to the fact that although the mixing of two insulins is a skill the LPNs learned in nursing school, it is not a task they currently perform in Home Care. If unfamiliarity with this task was the reason for the low score for this question, then more education in this area will be needed since the mixing of two insulins is a task that LPNs in Home Care will be performing in the not too distant future.

With regard to the post-test scores displayed in Table 11, 7 participants answered question #5 incorrectly. As well, 8 of the participants answered question #2 incorrectly. All of the participants answered question #4 correctly.

Based on the results above, it would appear that some of the participants found the presentation on the topic of mixing insulins to be of benefit to them because fewer of them answered the question related to this task incorrectly. This was not the case with question #2, however, because the same number of participants answered the question incorrectly in both the pre-test and the post-test. As the results also indicate, it was the same participants who answered the question incorrectly on both occasions. It was, however, reassuring to see that none of the participants answered question #4 incorrectly on either the pre-test, or the post-test. The fact that only four participants achieved 100%

on both the pre-test and post-test in this sub-test does, however, coincide with what is cited in the literature about nurses' performance with calculations. Although the participants did not fare as well in this sub-test as was hoped, they still obtained scores that, overall, were higher than those associated with transcribing physician's orders; the lowest scores of all the sub-tests in Part 1 of the pre-test and the post-test were obtained on this sub-test. To assess whether scores improved in the last two sub-tests, the data for the second part of the pre-test and post-test will now be presented.

Sub-test Scores – Part 2

Part 2 of the test consists of two sub-tests which include a true/false test related to knowledge about insulin and two pills, Glucophage and Glyburide, used to treat diabetes. The second sub-test assesses the participants' ability to correctly order the steps involved in insulin administration. Data related to scores obtained from the true/false test are displayed in Table 12.

Table 12

Sub-test - Glyburide/Glucophage/Insulin

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
1	6	33.0	11	61.0	28.0
2	10	56.0	16	89.0	33.0
3	10	56.0	12	67.0	11.0
4	9	50.0	14	78.0	28.0

(table continues)

Table 12 (continued)

Sub-test - Glyburide/Glucophage/Insulin

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
5	12	67.0	15	83.0	16.0
6	5	28.0	15	83.0	55.0
7	12	67.0	10	56.0	-11.0
8	14	78.0	17	94.0	16.0
9	9	50.0	12	67.0	17.0
10	16	89.0	16	89.0	0.0
11	8	44.0	13	72.0	28.0
12	13	72.0	13	72.0	0.0
13	8	44.0	11	61.0	17.0
14	12	67.0	18	100	33.0
15	14	78.0	13	72.0	-6.0
16	9	50.0	13	72.0	12.0
17	10	56.0	14	78.0	22.0
18	13	72	17	94.0	22.0
19	13	72	15	83	11.0
MEAN	10.7	59.4	14	77.4	18.0

The pre-test results displayed in Table 12 show that the range of scores was between 28% and 89%. The participant who obtained the lowest score of 28% on the pre-test was

participant #6, and the participant who obtained the highest score of 89% on the pre-test was participant #10. The mean obtained for the pre-test scores was 59.4%.

The post-test results displayed in Table 12 show that the range of scores was between 56% and 100%. The participant who obtained the lowest score of 56% was participant #7, and the participant who obtained the highest score of 100% was participant #14. The mean obtained for the post-test scores was 77.4%.

It is interesting to note that participant #6, who scored lowest on the pre-test, obtained the highest increase in percentage of score on the post-test; her mark in this case was 89.0%. In contrast, two participants obtained lower scores on the post-test than the pre-test. Participant #7 obtained a score of 67% on the pre-test, and a score of 56% on the post-test. Participant #15 obtained a score of 78% on the pre-test, and a score of 72% on the post-test. Neither participant #7 or participant #15 experienced a decline of scores in any of the sub-tests presented in Part 1 of the test. They did, however, exhibit no, or minimal, increases in their scores throughout all of Part 1.

Based on the data displayed in Table 12, the participants obtained an overall increase of 18% from their pre-test to their post-test scores. This increase in percentage is larger than the increase in percentage of the scores presented for all the sub-tests in Part 1 of the pre-test and post-test. These results suggest that attending the educational session on medication administration helped them increase the participants' knowledge about medications used to treat diabetes.

Since insulin and the pills used to treat diabetes are different in their action and route of administration, the results presented in Table 12 were analyzed to determine if there

were more correct responses for questions related to one type of medication versus another. These results are presented in Table 13.

Table 13

Specific Responses - Glyburide/Glucophage/Insulin Sub-test

Participant	Glyburide (score out of 4)		Glucophage (score out of 4)		Insulin (score out of 10)	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
1	1	1	0	3	5	7
2	2	3	0	3	8	10
3	2	1	0	1	8	10
4	2	2	0	3	7	9
5	3	4	3	3	6	8
6	0	2	0	4	5	9
7	1	0	2	1	9	9
8	3	3	2	4	9	10
9	0	2	2	1	7	9
10	3	3	4	2	9	10
11	1	2	1	2	6	9
12	1	2	2	1	10	10
13	2	1	0	1	6	9
14	1	2	2	3	9	9
15	2	2	3	3	9	8

(table continues)

Table 13 (continued)

Specific Responses - Glyburide/Glucophage/Insulin Sub-test

Participant	Glyburide (score out of 4)		Glucophage (score out of 4)		Insulin (score out of 10)	
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
16	2	3	2	2	5	8
17	2	3	0	3	8	8
18	3	4	3	4	7	9
19	3	3	3	3	7	9
MEAN	1.8	2.3	1.5	2.5	7.4	8.9

The comparison of scores between the responses for the three medications are unequal because there were 10 questions for insulin, and only four questions each for Glyburide and Glucophage. In terms of correctly answering all the questions related to each medication, however, five participants answered all the insulin questions correctly, three participants answered all of the Glyburide questions correctly, and two participants answered all of the Glucophage questions correctly. None of the participants achieved a perfect pre-test and post-test score for the questions related to Glyburide and Glucophage, but one participant did obtain a perfect score on the insulin questions for both the pre-test and the post-test. If an arbitrary pass mark of 50% was established for each of the sub-tests, the overall score related to the questions about insulin would be higher than those associated with the other two medications.

It is interesting to note that, overall, the participants seemed to know more about insulin than the oral anti-diabetic medications. Perhaps the reason for this is because

insulin is given by injection, which may make it seem to be a more important medication than medications that are administered by the oral route. Regardless of the reason for the difference in scores between the two types of medications, however, the results do indicate that a lack of knowledge may be present regarding the oral anti-diabetic medications.

In addition to testing the participants' knowledge about oral anti-diabetic medications and insulin, another sub-test was developed to assess their ability to correctly identify the steps involved in drawing up and administering insulin to a client. This sub-test represents the completion of Part 2 of the pre-test and post-test, and consists of 11 steps involved in administering insulin. The scores obtained from this sub-test are displayed in Table 14.

Table 14

Sub-test - Steps of Insulin Administration

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
1	3	27.0	11	100	73.0
2	11	100	9	82.0	-18.0
3	9	82.0	7	64.0	-18.0
4	9	82.0	9	82.0	0.0
5	5	45.0	4	36.0	-9.0
6	9	82	11	100	18.0

(table continues)

Table 14 (continued)

Sub-test - Steps of Insulin Administration

Participant	Pre-test	Percent	Post-test	Percent	Percent Change
7	7	64.0	9	82.0	18.0
8	7	64.0	3	27.0	-37.0
9	11	100	11	100	0.0
10	9	82.0	9	82.0	0.0
11	11	100	11	100	0.0
12	9	82.0	8	73.0	-11.0
13	4	36.0	4	36.0	0.0
14	8	73.0	9	82.0	9.0
15	9	82.0	9	82.0	0.0
16	11	100	11	100	0.0
17	9	82.0	11	100	18.0
18	7	64.0	9	82.0	18.0
19	9	82	9	82	0.0
MEAN	8.3	75.2	8.6	78.5	3.3

The pre-test results show that the range of scores was between 27% and 100%. The participant who obtained the lowest score of 27% on the pre-test was participant #1.

Three participants obtained the highest score of 100% were participants #9, #11, and #16.

The mean obtained on this pre-test was 75.2%.

The post-test scores displayed in Table 14 show that the range of scores was between 27%, and 100%. The participant who obtained the lowest score of 27% was participant #8. Six participants obtained the highest score of 100% on the post-test; these were participants #1, #6, #9, #11, #16, and #17. The mean obtained on this post-test was 78.5%.

As can be seen from Table 14, the change in the percentage of an increase in scores from the pre-test to the post-test is only 3.3 %. As well, participants #2, #3, #5, #8, and #12 all experienced a decrease in their post-test scores; participant #8 experienced the greatest decrease of 37%. With the exception of participant #2, none of the participants had experienced a decrease in post-test scores in the previous sub-tests. The sub-test that participant #2 achieved a lower post-test score on was that of the medication administration sub-test in Part 1 of the post-test. It is also interesting to note that participant #1, who obtained the lowest score of 27% on the pre-test, was one of the participants who obtained 100% on the post-test.

The scores presented in Table 14 relate to all the steps involved in insulin administration. Similar to the medication administration pre-test and post-test in Part 1, a sub-component of the insulin administration test was analyzed to determine how the responses were distributed for the actual procedure of injecting the insulin. In this component, participants had to indicate that they would first pinch the skin, insert the syringe, and then release the skin. Scores for this component are presented in Table 15.

Table 15

Specific Responses - Three Steps of Actual Insulin Administration Sub-test

Pre-test				Post-test		
Participant	P	I	R	P	I	R
1						
2						X
3		X	X	X	X	
4			X			X
5	X	X	X	X		X
6						
7			X			
8	X		X	X	X	X
9						
10	X		X			X
11						
12			X			
13	X	X	X	X		X
14			X			
15			X			X
16						

(table continues)

Table 15 (continued)

Specific Responses - Three Steps of Actual Insulin Administration Sub-test

Pre-test				Post-test		
Participant	P	I	R	P	I	R
17		X	X			
18	X		X			X
19			X			X
Participants	5	4	13	3	2	10
Incorrect						

Note: P = pinch skin; I = inject; R = release of skin

As can be seen from the data in Table 12, almost 2/3 of the participants indicated in the pre-test that they would not release the skin after injecting the insulin syringe. The scores in this area improved slightly on the post-test. The implication of not releasing the skin after injecting insulin, and hence, performing the procedure in an incorrect order is that the insulin would not be absorbed in an efficient manner. This implication, as well as others in relation to the results presented in this chapter, will be discussed in the following chapter.

CHAPTER 5

CONCLUSION

This chapter consists of an overall summary of the study presented in the first four chapters of this thesis, and a discussion of how the results obtained from the study have implications for the LPN supervisors in the Home Care program. The limitations of the study design, as well as answers to the three research questions that were developed for this study are also discussed. Although there are limitations to the design of this study, the results indicate that the knowledge levels of medication administration of the participants in this study were lower than expected. Some of the possibilities for this outcome are addressed in this chapter, as well as recommendations for future educational sessions in this area. Briefly, these recommendations are to have mandatory educational sessions on medication administration for community-based LPNs using the ELM by Kolb (1981), more frequent performance evaluations of community-based LPNs, and replication of this study using the Solomon Four Group design (Campbell & Stanley, 1966). The chapter concludes with a brief discussion on the importance of ensuring health care providers are competent and how the results obtained from this study can be used to enhance this competence.

Summary

In summary, the purpose of this study was to assess the medication administration knowledge of community based Licensed Practical Nurses (LPNs) employed by a regional health authority. The reason this study was conducted was because there was an increase in the number of reported medication errors made by a specific group of community-based LPNs over two years, 1997 to 1998. In 1997, 14 separate medication

errors were reported, and in 1998, 43 separate medication errors were reported. The reason for the increase in the number of medication errors made is not known; however, it is known that medication errors occur when the "five rights" rule of administering medications is not followed. These rights consist of administering the *right dose* of the *right medication* to the *right client* by the *right route* at the *right time* (Nursing81, 1981, p. 12). The fact that these rights were not being followed, which in turn, resulted in the making of medication errors, was of concern to this researcher and the supervisor of the nursing unit. To address this concern, the researcher developed a medication review module for the LPNs that was to be presented in an educational session. The knowledge level of the LPNs regarding medication administration was to be measured both before and after they attended the session.

The medication review module was based on a review of the literature, which is presented in Chapter 2 of this thesis. Several studies discussed in this review indicate that many factors are associated with the making of medication errors. Some of these factors include lack of knowledge about the purpose and action of medications, improper checking of medication labels, incorrectly transcribing physician orders, and incorrectly calculating the dosages of medications that are to be administered. These factors are categorized as individual factors associated with medication errors, which contrast with systemic factors associated with medication errors that are also identified in the literature. The difference between the two types of factors is that individual factors relate to factors that can be controlled by individuals, whereas systemic factors relate to factors that are beyond an individual's control; a dispensing system in a hospital is an example of a systemic factor.

In addition to reviewing studies related to factors associated with the making of medication errors, studies related to strategies designed to reduce the incidence of these errors were also reviewed. The outcome of this review was that various strategies have been employed with regard to the prevention of medication errors. Since not all the strategies could, realistically, be applied to community-based LPNs, only the studies regarding educational strategies were reviewed and presented in this thesis. Three of these studies, which were the ones conducted by Bayne and Bindler (1997), Flynn et al. (1996), and Werab et al. (1994) were used to develop the design for this study.

In addition to reviewing educational strategies, models of educational interventions were also reviewed. The model selected for designing the educational session for this study was the Experiential Learning Model by Kolb (1981). The reason why this model was selected and used in the design of the study was because it addressed a variety of learning styles and focused upon active, versus passive, learning.

The design of this study, which is described in Chapter 3 of this thesis, was quasi-experimental, and included a pre-test and a post-test, which were both administered before and after participants attended an educational session related to the medication administration module. The module consisted of two parts; Part 1 consisted of five separate areas specifically related to the process of administering medications, and Part 2 consisted of two separate areas related to the knowledge of insulin, and oral anti-diabetic medications. Both the pre-test and the post-test contained the same questions, and the participants were made aware of the fact that they would be asked to write these tests in conjunction with attending the educational session. The sample consisted of 19 LPNs; one of whom was male. Since the results of all the participants were anonymous, the

researcher was not able to determine whether his score was any different than the scores of the female participants. Consent was obtained by all of the participants before they participated in the study. The participants were also informed that they would receive the results of the data analysis within six months. The session was held on two separate days to accommodate as many LPNs as possible. The total time commitment for each session was 2 ½ hours. Some of the limitations of this study, which are addressed in more detail in the third chapter, include small sample size, which limits generalizability, voluntary participation, and testing effects. In spite of the limitations, however, the data obtained from the participants' pre-tests and post-tests, which are presented in the fourth chapter of this thesis, revealed some interesting and important findings.

The main finding obtained from the data collection for this study was that the overall scores of participants for both the pre-test and post-test increased by 9.6% from the writing of the pre-test to the writing of the post-test. A more detailed analysis revealed that scores increased by 7% on the writing of Part 1 of the pre-test to the writing of Part 2 of the post-test, and scores increased by 12% on the writing of Part 2 of the pre-test to the writing of Part 2 on the post-test. These results did not, however, provide insight of what areas of the test reflected highest and lowest scores. As a result, the data were further analyzed with regard to each sub-test.

Results of each of the sub-tests indicated that the areas where the participants' scores are lowest throughout the pre-test and post-tests are those of the transcription of physician orders, calculations of medication dosages, lack of knowledge about medications, and checking of the medication labels. These results reflect some of the findings in the literature, and all areas are identified in Table 1 as being factors

associated with the making of medication errors. If these results are indicative of how some of the participants actually perform their medication administration tasks, then there is the possibility that some of the medication errors that were documented in Chapter 1 of this thesis may have been due to one or more of these four factors. Thus, in spite of this study's limitations, the results do have implications. These implications, along with recommendations to increase and assess the knowledge level of the LPNs working in Home Care, will now be discussed.

Discussion

The overall results of the data collection for this study indicated that the participants' knowledge base about medication administration increased by 9.6% after they had attended an educational session on this topic. This figure in itself does not provide much information regarding which areas the participants found most difficult. Upon examining the scores of each sub-test, however, it is evident that the one area the participants experienced the most difficulty with was transcribing physician orders.

The low scores in the area of transcribing physician orders has implications for the current nursing practice of the LPNs because one of the tasks that they are required to do is to re-copy medication sheets each month. To complete this task, the LPNs must check the physician's orders to ensure the orders and their transcription onto the medication sheets match. If the orders are not transcribed correctly, and the nurse only follows what is written on the current medication sheet, then a medication error will occur when the medication in question is administered to a client.

Given that the orders used in the test were actual orders, and the fact that about 42% of the participants obtained a score of zero on the post-test, the researcher questions

whether physician orders are being checked by community-based LPNs before medication sheets are recopied. The researcher also questions whether the physician's orders are being checked before the prescribed medications are administered. These questions also lead to a larger issue, which is the fact that although most of the LPNs in the study could correctly recall the "five rights" rule of medication administration, they were not able to apply the rule to transcribing the orders. This was evident because they did not indicate that the route of administering the medication was missing from the orders they were asked to transcribe.

In addition to transcribing physician orders, another area of the pre-test and the post-test that warrants consideration is that of the scores obtained on the medication administration sub-test. Although the majority of the post-test scores were 80% or higher, it was found that upon a specific analysis of the three checks sub-test, more than 50% of the participants had incorrect responses in this area. The check that had the most incorrect responses was checking the label while returning the medication to its original location. The fact that this label is not checked a third time does not, in itself, constitute a medication error; however, it does increase the potential for the making of a medication error. The reason for this is because the third label check is an additional safety precaution. By administering a medication, and then coming back to check the label before returning the medication to its original location, it is quite possible that the LPN could discover that the wrong medication, or wrong dose of the medication, had been administered. If the third label check had been performed, however, it is quite possible the LPN could have prevented this error from occurring. The fact that the improper

checking of medication labels contributes to the occurrence of medication errors has also been identified by Long and Johnson (1981).

Although some nurses may not perform the three label checks when administering medications, they are sometimes fortunate enough to avoid making a medication error. This fortunate situation can, however, quickly turn to a misfortunate situation in the event that an error is made in the calculation of a medication dosage. Based on the results obtained from the sub-test on medication calculations, it is possible that the likelihood of a medication error occurring as a result of an incorrect calculation is greater than that of not checking the medication label three times.

In the Practical Nursing program offered by Assiniboine College (1999), the passing mark for a medication calculation test is 90 %; some schools of nursing only require 80% to pass a medication calculation test. With regard to Assiniboine College, however, the students are allowed to write the calculation test three times in order to obtain 90%; if they do not achieve 90% on the third writing of the test, they are asked to leave the program before they have even administered one medication to a client. In essence, the student has been deemed to be unsafe and is at risk of causing client injury. If the results obtained from the calculation questions on the post-test in this study were applied to the rules of the college, then about 63% of the participants in this study would have had to re-write their calculation test. Even if the passing mark had been 80%, about 42% of the participants would have had to re-write their calculation test. Unfortunately, the participants in this study are no longer students and, as previously discussed, nurses do not excel in performing calculations. Although the results of this study are to be interpreted with caution, the results obtained by this researcher seem to reflect the

findings in the literature in this area. Given that the calculations on the post-test were simple ones and are ones that are used frequently, it is worrisome that so many of the participants did not achieve at least 90 % on this area of the test.

Similar to the calculation sub-test, the Glyburide/Glucophage/insulin test also warrants attention. Although the average overall score for the insulin component of this test indicates that the LPNs have a good knowledge base regarding this medication, the scores related to the oral anti-diabetic agents indicates that their knowledge base is limited in this area. This has implications for client care because the incidence of non-insulin dependent diabetes doubled from 1960 to 1980 (Watkins, Drury, & Taylor, 1990), and is anticipated to keep on rising as the population ages. This, in turn, means that more medications to treat diabetes are most probably going to have to be administered in the future. Community-based LPNs will directly be affected by this occurrence because the number of elderly clients who receive Home Care is continuing to increase (Hollander Analytical Services, 2000). If the LPNs do not know what the action or side effects of the oral anti-diabetic medications are, as is indicated by the scores reflected in this area of the post-test, then the potential for complications related to diabetes increases. For instance, hypoglycemia, or low blood sugar, is a side effect of Glyburide (Canadian Pharmaceutical Association, 1997). If the LPNs are not aware of this, they may not monitor this side effect due to lack of knowledge about the medication. As previously mentioned, a lack of knowledge about specific medications has also been identified by Boggs, et al. (1988), Cheek (1997), Conklin et al. (1990), Leape et al. (1995), and Markowitz et al. (1980) as being a factor that contributes to the making of medication errors.

Unlike oral anti-diabetic agents, insulin is administered by subcutaneous injection according to specific steps. The LPNs in this study were asked to correctly identify the order of these steps in the last sub-test of the pre-test and the post-test. Only about 32% of the participants achieved 100 % in this area. Upon further analysis of the post-test data, it was noted that about 53% of the LPNs indicated that they would not release the skin after injecting the medication. Although this does not constitute a medication error, it can affect the absorption of insulin, which, in turn, can affect blood sugar levels.

Thus far the results of the pre-test and the post-test that the LPNs wrote as part of this study suggest that more information regarding medication administration would be beneficial. It is not known if some of the lower scores were due to nervousness at writing the tests, or if the LPNs were deficient in their knowledge about medication administration. It is also puzzling as to why some of the participants experienced a decrease in their scores on the post-test. Perhaps one reason for this could have been due to the length of time of the session, which may have caused some of the participants to become tired. The results on the pre-test and the post-test may have different if the session had been presented over two days, which was the original intent.

The results of the data obtained from the scores on the pre-test and post-test that the participants in this study wrote are by no means conclusive because the study design possesses several limitations. For example, the sample size was small, all the participants were voluntary, and there was no random assignment used. All of these limitations have an impact on the generalizability of the results to community-based LPNs. As well, bias could be present because all the materials and tests used in this study were developed by the researcher. When other studies are examined, however, it can be seen that similar

limitations are present in them as well. With regard to the study by Werab et al. (1994), for example, the sample size was very small and consisted of 11 RNs and only one LPN. Sample sizes were slightly larger in the studies conducted by Bayne and Bindler (1997), and Flynn et al. (1996); however, the number of LPNs in the samples were either non-existent, or very small. In the study by Bayne and Bindler (1997) for example, there were 67 RNs, and no LPNs in the sample, and in the study by Flynn et al. (1996), there were 129 RNs, and only 21 LPNs in the sample. Thus, although it can be seen that the sample of the number of LPNs in this researcher's study was small, it was still larger than the samples of the numbers of LPNs in the studies by Bayne and Bindler (1997), and Werab et al. (1994).

In addition to small LPN sample sizes, another limitation that is present in the design of this researcher's study, which is also present in the three studies discussed above, is that none of the materials used in the studies were standardized. Similar to this researcher's study, all the materials were researcher-developed. Thus, bias and a lack of content validity could also have been present in these studies.

One limitation that is present in this researcher's study, and in the study by Werab et al. (1994), but is not present in the studies by Bayne and Bindler (1997), and Flynn et al. (1996), is that random assignment was not used. This, in turn, would decrease the generalizability of results. Furthermore, the fact that there were no RNs in the sample in this study, but there were RNs in the other three studies has implications because the RNs' knowledge base about medication administration may have been at a higher level than the knowledge base of the LPNs in the samples. This, in turn, may have influenced the outcome of the results in all these studies.

Thus, although this researcher's study does have limitations that have an effect upon the generalizability of its results, it can also be seen that other studies have similar limitations. In essence, the design of this study is not, if any, worse than the designs used in the studies by Bayne and Bindler (1997), Flynn et al. (1996), and Werab et al. (1994). As well, the results obtained in these three studies, as well as the researcher's study, were all similar in that higher marks were reflected in all of the post-tests in all the studies. It should also be noted that all three of these studies were conducted in a hospital setting, whereas this researcher's study was conducted in community setting.

The fact that this study possessed some limitations also affect how the research questions established for this study can be answered. For instance, the first research question was: What will the knowledge level of community-based LPNs be in regard to medication administration before attending two educational sessions on medication administration? Although this question can be answered with regard to the fact that the knowledge level of the LPNs was assessed prior to their attendance at an educational session, it is limited by the fact that there were only 19 LPNs who wrote the pre-test. This, in turn, affects the generalizability of the results. As well, the intent was to have two separate educational sessions, with one session consisting of Part 1 of the medication administration module, and another session consisting of Part 2 of the medication administration module. This did not materialize due to time constraints on part of the LPNs. This situation may not have had any impact on the results obtained from the writing of the pre-test, however, it may have had an impact on the results obtained on the writing of the post-test, which refers to the second research question.

The second research question developed for this study was: What will the knowledge level of community-based LPNs be in regard to medication administration after attending two educational sessions on medication administration? Since both parts of the medication administration module were presented in one educational session, this research question cannot effectively be answered. The reason for this is because by presenting all the information in one session, the participants in the study may have experienced an overload of information, and may have been tired by the time they wrote the post-test. This, in turn, may have been a factor that caused some LPNs to obtain lower scores on each post-test because they only attended one educational session; the scores of these LPNs may have been higher if they had attended two separate, and shorter sessions. Thus, the answer to this research question is based solely on the results obtained from writing the post-test after one session. As previously stated, these results did show an increase in the knowledge of medication administration from the writing of the pre-test. It is quite possible that this increase in knowledge may not only have been due to the learning of new information presented in the educational session, but it may also have been due to testing effects.

The third research question developed for this study was: How much knowledge about medication administration will be retained by the LPNs eight weeks after the second educational session ended? The researcher was not able to answer this question because it was not possible for the participants to do the post-test. This is unfortunate because it would have allowed this researcher to assess how much information was retained by the participants in the study. It is well documented that information is not retained for long periods of time once it is presented. For instance, McLeish (1968)

(cited in Andrusysyn, 1990) noted that in several studies, knowledge retention tested immediately post-lecture indicated that only 41% of the information could be recalled by students. This figure dropped to 17% one week later. Thus, it is quite possible that a similar situation could apply to the LPNs in this study; due to the fact that there was no retention post-test, however, this will never be known for these LPNS.

The fact that it is difficult to answer all the research questions developed for this study, and the fact that the results must be interpreted with caution due to the limitations of the study design, are the basis for the recommendations made by this researcher. These recommendations relate to both the results obtained in this study as well as the study design, and are discussed below.

Recommendations

The first, and foremost, recommendation that this researcher would make is that all LPNs be required to attend regularly scheduled educational sessions on different aspects of medication administration. Although the results of this study are not conclusive, they do indicate that there are serious gaps in the knowledge base of the LPNs who participated in this study. This lack of knowledge, as was previously discussed, is one factor that contributes to the making of medication errors. Thus, it is essential that LPNs upgrade their knowledge base regarding medication administration in order to prevent a further increase in the number of medication errors being made and reported in the workplace. A pre-test and post-test could be administered before and after each educational session to see if an increase in knowledge was present after attending these sessions. A test alone, as was discovered by Calliari (1995), however, would not be effective in increasing the knowledge base of the LPNs. The reason for this is because

the LPNs would be tested on the knowledge base they currently possess, without any new knowledge about medications being added. As well, it is also important for the LPNs to have ongoing educational sessions because many LPNs in Home Care have been employed in their current position for more than 10 years, and had few, if any, educational sessions regarding medication administration since they started working in this capacity. Furthermore, ongoing professional education for community-based LPNs would be consistent with many other professions which require their members to seek out additional education in their specific area of employment.

In addition to conducting ongoing educational sessions about medication administration, this researcher would recommend that the format of the sessions be designed according to the ELM (Kolb, 1981), which, as was previously mentioned, was the educational intervention used by this researcher. This model was selected because it was designed to meet a variety of learning needs. For instance, to acquire *concrete experiences*, the participants were presented with examples of the types of medication errors their peers had made over the past two years. They were then asked to discuss how these medication errors could have been prevented, or how they may have occurred (*reflective observation*). A brief lecture addressing medication policies and administration was then be presented (*abstract conceptualization*). Once this was been completed, the participants were given a case study to analyze (*active experimentation*) in small groups. Each group was then asked to present their solutions to a series of questions posed in the case study. To successfully complete this assignment, the LPNs needed to draw upon their previous knowledge and experience regarding medication errors and incorporate new learning into the project. By doing this, they used their own

experiences to guide them to formulate and to integrate new concepts in the area of medication administration.

Inclusion of the case study was perhaps the most important activity of the learning cycle because not only do case studies promote cooperative learning and active participation (Glendon & Ulrich, 1992), they also facilitate problem-solving, and application of theory to practice (Dailey, 1992). In essence, once the participants in this study completed the Kolb (1981) learning cycle, they should possess the ability to apply this learning to the clinical area. Based on the fact that the LPNs are not observed on a regular basis while working in the community, it is difficult to assess whether this is the case.

To determine how well the LPNs are applying their knowledge about medication administration in the community setting, this researcher would also recommend that more frequent performance evaluations be conducted on all LPNs employed with Home Care. As well, this researcher would recommend that more frequent evaluations be performed on LPNs who reported their medication errors. By doing this, the supervisor of the LPNs would ensure that the medications were being administered correctly and, if they were not, could implement corrective, not disciplinary, action to help the LPNs reduce their risk and, hence, incidence of the making of medication errors. Given that the community-based LPNs work with very little supervision in Home Care, evaluations of their performance, especially in the area of medication administration, is of the utmost importance.

A third recommendation this researcher has is to repeat this study, with the same module, using a better research design, such as the Solomon Four Group design

(Campbell & Stanley, 1966). The reason for this is because testing effects would be reduced, and the results would be more generalizable than the ones obtained in this study. This researcher does, however, recognize the fact that a large sample size would be required, and that some of the participants would not be part of the educational session. If it was feasible, however, this researcher would recommend offering the session at an alternate time for those who did not have the opportunity to attend while the study was being conducted. This session would be held after a retention post-test, which would also be part of the design, had been written.

Although the assessment of post-test knowledge would not directly help reduce the incidence of medication errors, it would, indirectly, be of benefit because it would indicate how much information the LPNs retained after their attending their educational session(s) on medication administration. Replication of this study would also be useful because if enough results were obtained that were generalizable to community-based LPNs, which indicated that they were deficient in specific areas of medication administration, then perhaps standardized programs could be established for educating the LPNs when they are employed as community nurses. This, in turn, would constitute a proactive, versus a retroactive, approach in the area of medication error prevention. To help reduce bias and power between the researcher and the participants in the replication of this study, this researcher would also suggest that future researchers solicit one RN to present the information in the educational session, and solicit another individual to administer the pre-test and the post-test to the participants.

The prevention of medication errors will become even more essential as the caseload of the LPNs, and the need for these nurses continues to grow. To date, over 30,000

people are using the Home Care program in Manitoba (Manitoba Health, 1999, p. 18), and its usage is expected to grow in the future. Part of the reason for this increased need is because of an aging population, and the fact that it costs less to provide care in the community than it does in hospitals. As more individuals are being discharged from hospital sooner than they used to be however, their care requirements will be more complex. Many of these care needs will be met by LPNs since their role is expanding to the point where, in some areas of the province, they administer intravenous medications. With this increased responsibility comes the need for LPNs to know the action and side effects of the medications they are giving, as well as being able to correctly calculate dosages.

The importance of LPNs being knowledgeable about the medications they administer cannot be stressed enough. This is especially significant because individuals over the age of 65 currently account for 50% of all health care costs (Alexander & Ames, 1998) (cited in Crowley, Zitner, & Faraday-Smith, 2000, p. 5). If adverse occurrences happen because of medication errors, the cost to the health care system in terms of possible hospitalization and increased medical assistance will be even greater. Medication errors can also be costly to the providers of care. For instance, the average payment made to plaintiffs in lawsuits in 1993 that involved serious medication errors in the United States was \$120,722 per case (Physicians Insurers Association of America, 1993). Thus, it is not only in the patient's and health care system's best interest that we have competent health care professionals employed in the community, it is also in their own best interest.

Since it is beneficial for the community-based LPNs participating in this study to attend professional development sessions to enhance job performance, it was decided to

focus on ensuring that these LPNs possessed a knowledge level that would enable them to reduce the risk of making medication errors. Education strategies have the potential to directly address many factors identified as individual influences on medication errors, and indirectly, to help LPNs cope with challenging systemic factors. The lack of knowledge by nurses in the area of medication administration, which can contribute to the making of these errors, has previously been documented. Since the medication administration knowledge level of the community-based LPNs had not been assessed since they began working for the health authority, it was not known whether this could be a possible factor related to the occurrence of some of the medication errors that have been reported. As a result, it was decided that measuring this knowledge would be of value and became the basis for this study.

The study performed by this researcher was not of an experimental design and did not yield data that can be generalized or viewed with much credibility. It does, however, provide some insight as to the knowledge level of some of the LPNs working in the community. Although their scores increased on an overall basis after they participated in the educational session, the results suggest that there is still a need for more education in the area of medication administration.

The recommendation of having additional educational sessions in the area of medication administration will be presented to the supervisor of the nursing unit. She can determine what action, if any, should be taken. It would, however, be in the best interest of the public if it were established that the LPNs administering medications in the community were competent in this area. Ensuring that their knowledge regarding medication administration is adequate is the first step in working toward meeting this

goal. This will become even more important as the need for care in the home and complexity of care continues to rise.

REFERENCES

Ahmed, D., & Fecik, S. (1999). Med errors: The fatigue factor. American Journal of Nursing, 9, 12.

Andreoli, E. (2000). Mind your own business: Avoid medication errors resulting from ambiguous orders. Arkansas Nursing News, 16, 18-20.

Andrusyszyn, M. (1989). The effect of the lecture discussion teaching method with and without audio-visual augmentation on immediate and retention learning. Nurse Education Today, 10, 172-180.

Arndt, M. (1994). Research in practice: How drug mistakes affect self-esteem. Nursing Times, 90 (15), 27-30.

Assiniboine Community College. (1999). Practical nursing program. [Brochure]. Brandon, MB: Author.

Atack, L., & Kenny, R. (1998). Care co-ordination: An expanded role for nurses. Canadian Nurse, 94 (7), 41-45.

Bayne, T., & Bindler, R. (1988). Medication calculation skills of registered nurses. Journal of Continuing Education in Nursing, 19, 258-262.

Bayne, T., & Bindler, R. (1997). Effectiveness of medication calculation enhancement methods with nurses. Journal of Nursing Staff Development, 13, 293-301.

Bechtel, G. A., Vertrees, J. L., & Swartzberg, B. (1993). A continuous quality improvement approach to medication administration. Journal of Nursing Care Quality, 7 (3), 28-34.

Blegen, M. A., Goode, C. J., & Reed, L. (1998). Nurse staffing and patient outcomes. Nursing Research, 47, 43-50.

- Blegen, M. A., & Vaughn, T. (1998). A multisite study of nurse staffing and patient occurrences. Nursing Economics, 16, 196-203.
- Boggs, P., Brown-Molnar, C., & DeLapp, T. (1988). Nurses' drug knowledge. Western Journal of Nursing Research, 10, 84-93.
- Booth, B. (1994). Management of drug errors. Nursing Times, 90 (15), 27-30.
- Calliari, D. (1995). The relationship between a calculation test given in nursing orientation and medication errors. Journal of Continuing Education in Nursing, 26, 11-14.
- Campbell, D., & Stanley, J. (1966). Experimental and quasi-experimental designs for research. Chicago: Rand McNally.
- Canadian Pharmaceutical Association. (1997). Compendium of pharmaceuticals and specialties (32nd ed.). Ottawa, ON: Canadian Pharmaceutical Association.
- Cavanagh, S., Hogan, K., & Ramgopal, T. (1995). The assessment of student nurse learning styles using the Kolb Learning Styles Inventory. Nurse Education Today, 15, 177-183.
- Cheek, J. (1997). Nurses and the administration of medications. Clinical Nursing Research, 6, 253-274.
- Cohen, M. (1991). 200 medication errors and how to avoid them. Springhouse, PA: Springhouse.
- Conklin, D., MacFarland, V., Kinnie-Steeves, A., & Chenger, P. (1990). Medication errors by nurses: Contributing factors. AARN, 46 (1), 8-9.

Crowley, B., Zitner, D., & Faraday-Smith, N. (2000). Operating in the dark: The gathering crisis in Canada's Public Health Care System. Atlantic Institute for Market Studies.

Cullen, P. D. (1998). Delaware RNs' reasons for nonparticipation in continuing education. Journal of Continuing Education in Nursing, 29, 228-233.

Dailey, M. (1992). Developing case studies. Nurse Educator, 17 (3), 8-11.

Flynn, E. R., Wolf, Z. R., McGoldrick, T. B., Jablonski, R. A., Dean, L. M., & McKee, E. P. (1996). Effect of three teaching methods on a nursing staff's knowledge of medication error risk reduction strategies. Journal of Nursing Staff Development, 12, 19-26.

Fuqua, R., & Stevens, K. (1988). What we know about medication errors: A review of the literature. Journal of Nursing Quality Assurance, 3 (1), 1-17.

Gay, L. (1981). Educational research: Competencies for analysis and application (2nd ed.). Toronto, ON: Merrill.

Gladstone, J. (1995). Drug administration errors: A study into the factors underlying the occurrence and reporting of drug errors in a district general hospital. Journal of Advanced Nursing, 22, 628-637.

Glendon, K., & Ulrich, D. (1992). Using cooperative learning strategies. Nurse Educator, 17 (4), 37-40.

Government of Canada. (1999). Strengthening health care for Canadians: [Brochure]. Ottawa, ON: Government of Canada.

Hollander Analytical Services Ltd. (2000). National evaluation of the cost-effectiveness of Home Care, 1 (1), 1-8.

- Jambunathan, J. (1995). Using Kolb's LSI to study learning styles of junior baccalaureate nursing students. Nurse Educator, 20 (3), 7.
- Katz, N., & Heimann, N. (1991). Learning style of students and practitioners in five health professions. Occupational Therapy Journal of Research, 11, 238-244.
- Katzer, J., Cook, K., & Crouch, W. (1998). Evaluating information: A guide for users of social science research (4th ed.). New York, NY: McGraw-Hill.
- Kersaitis, C. (1997). Attitudes and participation of registered nurses in continuing professional education in New South Wales, Australia. Journal of Continuing Education in Nursing, 28, 135-139.
- Kolb, D. (1981). Learning styles and disciplinary differences. In A. W. Chickering & Associates (Eds.), The modern American college (pp. 232-255). San Francisco: Jossey-Bass.
- Laschinger, H., & Boss, M. (1989). Learning styles of baccalaureate nursing students and attitudes toward theory-based nursing. Journal of Professional Nursing, 5, 215-223.
- Leape, L. L., Bates, D. W., Cullen, D. J., Cooper, J., Demonaco, H. J., Gallivan, T., Hallisey, R., Ives, J., Laird, N., Laffel, G., Nemeskal, R., Petersen, L. A., Porter, K., Servi, D., Shea, B. F., Small, S. D., Sweitzer, B. J., Thompson, B. T., & Vliet, M. V. (1995). Systems analysis of adverse drug events. Journal of the American Medical Association, 274 (1), 35-43.
- Linares, A. (1999). Learning styles of students and faculty in selected health care professions. Journal of Nursing Education, 9, 407-414.
- LoBiondo-Wood, G., & Haber, J. (1994). Nursing research: Methods, critical appraisal, and utilization (3rd ed.). Toronto, ON: Mosby.

Long, G., & Johnson, C. (1981). A pilot study for reducing medication errors.

Quality Review Bulletin, 1 (4), 6-9.

Ludwig-Beymer, P., Czurylo, K. T., Gattuso, M. C., Hennessy, K. A., & Ryan, C. J.

(1990). The effect of testing on the reported incidence of medication errors in a medical center. Journal of Continuing Education in Nursing, 21, 11-17.

Manitoba Association of Licensed Practical Nurses. (1998). Role & scope of practical nursing. Practice advisory statements. [Brochure]. Winnipeg, MB: Author.

Manitoba Government. (1999). Largest ever commitment to health care:

Gilleshammer. [Brochure]. Winnipeg, MB: Author.

Manitoba Health. (1999). Making health care work for you. [Brochure]. Winnipeg, MB: Author.

Markowitz, J., Pearson, G., Kay, B., & Loewenstein, R. (1981). Nurses, physicians, and pharmacists: Their knowledge of hazards of medications. Nursing Research, 30, 366-370.

McGovern, K. (1986). Ten steps for preventing medication errors. Nursing 86, 16 (12), 36-39.

Murray, T. (1998). From outside the walls: A qualitative study of nurses who

Recently changed from hospital-based practice to home health care nursing.

Journal of Continuing Education in Nursing, 29 (2).

Nursing81 Books. (1985). Nursing photobook – Giving medications. Horsham, PA:

Intermed Communications.

Osborne, J., Blais, K., & Hayes, J. (1999). When is it a medication error? Journal of

Nursing Administration, 29, 33-38.

Physician Insurers Association of America (PIAA). (1993). PIAA medication error study. Lawrenceville, NJ: Author.

Picard, A. (2000). Costs much lower if elderly patients receive Home Care [On-line]. Available: www.homecarestudy.com.

Polit, D., & Hungler, B. (1991). Nursing research: Principles and Methods (4th ed.). London: J. B. Lippincott.

Romero, J., Tepper, B., & Tetrault, L. (1992). Development and validation of new scales to measure Kolb's (1985) learning style dimensions. Educational and Psychological Measurement, 52, 171-180.

Roseman, C., & Booker, J. M. (1995). Workload and environmental factors in hospital medication errors. Nursing Research, 44, 226-230.

Svinicki, M., & Dixon, N. (1987). The Kolb model modified for classroom activities. College Teaching, 35 (4), 141-146.

Walters, J. A. (1992). Nurses' perceptions of reportable medication errors and factors that contribute to their occurrence. Applied Nursing Research, 5, 86-88.

Watkins, P., Drury, P., & Taylor, K. (1990). Diabetes and its management (4th ed.). Boston: Blackwell Scientific.

Werab, B., Alexander, C., Brunt, B., & Wester, F. (1994). The use of medication modules for medication administration problems. Journal of Nursing Staff Development, 10, 16-21.

White, M., Amos, E., & Kouzekanani, K. (1999). Problem-based learning: An outcomes study. Nurse Educator, 24 (2), 33-36.

White, K., Eagle, J., McNeil, H., Dance, S., Evans, L., Harris, H., & Reid, M. (1998).

What are the factors that influence learning in relation to nursing practice? Journal for Nurses in Staff Development, 14, 147-153.

Wolf, Z. (1989). Medication errors and nursing responsibility. Holistic Nursing Practice, 4 (1), 8-17.

Wolf, Z. (1994). Medication errors: The nursing experience. Albany: Delmar.

Worrell, P., & Hodson, K. (1989). Posology: The battle against dosage calculation errors. Nurse Educator, 14, 27-31.

Appendix A

Medication Review Module

For LPN's

Employed with

*Winnipeg Community and Long Term
Care Authority*

December, 1998
(First Draft)

Acknowledgements

I would like to thank Louise Friesen, Nursing Unit Supervisor, and Sue MacKenzie, Director of Special Projects of the Winnipeg Community and Long Term Care Authority for granting me permission to develop this medication review module for scholastic purposes. I would also like to thank Michelle Green and Carol McDougall, Nursing Resource Coordinators, for identifying some of areas of LPN medication administration where improvement is needed, and for allowing me to access their medication error incident reports.

Janet Sinclair, RN, BScN

PART 1

MEDICATION REVIEW MODULE - FORMAT

The medication review module consists of two parts. The first part addresses procedures related to medication administration, and the second part relates to insulin administration. The module will be presented in two educational sessions, each of which will be approximately 1 ½ hours in duration.

The educational sessions are designed to refresh/increase your knowledge levels about medication administration (lack of knowledge can contribute to the occurrence of medication errors). To determine whether presenting this medication module is helpful in this area, each nurse will be invited to participate in a study related to the educational sessions. Each study participant will be asked to complete a pretest at the beginning of each session, and a posttest at the end of each session. The same posttest will be administered again in 8 weeks' time. These tests are not a "pass/fail" item; they are only being used to assess whether an increase in knowledge about the topics being presented has occurred.

MEDICATION REVIEW MODULE – OUTLINE

Educational Session #1

Explanation of Study

Consent from Participants

Pretest – to be Completed by Study Participants

Purpose of Educational Sessions

Discussion re: Preventing Medication Errors

Brief Overview of:

Medication Errors – Definition

Five Rights

Three Checks

Factors Associated with Medication Errors

Parts of a Medication Order

Case Study – Groupwork

Posttest – to be Completed by Study Participants

OBJECTIVES - EDUCATIONAL SESSION #1

General Objective:

Upon completion of the first educational session related to the Medication Review Module, participants will possess an increased knowledge base regarding the correct procedures related to medication administration.

Specific Learning Objectives:

Upon completion of the first educational session related to the Medication Review Module, participants will, in writing, be able to:

- 1.) Correctly number the order of the three checks of medication labels
- 2.) Correctly state the five rights of medication administration
- 3.) Correctly perform five out of five hypothetical medication calculations
- 4.) Correctly identify four out of four physician orders that do not adequately reflect all six parts of a medication order

Purpose of Medication Review Module Educational Sessions

Incident reports regarding medication errors made by Home Care LPN's were reviewed for 1997 and 1998.

If medication errors repeated on a daily basis prior to being noticed are taken into consideration, **14 medication errors were made in 1997** (12 separate incidents). **The total of medication errors** made by LPN's in **1998** increased to **240** (43 separate incidents; one error was made for 83 consecutive days before being noticed).

To address the issue of medication errors being made by Home Care LPN's, a medication module reviewing medication administration has been developed.

MEDICATION ERRORS - DEFINITION

“Medication errors are unintentional mistakes associated with drugs and intravenous solutions that involve patients and are made during the prescription, transcription, dispensing, and administration phases of drug preparation and distribution (Wolf, 1989) (cited in Flynn, 1996, p. 19)”

TWO TYPES OF MEDICATION ERRORS

1.) Errors of Commission

Example: Administering the wrong medication to a client

2.) Errors of Omission

Example: Administering three pills to a client when there are supposed to be four



Medication errors can be life-threatening to the client

SOMETHING TO THINK ABOUT...

An analysis of medication error reports submitted by nurses and pharmacists in various health care settings throughout the United States over the past 20 years

“...indicate that one out of every five doses of medication administered may be given to the wrong patient, in the wrong dose, by the wrong route, at the wrong time, or even as the wrong drug” (Cohen, 1991, p. iii).

THREE CHECKS

**The label of a medication must be checked three times
(Kozier, 1979, p. 840)**

Check each medication when:

- 1.) Reaching for the medication container
- 2.) Immediately before pouring the medication
- 3.) Returning the medication to its correct place



It is also very important to check to ensure your client does not have any allergies to the medication(s) you are administering to him or her.

FIVE RIGHTS

“...almost two thirds of all medication errors occur because nurses disregard the *Five Rights* system (Nursing81 Books, 1981, p.12).

Five Rights:

1.) Right medication



2.) Right client



3.) Right dose



4.) Right route



5.) Right time



Facilitator's Notes – Five Rights

Numerous examples of medication errors made by nurses are present in the literature. In addition to articles, there is also a book written by Cohen (1991) which provides examples of medication errors made nurses throughout the United States.

Based on the literature reviewed, many of the medication errors made consisted of medications being administered : 1.) to the wrong client 2.) in the wrong dose 3.) by the wrong route 4.) in an incorrect dose (King, 1983; Gardner, 1987; Williams, 1990; Ferner, 1992) (cited in Gladstone, 1995, p. 629). The most common medication error made found by Long and Johnson (1981) (cited in Calliari, 1995, p.12) and McGovern (1986) (cited in Calliari, 1995, p. 12) was that of administering the incorrect dose of medication to clients. In studies by Calliari (1995), Hill and Wigmore (1967) (cited in Ludwig-Beymer et al.), and Barker, Mikeal, Pearson, Illig, and Morse (1982) (cited in Ludwig-Beymer et al.) however, omission of medications was noted to be the major cause of medication errors.

From the foregoing, it can be seen that many medication errors are made as a result of nurses overlooking the “five rights” when they administer medication. Most of the literature reviewed thus far relates to medication errors made in hospitals. From the Home Care LPN medication incident reports reviewed for 1998, it was noted that out of the 43 separate incidents reported, 15 medication errors involved administering the incorrect dose of medication to clients in the form of a medication set-up, or in person. Another 15 incidents were caused by missed visits, neglecting to include all the prescribed medications in the client's medication dosette or neglecting to perform a medication set-up. The remainder of the medication incidents were due to LPN's not following physicians' orders correctly, dispensing medications when they were discontinued, and administering the wrong medication. Three incidents involved incorrect medication set-ups, but were not clearly specified (1997 data was not used here due to lack of specifics).

Thus, although the literature reviewed mainly reflects medication errors made by hospital nurses, similar medication errors are also occurring in the community. **Nurses need to ensure they are following the “five rights” when they administer their medication to clients** – this is especially significant for clients who only have the nurse as their advocate.

FACTORS ASSOCIATED WITH MEDICATION ERRORS

Several factors related to the cause of medication errors have been identified in the literature. Some of these factors are:

- 1.) *Fatigue*
- 2.) *Time pressure*
- 3.) *Cluttered workplace*
- 4.) *Distraction*
- 5.) *Poor lighting*
- 6.) *Not following clarifying/physician orders correctly*

Many situations cited have also involved the factor of
calculation errors



PARTS OF A MEDICATION ORDER
(Adapted from Kozier, Erb, & Olivieri, 1991, p. 1260)

- 1.) Client's full name, **PHIN** number, **DOB**, and address
- 2.) Date and time the order is written
- 3.) Name of the medication to be administered
- 4.) Dosage and frequency of the medication
- 5.) Method of administering the medication
- 6.) Signature of the physician and/or the nurse

VERBAL ORDERS



If a **telephone order** is given by the physician, the nurse must write the order according to steps 1-5. She/he must then write ***verbal order or V.O.*** on the order and then sign his/her name and designation. The order must then be signed by the physician within one week (fax the order to the physician; have him/her sign it and fax it back to you).

Facilitator's Notes – Medication Errors

Inform the nurses that it is difficult to determine whether the increased number of medication errors cited for 1998 (compared to 1997) is actually due to more errors being made, or better documentation of the errors – this needs to continue to be monitored. Regardless, many of the nurses may experience factors which put them at risk of making medication errors – for instance, some client's suites are very cluttered, and have very poor lighting. It has also been noted in the literature that many nurses have poor calculation skills.

Emphasize how important it is for the nurses to take the time to thoroughly check the medications they are administering. It is understandable that time is a problem sometimes – but, is it worth the risk of making a medication error just so they will be finished their run on time, or will not be late for their next visit?

It is also important that each nurse check both the computer printout and written schedule of the clients on their run. Some clients will realize that they have not been seen by their nurse, but others may not – they will not be able to alert anyone if they have missed their medications.

Stress the importance of having the nurses report an error if they have made one – the consequences of them not doing so could be much greater than the ramifications of an incident report – action can be taken to prevent disastrous effects of administering a wrong medication if someone is alerted to the error (the literature also indicates that nurses are afraid to report medication errors because of the disciplinary action they fear they will receive).

. When the number of client visits each nurse makes is taken into consideration, the actual number of medication errors is small in comparison. We know that errors will be made. The potential to make medication errors is always present. Any nurse who administers medication must always keep this in mind. Precautions must be taken by every nurse to try and reduce the number of errors made. The need for nurses to follow the five rights and three checks of medication administration cannot be understated. In essence, these two procedures serve as protection not only for the client, but the nurse as well.

PART 2

MEDICATION REVIEW MODULE – OUTLINE

Educational Session #2

Brief summary of First Educational Session

Questions/Concerns from Group

Pretest – to be Completed by Study Participants

Brief Overview of:

Hypoglycemic Agents (Glucophage and Glyburide)

Mixed Insulin Administration – Demonstration/Discussion

Insulin Administration

Insulin Storage

Case Study – Groupwork

Posttest – to be Completed by Study Participants

Conclusion

OBJECTIVES – EDUCATIONAL SESSION #2

General Objective:

Upon completion of the second educational session related to the Medication Review Module, participants will possess an increased knowledge base regarding oral hypoglycemic agents and proper insulin administration.

Specific Learning Objectives:

Upon completion of the second educational session related to the Medication Review Module, participants will, in writing, or by performing a return demonstration, be able to:

- 1.) Correctly identify the difference between Glucophage and Glyburide in terms of their action, purpose, and side effects
- 2) Correctly demonstrate, as per the outline, all the steps involved in drawing up mixed insulin
- 3.) Correctly identify 11 steps involved in insulin administration
- 4.) Correctly identify the “body log” as a tool for selecting insulin administration sites
- 5.) Correctly indicate that different insulin injection sites are to be used each time
- 6.) Correctly identify two factors related to insulin storage
- 7.) Correctly identify when mixed insulins are to be administered

***HYPOGLYCEMIC AGENTS – GLUCOPHAGE
(Metformin)***

ACTION:

Increases the effect of Insulin on peripheral receptor sites

Reduces glucose absorption from the bowel

PURPOSE:

Controls hyperglycemia in Metformin responsive, stable, people with Type II diabetes when dietary management alone does not work

Can be helpful in treating obesity

SIDE EFFECTS:

Does not cause hypoglycemia when used alone

Metallic taste in mouth, nausea/vomiting, epigastric distress, and in some cases, malabsorption syndrome

DOSAGE:

500 mg. TID or QID; Maximum dose not to exceed 2.5 grams (Should be taken with food)

Facilitator's Notes – Glucophage

Action:

Potentiates the effect of Insulin, or increases the effect of Insulin on peripheral receptor sites (Canadian Pharmaceutical Association, 1997, p. 630-631)

Does not require intact islets in order to exert its effect (Watkins, Drury, & Taylor, 1990, p. 93)

Does not boost pancreatic insulin production (Hillson, 1992, p. 76)

Purpose:

Controls hyperglycemia in Metformin responsive, stable, mild, nonketosis prone maturity onset type of Type II diabetes not controlled by dietary management (Canadian Pharmaceutical Association, 1997, p. 630)

Can be of value in treating overweight people if they adhere to their weight reducing diet (Hillson, 1992, p. 76)

Side Effects:

Lactic acidosis – very rare – can occur in people who have kidney failure, low blood pressure, liver disease, or in those who are very ill (Hillson, 1992, p. 76; Watkins et al., 1990, p. 93)

Not one single case of lactic acidosis noted in Canada (Canadian Pharmaceutical Association, 1997, p. 631)

Does not cause hypoglycemia unless taken in overdose (Hillson, 1992)

Epigastric distress, nausea/vomiting, malabsorption syndrome, metallic taste in mouth

Dosage:

Usual dose = 500 mg. 3-4x/day; maximum dose = 2.5 gm. (Canadian Pharmaceutical Association, 1997, p. 631)

HYPOGLYCEMIC AGENTS – GLYBURIDE
(Diabeta)

ACTION:

Stimulates insulin secretion from beta cells of the pancreas

Ineffective in the absence of functioning beta cells

PURPOSE:

Used in non-insulin dependent Type II diabetes to control hyperglycemia

SIDE EFFECTS:

Hypoglycemia, nausea, epigastric fullness and heartburn are most common – tend to be dose-related

Possible weight gain

DOSAGE:

Usual dose = 2.5mg – 10 mg/day; doses over 10 mg should be divided and given BID. Maximum dose not to exceed 20 mg/day (Give before or with meals)

Facilitator's Notes – Glyburide

Action:

Stimulates insulin secretion from beta cells of the pancreas (Canadian Pharmaceutical Association, 1997, p. 1511; Watkins, Drury, & Taylor, 1990, p. 92)

Ineffective in the absence of functioning beta cells (Canadian Pharmaceutical Association, 1997, p. 1511)

Stimulation of insulin release may also stimulate weight gain (Watkins et. al, 1990, p. 92)

Purpose:

To lower blood glucose levels (Deglin, Hazard, & Vallerand, 1991, p. 519)

Used in non-insulin dependent Type II diabetes to control hyperglycemia (Canadian Pharmaceutical Association, 1997, p. 1511)

Side Effects:

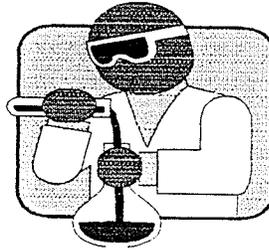
Hypoglycemia, nausea, epigastric fullness and heartburn are common. These side effects tend to be dose-related and disappear when the dose is decreased (Canadian Pharmaceutical Association, 1997, p. 1511)

Oral anticoagulants, sulfonamides, and salicylates may increase effectiveness of the drug and cause **hypoglycemia**; thiazides may decrease effectiveness (Deglin, Vallerand, & Russin, 1991, p. 519)

Dosage:

Usual dose = 2.5-10 mg. 1x/day; if over 10 mg./day, dose should be divided and given BID. Maximum dose = 20 mg./day (Deglin, Vallerand, & Russin, 1991, p. 519).

MIXED INSULIN ADMINISTRATION



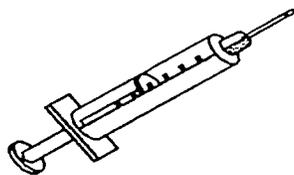
Part 1

- 1.) Prepare clean work area
- 2.) Gather alcohol swabs, insulin, and appropriate syringe
- 3.) Wash hands
- 4.) Check regular insulin for any particles adhering to the sides of the vial. Also check for cloudiness, discolouration, and/or “white strings” in insulin - if any of these are present, do not use this insulin (Steil & Deakins, 1990, p. 38)
- 5.) Check intermediate/long-acting insulin (“cloudy” insulin) for clumping – do not use if this is present
- 6.) Gently roll “cloudy” insulin vial between palms. Do not shake

MIXED INSULIN ADMINISTRATION

PART 2

- 1.) Remove the protective cap from insulin vials if present
- 2.) Wipe the top of each vial with an alcohol swab
- 3.) Uncap syringe and draw back plunger to the prescribed number of units ordered for the intermediate/long-acting insulin



- 4.) Inject air in syringe into the vial of intermediate/long-acting insulin – **ensure needle does not touch insulin**
- 5.) Remove needle/syringe
- 6.) Draw back plunger of syringe to the prescribed number of units ordered for the regular insulin
- 7.) Inject air in syringe into the vial of regular insulin

MIXED INSULIN ADMINISTRATION

PART 3

- 1.) With needle still in place, use one hand to invert the vial
- 2.) Draw back the plunger with the free hand to the prescribed number of units for this insulin
- 3.) Remove needle/syringe from vial
- 4.) Insert needle/syringe into the vial of intermediate/long-acting insulin
- 5.) Invert vial as per first step
- 6.) Withdraw the prescribed number of units for this insulin – the combined amount of insulin should now equal the total number of units of insulin prescribed for the client
- 7.) Remove the needle/syringe from vial and cap
- 8.) Return vials to storage area in client's home
- 9.) Wash hands

Facilitator's Notes – Mixed Insulin Administration

It would be beneficial to the participants if the discussion about this topic could be done with a demonstration of the technique at the same time.

If the **“cloudy”** or intermediate/long-acting insulin is drawn up before the **“clear”** or regular insulin, some of the “cloudy” insulin could accidentally be injected into the regular insulin. If this occurs, the regular insulin could become contaminated with enough “cloudy” insulin to delay the onset of the regular insulin’s action (Steil & Deakins, 1990, p. 37). The reason for this is because some insulins contain an additional modifying protein such as protamine, which decreases the absorption rate of insulin (Kozier, Erb, & Olivieri, 1991, p. 1274). Thus, the protein added into a “cloudy” insulin could affect the action of regular insulin if injected into the vial inadvertently.

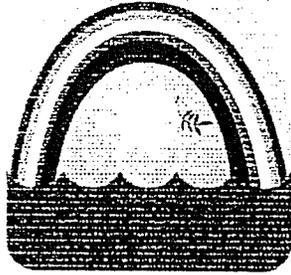
If regular insulin contaminates “cloudy” insulin, the problem of onset time of action of the “cloudy” insulin is not as great as with regular insulin being contaminated. The reason for this is because the dose of the regular insulin is usually smaller than that of the “cloudy” insulin and as a result, does not affect the overall action of the insulin.

White “strings” observed in insulin could be due to improper technique in drawing up the “clear” and “cloudy” insulins (Steil & Deakins, 1990, p. 37).

Clumped particles against the inside of an insulin vial is known as **“frosting.”** If observed, the insulin should not be given because it indicates a loss of its potency. Instead of lowering blood glucose levels, it could actually increase them (p. 38). This is usually seen with intermediate and 30/70 mixtures. Frosting can usually be avoided by keeping insulin away from extreme temperatures.

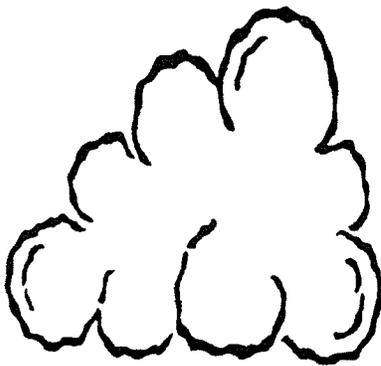
Shaking insulin vigorously can also cause **“frosting.”** Advise participants to inform their female clients not to carry insulin in their purses.

REMEMBER:



CLEAR INSULIN

IS DRAWN UP BEFORE

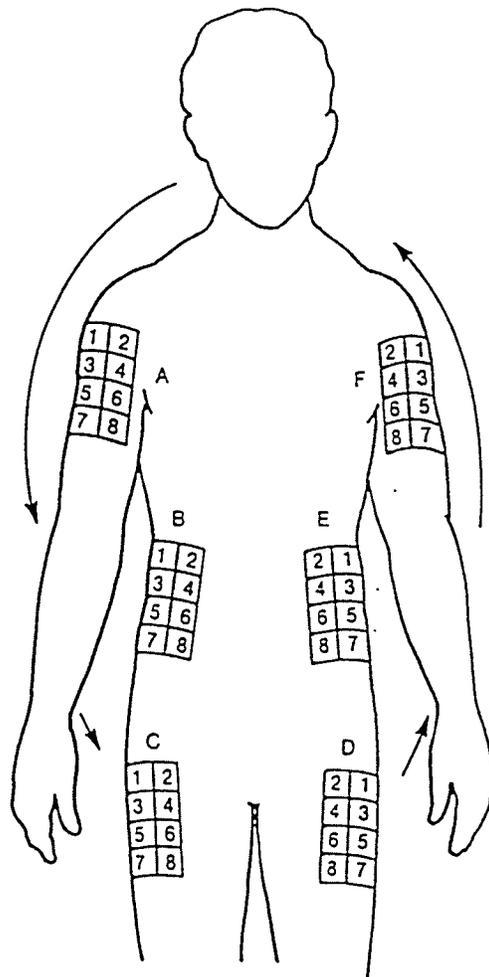


CLOUDY INSULIN

INSULIN ADMINISTRATION

- 1.) Wash hands
- 2.) Select site where insulin is to be injected – *use a different site each time* - a *body log* can serve as a guide

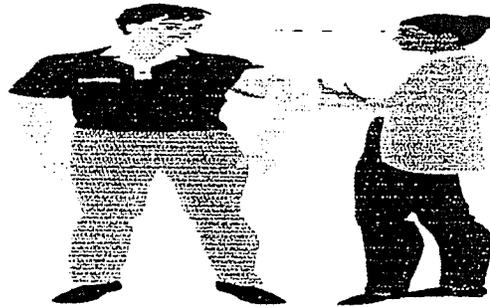
Body Log



(Walsh, Persons, & Wieck, 1987, p. 378)

INSULIN ADMINISTRATION – CONTINUED

- 3.) Ensure site is free of bruises and abrasions
- 4.) Cleanse site with an alcohol swab and let dry
- 5.) Pinch up a portion of skin to approximately 1-2 inches in height. Use non-dominant hand – hold skin firmly
- 6.) Hold syringe like a pen in the other hand and inject into pinched skin at a 90 degree angle
- 7.) Release skin



- 8.) Push plunger down – insulin dose should be injected within five seconds
- 9.) Hold alcohol swab near the needle and pull needle out of skin
- 10.) Press alcohol swab against the site for several seconds and then remove – ***do not rub site***
- 11.) Chart insulin administration on medication record

Facilitator's Notes – Insulin Administration

If the site is not allowed to dry after it has been cleansed with an alcohol swab, the client may experience a stinging sensation because alcohol will be injected into the skin along with the insulin (Nursing85 Books, 1985, p. 340)

Sites need to be rotated to prevent atrophy or lipodystrophy from occurring – if sites become fatty, the insulin will not be absorbed as quickly as normal (Steil & Deakins, 1990, p. 39)

The abdomen is the site where insulin is absorbed the quickest (Steil & Deakins, 1990, p. 38) and most evenly (United States Pharmacopeia, 1994, p. 760)

Inject insulin at a 45 degree angle for children and very thin people

Releasing the skin prior to injecting the insulin will prevent the irritation of nerve fibers, and injecting the drug into skin that is compressed (Nursing85 Books, 1985, p. 341)

INSULIN STORAGE

- 1.) Pre-mixed insulin (ie- Novolin 30/70) can be drawn up and stored in the refrigerator for two weeks
- 2.) If NPH and regular insulin are drawn up together, the medication must not be given for at least 24 hours
- 3.) If regular and Lente insulin is drawn up, it is to be injected immediately
- 4.) The expiration date on insulin vials only applies to insulin that is refrigerated
- 5.) Do not use insulin if expiration date has passed even if the insulin has been stored unopened in the refrigerator

Facilitator's Notes – Insulin Storage

When mixing insulins, binding occurs. In the case of mixing NPH/regular together, binding will not reach equilibrium for 24 hours (Arenson, 1989, p. 3) If this mixture is drawn up and given immediately, the effect would be similar to that of injecting two separate insulins. The binding would be minimal and as a result, the regular insulin would act much quicker than if the mixture was left for 24 hours (Steil & Deakins, 1990, p.38). Note: Regular insulin contains no binding agents.

It is best to administer doses of insulin within the same time frame each day. For instance, if it usually takes five minutes to prepare the injection, then it should be given as soon as it is drawn up. If the insulin is drawn up but not given for half an hour one day, for example, the action time due to binding could be slower than if given immediately after drawing it up (p. 38)

A vial of insulin that is being used and kept at room temperature is good for one month – it should be discarded after that time (United States Pharmacopeia, 1994, p. 760). The potency of insulin left at room temperature decreases by 1.5% per month (Steil & Deakins, 1990, p. 38).

References

Arenson, D. (1989). Discussion of mixed insulin guidelines. In Manitoba Health, Continuing care nursing procedures (Reference Material, pp. B1-B8). Winnipeg: Manitoba Health.

Calliari, D. (1995). The relationship between a calculation test given in nursing orientation and medication errors. Journal of Continuing Education in Nursing, 26(1), 11-14.

Canadian Pharmaceutical Association. (1997). Compendium of Pharmaceuticals and Specialties (32nd ed.). Ottawa: Canadian Pharmaceutical Association.

Cohen, M. (1991). 200 medication errors and how to avoid them. Pennsylvania: Springhouse.

Deglin, J., Vallerand, A., & Russin, M. (1991). Davis's drug guide for nurses (2nd ed.). Philadelphia: F.A. Davis.

Flynn, E., Robinson, Z., McGoldrick, T., Jablonski, R., Dean, L., & McKee, E. (1996). Effect of three teaching methods on a nursing staff's knowledge of medication error risk reduction strategies. Journal of Nursing Staff Development, 12(1), 19-26.

Gladstone, J. (1995). Drug administration errors: A study into the factors underlying the occurrence and reporting of drug errors in a district general hospital. Journal of Advanced Nursing, 22(4), 628-637.

Hillson, R. (1992). Diabetes: A new guide. London: Optima.

Kozier, B., Erb, G., & Olivieri, R. (1991). Fundamentals of nursing: Concepts, process and practice (4th ed.). New York: Addison-Wesley.

Ludwig-Beymer, P., Czurylo, K. T., Gattuso, M. C., Hennessy, K. A., & Ryan, C. J.

(1990). The effect of testing on the reported incidence of medication errors in a medical center. Journal of Continuing Education in Nursing, 21, 11-17.

Nursing87 Books. (1981). Nursing photobook – Giving medications. Horsham, PA: Intermed Communications.

Nursing85 Books. (1985). Procedures. Pennsylvania: Springhouse.

Steil, C., & Deakins, D. (1990). Today's insulins: What you and your patient need to know. Nursing 90, 20(8), 34-39.

United States Pharmacopeia. (1994). Complete drug reference. Yonkers, NY: Consumer's Union.

Walsh, J., Persons, C., & Wieck, L. (1987). Manual of home health care nursing. Philadelphia: J.B. Lippincott.

Watkins, P., Drury, P., & Taylor, K. (1990). Diabetes and its management (4th ed.). Boston: Blackwell Scientific.



Winnipeg
Community & Long Term Care
Authority

Office des soins communautaires
et de longue durée de Winnipeg

4 - 189 Ivanson Street
Winnipeg, Manitoba
R3G 0N9

Appendix B
Letter of Support

June 7, 1999

Ms. Janet Sinclair

R

Dear Janet:

This letter acknowledges that I have reviewed the study proposal you submitted for the LPN Education Sessions regarding medication administration.

I believe that implementation of these educational sessions would be of significant value to the WCA - Home Care Nursing Program. I support your study that evaluates the current knowledge base of the LPNs and the potential for improvement in this particular area of nursing practice.

I look forward to working together with you as you prepare for the implementation of these sessions. There is certainly a potential for application of your study to the general nursing program in Home Care and I eagerly await the results of the education sessions.

Sincerely,

Louise Friesen, RN BN
Program Supervisor - Nursing

Appendix C

Pre-test/post-test

You are about to administer a medication to your client. Please indicate the correct steps involved in this procedure by placing a number from 1-10 in the space provided beside each step.

___ Document the medication given

___ Obtain the medication from the client's supply

___ Identify the client

___ Check for allergies

___ Read the drug label

___ Read the drug label

___ Read the drug label and discard the empty package

___ Compare the drugs and doses available in the client's medication supply with information on the physician's order sheet and medication record

___ Administer the medication

___ If this is the first time you are administering this medication to your client, inform him or her of its name and purpose

(Source: Cohen, M., Taking this test will help you avoid errors. Nursing90, 20(3), 23)

Please state the five rights of medication administration in the spaces provided below.

1.) _____

2.) _____

3.) _____

4.) _____

5.) _____

*Pre-test/Post-test***MEDICATION CALCULATIONS**

The following situations represent medications ordered for your clients. You are to administer each of these medications in a single dose during your daily morning visit. Please state how much medication you would administer for each client based on the drug that is available in the home. Your work can be shown in the spaces provided for each situation.

Client A:

Ordered: Ampicillin 1 gm. po Q6H

Available: Ampicillin 250 mg. per capsule

Answer: _____

Client B:

Ordered: Digoxin 0.50 mg. po OD

Available: Digoxin 0.125 mg. per tablet

Answer: _____

Client C:

Ordered: Metformin 750 mg. po TID with meals

Available: Metformin 500 mg. per tablet

Answer: _____

Client D:

Ordered: Lasix 10 mg. po OD

Available: Lasix 20 mg. per tablet

Answer: _____

Client E:

Ordered: 9 units of regular acting Insulin to be mixed with 17 units of intermediate acting Insulin to be administered subcutaneously AMAC OD

Available: One 10 ml. vial of short acting Insulin, 100 units per ml., and one 10 ml. vial of intermediate acting Insulin, 100 units per ml.

Answer: _____

Physician Orders

Pre-test/Post-test

Transcribe the orders below onto the medication sheet which follows this page. State why you would or would not give each medication as prescribed in the space underneath each order.

Order #1

⑥ Inovane 7.5
15.75 M.D.

Order #2

Start Hydrochlorothiazide alone
12.5 mg once daily

Order #3

↑ vitamin E to 800 I.U. O.D.

Order #4

⑤ ~~ZANTAC~~ 150 I.Bid

Pre-test/post-test

Please indicate whether the statements below are true or false by marking T for true, and F for false in the space provided beside each statement.

- _____ **Glyburide** is used for people who have Type I diabetes
- _____ **Glucophage** can be helpful in treating obesity
- _____ Hypoglycemia is a side effect of **Glucophage** when it is used alone
- _____ **Glucophage** stimulates insulin secretion from beta cells of the pancreas
- _____ One possible side effect from **Glyburide** is weight gain
- _____ **Glyburide** is effective in the absence of functioning beta cells
- _____ **Glyburide** is used to control hypoglycemia in people with Type II diabetes
- _____ **Glucophage** works well with people who have unstable Type II diabetes
- _____ Women should carry **insulin** in their purse
- _____ A vial of **insulin** should not be used if there is discolouration or "white strings" present
- _____ When mixing **insulin**, the intermediate or long-acting **insulin** is drawn up before the regular **insulin**
- _____ A "body log" can serve as a guide for selecting **insulin** administration sites
- _____ A different site is to be used each time **insulin** is administered
- _____ **Insulin** can be injected at a 90 degree angle
- _____ **Insulin** injection sites should be gently massaged after **insulin** administration
- _____ **Insulin** can be used after its expiration date as long as it has been kept unopened in the refrigerator
- _____ The combination of **Lente** and regular **insulin** does not have to be administered immediately after drawing it up from both vials
- _____ Pre-mixed **insulin** (ie- **Novolin 30/70**) can be drawn up and stored in the refrigerator for two weeks

Pre-test/post-test

You are about to administer an **insulin** injection to your client. Please indicate the correct steps involved in this procedure by placing a number from 1-11 in the space provided beside each step.

_____ Pinch up a portion of skin approximately 1-2 inches in height

_____ Release skin

_____ Wash hands

_____ Chart **insulin** administration on medication record

_____ Select site where **insulin** is to be injected

_____ Hold **insulin** syringe like a pen and inject into skin

_____ Ensure **insulin** injection site is free of bruises and abrasions

_____ Hold alcohol swab near the needle and pull needle out of skin

_____ Push plunger down

_____ Press alcohol swab against **insulin** injection site for several seconds and then remove

_____ Cleanse **insulin** injection site with an alcohol swab and let dry

Appendix D

Participant Consent Letter

November 29, 1999

My name is Janet Sinclair and I am a graduate student in a Master of Education program at the University of Manitoba. I will be conducting a research study as part of the thesis requirements for my degree.

The University of Manitoba requires that any research project involving human subjects must receive the informed consent of participants. This requirement has been put in place to assure that the rights of participants in every research project are respected and that confidentiality is maintained at all times. To fulfill this requirement, you are asked to read the study description and conditions carefully and, if willing, give your written consent to participate in this study. This research will be supervised by Dr. Rodney Clifton who can be contacted at 474-9625.

Medication incident reports completed by Licensed Practical Nurses (LPNs) in the Home Care program were reviewed by this researcher for the years of 1997 and 1998. It was noted that there was a significant increase in the number of medication errors in 1998. Many factors may be responsible for the increase in these errors, including lack of knowledge about the medications being administered, or lack of knowledge about medication administration policies. To address this issue, a medication module was developed by the researcher, in collaboration with the staff and supervisor of the Nursing Unit. This module is to be presented in two separate educational sessions. Each session will last for approximately 1 ½ hours, and will be held during times specifically scheduled for staff development. The months in which these sessions are scheduled to be held are October and November, 1999.

The purpose of this study is to determine if the two medication administration review educational sessions have an effect upon the medication administration knowledge of community-based licensed practical nurses (LPNs) employed by the Winnipeg Community and Long Term Care Authority (the name of this authority is not mentioned anywhere in the study). The procedures to be used for data collection throughout this study consist of obtaining scores from pre-tests and post-tests you will be asked to complete at the beginning and end of each educational session. The pre-test and post-test for the first session will be the same, and will be based on the content of the session. The pre-test and post-test for the second session will also be the same, and likewise, will be based on the content of the session. It is anticipated that these four tests should take approximately fifteen minutes to complete. Eight weeks after the completion of the second educational session, you will then be asked to complete both of the post-tests again. A case study will also be included with this post-test. It is

anticipated that the time required to complete this post-test will be approximately 30 minutes.

You will not be asked to write your name on any of the tests you write. Instead, you will be asked to write a code on the front page of the test that only you can identify. In order to remember the code for each test, I would ask that you write down the numerical date of your birth on each test that you write. The researcher does not have access to your name and corresponding birthdate. This in turn will enable you to remain anonymous, and allow for collection of scores from all three tests. The answers you provide on the tests are not to be thought of as a reflection on your work performance. Rather, your answers will provide the researcher, and indirectly, the staff in the nursing unit with guidelines to determine whether more educational sessions on medication administration would be worthwhile in the future. The results of this study will be confidential and coded data files will be accessible only to you and the researcher. As part of the dissertation of the research, a summary of the data with identifying codes removed will be presented to the staff in, and the supervisor of, the nursing unit. The Director of Planning and Special Projects will also be made aware of the results. A similar summary of these data may be used if this research is published at a later date.

Participation in this research study is voluntary. All participants are free to decline, or to withdraw at any point in the research, without fear of repercussion. If withdrawal is requested, any data generated would be destroyed. Under no circumstances will the raw data for individuals be reported back to the workplace. Your participation in this research project will in no way influence your evaluation in the Home Care nursing program.

Participants will have access to their own personal data files (identified by the code you have written on your tests). Once analysis of the data is complete, a summary of the findings will be mailed to you at your request, to your permanent mailing address. If you would like a summary of the results mailed to you, please write your address on the envelope provided to you by the researcher. These envelopes will be placed in a confidential file until they are to be used to mail you the results of the study. These results will be presented in a table format, and you will be able to determine whether scores increased or decreased after the first pre-tests you wrote at the beginning of each educational session. You will also be able to assess whether scores changed between the time of writing the first two post-tests, and the last post-test.

Please sign and date this letter in the space provided below to indicate your consent to participate in this research under the conditions described above, and return it to the researcher immediately prior to writing the first pre-test at the beginning of the first educational session. Photocopies of the signed letter will be provided to you upon request. If further information is required, please

contact the researcher at 788-8337, or the research supervisor, Dr. Rodney Clifton, at 474-9625.

(Signature of Researcher)

(Date)

(Signature of Participant)

(Date)

(Name of Participant – please print)

Would you like a copy of this letter for your records? yes no