CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Currently in South Africa, there is a huge intensive care trained nurse crisis (Scribante, Schmollgruber & Nel, 2004; Kyriacos & Mayers, 2006). This has ultimately led to placement of sub-professional nurses so as to ensure continuity of patient care. In most cases, these nurses are not competent enough to provide proper care in all situations because they don't possess adequate skills, knowledge and experience in the speciality as highlighted by Ball and McElligot (2003). To ensure proper patient care by the few available specialist nurses in the ICU, an appropriate means should be employed in calculating staffing requirements based on patients' needs (Telles & Castilho, 2007).

This review will describe ICU nurse shortage, cost constraints and skill-mix as factors necessary to consider during staff allocation and patient care. Nursing workload and staffing requirements will also be discussed including development of the three versions of TISS and their importance in the ICU. Finally, other scoring systems which were developed after criticism of TISS including subjective methods currently employed in the ICUs in determining staffing requirements plus their limitations will also be described.

2.2 SHORTAGES OF ICU NURSES, COST CONSTRAINTS AND SKILL-MIX

Scribante et al. (2004:111) state that there is an acute shortage of critical care nurses and only around 26% of the nurses working in the critical care units in South Africa are suitably trained. This acute shortage of trained and experienced ICU nurses coupled with

cost constraints has favoured the placement of generalist, newly qualified and agency nurses as well as sub-professional nurses in most ICUs so as to ensure the continuity of patient care. A number of studies explain the relationship between nurse to patient ratios, skill-mix of staff, patient care, and errors both in nursing and in critical care specifically.

Williams, Schmollgruber and Alberto (2006:395) suggest that critical care nursing skills should be used in direct patient care and in professional roles that require expert nursing knowledge, skills and attributes and that, the many other tasks that can be completed by nonqualified and less expensive staff should be delegated to such staff. Studies conducted by Needleman, Buershaus and Mattke et al. (2002) and Whitman, Yookyung and Davidson et al. (2002) indicate that a reduction in the number of professional nurses providing direct patient care is associated with complications such as nosocomial infections, an increased risk of central line infection rates, pressure sore incidence, falls and use of physical restraints, medication errors, patient injuries and death. A study by Numata, Schulzer and van der Wal et al. (2006:440) found a statistically significant reduction in mortality associated with higher ICU staffing levels.

Pronovost, Dang and Dorman et al. (2001:203) also indicate that having fewer ICU nurses versus more ICU nurses per patient is independently associated with an increased risk for complications. Their study indicates that nurses who care for three or more patients in the ICU may have less time to devote to patient care especially in preventive measures than the nurses who care for one or two patients. This is further supported by Pronovost, Jenckes and Dorman et al. (1999) for their study showed that not having an ICU nurse patient ratio of less than one to two increased the hospital length of stay and complications thus, increased use of resources and high ICU costs.

Binnekade, Vroom and de Mol et al. (2003:190) quote various authors such as Van & Schultz (1999); Tarnow-Mordi et al. (2000) who mentioned that adequate staffing of ICUs with appropriately trained ICU nurses is a major determinant in ensuring safe quality care. These authors further state that sometimes it is vital to make crucial decisions before a situation becomes critical and in this respect, the critical care nurse should possess knowledge, skills and values to make a correct nursing diagnosis and to act immediately so as to safeguard a patients' life. The necessity of a critical care nurse to possess knowledge and ability in dealing with patients' changing situations has been clearly outlined by Scribante et al. (1995:437) as per the responsibilities outlined in the South African critical care nursing scope of practice (SANC Regulation 2598).

A review by Rao and Suhasini (2003:330) suggests that the number of trained nurses should be worked out by the type of the ICU, the workload and type of patient load. The authors emphasize that in complex situations, two nurses may be required per patient. This is in conjunction with the fact that some types of patient problems require more nursing time. This demonstrates that the number of nurses required to appropriately staff a unit may not only be a function of knowledge and experience but also dependent on the type of patients cared for, in other words, the skill-mix should match patient needs in order to decrease clinical risk and promote recovery (Ball & McElligot, 2003:232).

The increasing number of ICU untrained nurses as reflected by the type of staff working in South African ICUs can lead to an overall dilution of specialized care, which could threaten the safety of the care provided by ICU nurses, as highlighted in a study by Binnekede et al. (2003:191). On the other hand, it is evident that highly qualified professional nurses are entitled to support and supervise less experienced staff so as to

ensure that safe care is provided, hence better patient outcome (Williams, et al., 2006). Although this is the case, at the same time it could add to the burden and strain of professional nurses working in ICU and they may not be able to maximally devote their time in patient care since they have to spare some time in supervision.

To conclude, patients' severity of illness, the complexity of treatment and the rapidly advancing technology in the ICUs, with the employment of sub-professionals in the area may not be in the best interest of the patients if employed for direct patient care as indicated by Ball and McElligot (2003). The amount of work in the ICU and the staffing requirements thus need to be identified so as to ensure a balance in the skill-mix.

2.3 NURSING WORKLOAD, AND STAFFING REQUIREMENTS IN ICU

The use of nursing staff is dependent on various activities provided at each ICU such as the number and type of diagnosis, severity of patients' illness and the therapeutic interventions required by the patient admitted to the ICU. Moreno and Miranda (1998:753) state that it is the overall daily amount of work that limits the provision of more differentiated care.

This is supported by Lundgren-Laine and Suominen (2007:101) for they indicate that nursing workload and nursing intensity are dependent not only on the number of patients but also on the number and structure of nursing staff. Thus, the demands of care vary from unit to unit and the staff requirements are the single most relevant organizational elements related to the variation of demands of care (Adomat & Hewison, 2004).

2.4 DEVELOPMENT OF THE THERAPEUTIC INTERVENTION SCORING SYSTEM (TISS)

For over 30 years in an attempt to demonstrate the cost-benefit ratio of ICU, a variety of instruments have been developed to measure not only severity of illness of the patients but also the amount of nursing workload (Goncalves, Padilha & Sousa, 2007:1). The earliest attempt to quantify severity of illness in a general critically ill population was by Keene and Cullen (1983) who devised a therapeutic intervention score (Bersten, Soni & Oh, 2003) which has undergone several changes with now three versions in existence as described below.

2.4.1 Original Therapeutic Intervention Scoring System (TISS)

TISS developed by Cullen et al. in 1974 is based on 57 therapeutic procedures and each intervention scores one to four points (Guiccione, Morena & Pezzi, et al., 2004:41). Its introduction was with the aims of estimating severity of illness, the workload for ICU staff and nursing resource allocation. Although it correlated fairly well with the severity of illness of patients, its use for this purpose was abandoned after the appearance of more specific scoring systems for measuring severity of illness such as the Acute Physiological and Chronic Health Evaluation (APACHE) which was developed in 1981 by Knaus et al. (Bersten, et al., 2003). Since then, the scoring system became recognized and has been used extensively as a measure of nursing workload in ICU (Miranda, Rijk & Schaufeli, 1996).

2.4.2 Therapeutic Intervention Scoring System (TISS-76)

The original TISS was updated in 1983 by Keene and Cullen forming TISS-76. It is one of the most applied scoring systems which mostly rely on therapeutic, diagnostic and nursing activities (Miranda, et al., 1996; Moreno & Morais, 1997). TISS-76 is currently used to determine the nurse to patient ratios and assess current bed utilization and need. Its development was based on the anecdotal 'tube sign' in use in the United States of America (Adomat & Hewison, 2004:305) and clinical judgement of a panel of experts in selecting and attributing weights to the items (Miranda, et al., 1996). Its philosophy was that the type and number of therapeutic activities in the ICU were related to the severity of patients' illness, hence the sicker the patient, the greater the number and complexity of treatments required (Kwok, Chau & Low, et al., 2005:258).

Despite of the instrument being widely used worldwide, it has undergone four major criticisms as follows: (i) it is time consuming, (ii) it is cumbersome and perhaps even boring, (iii) the items listed do not always adequately reflect patient care activities of nurses in the ICU and (iv) it does not reflect several other daily activities of the nursing staff that are equally important to the professionals and to the organization and management of the ICU (Miranda, et al., 1996:65). This led to development of other scoring systems so as to capture nursing dependency as will be reviewed later in this chapter. Recent innovations in critical care raised the need to re-examine the items in the TISS-76 and this led to development of the TISS-28.

2.4.3 Simplified Therapeutic Intervention Scoring System (TISS-28)

TISS-28 based on advanced statistical methods was developed by Miranda et al. (1996) from a large database of the foundation for research on intensive care in Europe (Kwok, et al., 2005:258). TISS-28 items were reduced from 76 to 28 therapeutic items through content and component principal analysis. This involved four steps: item selection, item clustering, item reduction and cross validation (Kwok, et al., 2005:258; Padilha, Sousa & Kimura, et al., 2007). In addition, 'work sampling' of nursing activities was undertaken and matched with TISS-28 items (Miranda, et al., 1996).

TISS-28 was developed as an instrument that classifies patients according to the severity of illness. It is based on the principle that the number of therapeutic interventions is related to the severity of the clinical conditions. The more severe the state of the patient, the larger the number of therapeutic interventions necessary for treatment and consequently, the higher the TISS-28 score, the longer the nursing time spent on such care (Padilha, et al., 2007:163).

Moreover, the simplified version (TISS-28) indicates that the association between the score and the distribution of time among the full range of nursing activities showed that one TISS-28 point equals to 10.6 minutes of nursing time spent on direct patient care, thus permitting a more accurate estimation of nursing workload in an ICU (Miranda, et al., 1996:72). This is thus an added advantage over and above the other versions mentioned earlier on.

Literature indicates that TISS-28 has been extensively validated in many studies. It has been widely tested in numerous multi-centre and single centre studies on independent populations in first world countries such as in Europe. Recently, the instrument was tested in two third world studies, namely Hong Kong (Kwok, et al., 2005) and Brazil (Padilha, et al., 2007). Both of these two countries have similar cost constraint issues as South Africa and this builds much confidence that the instrument can serve almost the same purpose in these three countries, considering their similarities.

To date, there is no evidence that the TISS-28 is in use in a South African setting. This raises the interest of introducing and assessing the validity of the instrument in one of the South African ICUs. Given the shortage of highly skilled and experienced ICU nurses in South Africa, there is a need to objectively determine nursing workload and nursing staffing requirements in these ICUs using a valid and reliable instrument so as to ensure quality patient care.

2.5 OTHER SCORING SYSTEMS

Yamase (2003) points out that recently, TISS was criticized that it does not include basic nursing activities and to deal with what was missing in the conventional measure of nursing workload, different authors developed new scoring systems mainly related to the nursing activities as described below.

2.5.1 Intensive Care Nursing Scoring System (ICNSS)

The Intensive Care Nursing Scoring System (ICNSS) was developed in three adult ICUs in Oulu University Hospital, Finland. It is used to highlight nurses' work and its effects on the patients and their relatives in a way not allowed by medical classifications and scoring systems. In the ICNSS, nursing outcomes consist of the effects of nursing interventions in response to the nursing diagnoses. Each score can be used to describe the nurses' workload needed to respond to patients' health problem. Thus, the total scores describe all the nurses needed to respond to the 16 nursing diagnoses. The workload increases when the patient has simultaneously severe or extremely severe health problems (Pyykko, Laurila & Ala-Kokko, et al., 2001:26).

2.5.2 Nine Equivalents of Nursing Manpower Use Score (NEMS)

The Nine Equivalents of Nursing Manpower Use Score (NEMS) was developed by reducing the TISS-28 items to nine items. Its items measure aspects such as basic monitoring, ventilatory care, all dialysis techniques and specific interventions. It is considered as a suitable therapeutic index to measure the nursing workload and its efficiency at ICU level. It is very simple and can be performed with a quick glance on the clinical data sheet. It guarantees repeatability and consistency (Iapichino, Radrizzani & Bertolini, et al., 2001:131; Pyykko, et al., 2001:17). Despite of it being simple, NEMS has fewer items as compared to TISS-28 which has more items and can score many therapeutic activities in intensive care patients hence TISS outweighs NEMS as an instrument for scoring nursing workload.

2.5.3 Oulu Patient Classification (OPC)

The Oula Patient Classification (OPC) was developed on the basis of Hospital systems study group classification in 1991-1993 at Oulu University Hospital, Finland. With the OPC and nurse resource registry, it is possible to calculate nursing intensity points per one working shift. Nursing intensity depends on patients' need for care and it indicates the nursing workload caused by the patients' caring needs (Lundgren-Laine & Suominen, 2007:98). However, the authors indicate that there has been no effective and proper use of OPC in patient information system hence it lacks flexibility of staffing in real time.

2.5.4 The Comprehensive Nursing Intervention Score (CNIS)

The Comprehensive Nursing Intervention Score (CNIS) was designed to obtain nursing workload in a most comprehensive manner from a total of 73 job items typically performed in the setting which also include basic nursing tasks. While it possesses a much higher potential, it is quite cumbersome to complete the score as it includes a large number of nursing job items. Because most of the CNIS job items are included in treatment procedure lists to make up a hospital bill, if one writes a simple programme to retrieve necessary information from a hospital system, it is possible to compute the CNIS automatically. If such programme is not available, it is not practical to use the CNIS to conduct a large survey on nursing workload (Yamase, 2003:307).

2.5.5 Project Research on Nursing (PRN)

The Project Research on Nursing (PRN) is a score which assigns points to each nursing activity according to their frequency, duration and need for more than one nurse. This

resulted to time consuming, thus it became unsuitable for routine use (Guiccione, et al., 2004:41).

2.5.6 Nursing Activities Score (NAS)

The Nursing Activities Score (NAS) proposed by Miranda, Nap and Rijk et al. (2003) is a modified version of TISS-28 with additional five new items. It measures the time consumed by nurses' activities at the patient level and represent the calculated percentage of nursing staff's time (one 24 hour period) dedicated to performance of the activities included in the instrument. Although studies have indicated that NAS explains 81% of the nursing time whereas TISS-28 explains only 43%, it is clearly shown that NAS is concerned with nursing activities mostly rather than vital therapeutic interventions delivered to an ICU patient (Miranda, et al., 2003:380; Guiccione, et al., 2004:41).

Since NAS is based on the average time consumption unlike TISS which is indirectly related to the severity of patients' illness, it is therefore hard to appropriately distribute the skills available to different patients in the unit using NAS because only the nursing activities that describe nursing workload are noted, without considering the level of severity of illness.

The following three sub-topics will discuss some of the methods widely in practice in most ICUs for measuring nursing workload and staffing requirements with their limitations as opposed to using TISS.

2.6 CENSUS BASED METHOD

Currently in South Africa, there is no nationally prescribed nurse to patient ratio and such ratios vary greatly across units (Scribante, et al., 2004:111). Despite the lack of this prescription, doctors normally demand that a one to one nurse patient ratio be implemented and therefore, most ICUs have resorted to using this system. As mentioned earlier, apart from the intensive care nurse shortage in South Africa, cost constraints is one of the factors that has led to placement of sub-professional nurses in most ICUs to ensure continuity of patient care and to cut down on the costs. This means that the number of patients available in the unit indicates the number of nurses required to care for them as pointed out by Adomat and Hewison (2004:301).

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A study by Adomat and Hewison (2004:301) indicates that the census approach entails counting patients and staff without taking full account of changing needs of the patient or the level of experience of the staff, and this can actually threaten patients' lives. The available staff may not be 'able' to meet the patients' needs and demands at a specific time. For example, unplanned emergency admissions or the unexpected deterioration of a patient's condition can result in a situation where staffing levels do not comply with the 'standard' ratio because the census driven system is too rigid to accommodate such changes (Adomat & Hewison, 2004:301).

On the other hand, patients can improve rapidly following treatment and fewer staff may be required. Consequently, although the 'standard' ratio is clear, widely recognized and accepted, it lacks flexibility and can lead to under or overstaffing of ICUs as stated by Anderson (1997) in (Adomat & Hewison, 2004:301). This is further supported by Ball and

McElligot (2003:234) who stated that in order to contribute to the recovery of patients from critical illness, increased flexibility of patient to nurse ratio need to be based on patients' needs rather than financial imperatives as practiced by some health care institutions.

This method has been recognized as not being cost effective and may further increase the cost constraints in the ICU. This is because a large amount of nursing resources will be required when in actual sense few nurses would have been enough to provide the same intensity of care only, if an appropriate method was employed to actually measure the amount of workload and staff required to render the care (Adomat & Hewison, 2004). Williams et al. (2006:397) state that the provision of ratios lessens the risk of ambiguity in what is acceptable practice, whereas if taken out of the context ratios can be expensive or under representative.

This thus points out the need of an objective measure of nursing workload and staffing requirements in the ICU so as to cut down on costs and at the same time provide quality patient care. This is because after scoring a patient the nurse is able to know the amount of interventions to deliver to that patient and the total time needed to perform these activities including the complexity of care needed by the patient. This is a very useful method unlike using the census based method whereby 'any' nurse can care for the patient without taking into account the amount of patients' needs, the skills and experience of the nurse rendering the care (Adomat & Hewison, 2004).

2.7 PATIENT DEPENDENCY CLASSIFICATION

Patient dependency classification is a strategy for categorizing patients according to the amount and complexity of their nursing care requirements. This form of classification of patients according to their needs was developed out of advice to accurately determine the optimal staffing levels to meet these needs. In most classification systems, patients are grouped according to the amount of nursing work required (Adomat & Hicks, 2003:403; Adomat & Hewison, 2004:301).

As pointed out in the literature, the Intensive Care Society (ICS) in England recognized that it was important to have some kind of scoring system to categorize patients according to their nursing needs in 1990 (Adomat & Hewison, 2004). As a result, most National Health Service (NHS) hospital trusts in England began using the First European Intensive Care Unit System (EURICUS-1), which calculates nurse to patient ratios (Miranda, 1997). Patients are therefore, placed in one of the four categories as explained by Adomat and Hicks (2003:403) and Adomat and Hewison (2004:301) based on the required nurse to patient ratio as follows:

Category 1 patients require close observation but not necessarily the continuous presence of a nurse at the bed side. The expectation is that one nurse can care for two patients. Category 2 patients require a nurse at the bedside continuously for 24 hours per day. It is generally accepted that patients in this group will form the majority of patients in an ICU. They will be very ill but will not require frequent interventions which constitute a major addition to workload. On the other hand, category 3 patients are those that are seriously ill and will require a minimum of 1.5 nurses for a large proportion of the shift. It is generally assumed that for a majority of a span of duty two nurses will be required to care for the

patient. Finally, category 4 patients are described as being the most seriously ill and require the attention of two nurses for the majority of the shift. This category is rarely used as patients generally become stabilized and re-categorize into category 2 or 3 or deteriorate and die during the shift.

Despite of being widely tested in Europe and United Kingdom, Adomat and Hewison (2004:302) indicates that the EURICUS-1 system has been criticized for not accurately reflecting the actual nursing time spent with patients in each category and that nursing workload is not a direct result of patient dependency rather it categorizes patient need. It is further indicated that this system can be used as a reliable instrument to determine nursing staffing levels but it may not give an accurate assessment of the skill-mix required (Adomat & Hewison, 2004:302).

According to Adomat and Hicks (2003:403), patient classification system has a general effect of over estimating nursing requirements over a total shift, since calculations are made for a whole shift rather than a small part. An explanation of this is that patients usually remain in category 3 or 4 for short periods only and therefore require more than one nurse for only brief periods (Adomat & Hicks 2003). Considering this, patient classification system may not to be cost effective and it can lead to further cost constraints in the ICUs.

In addition, in their observational study, Adomat and Hicks (2003:410) found out that assumptions made by ICS (1997) about the type of care needed by category 1 and 2 patients were not in fact supported by video evidence of actual care demanded and provided in that, nurses were found spending much time on category 1 patients than as

expected in category 2 patients. This thus indicates that workload measures such as the nursing workload patient category system are not an accurate reflection of the work generated by different levels of dependence (Adomat & Hicks, 2003). This therefore raises a need to explore an alternative method of determining nursing requirements that meet the demand of intensive care provision, that is cost effective and the one that does not compromise patient care.

2.8 SEVERITY OF PATIENTS' ILLNESS

Patients admitted to ICU can also be classified according to the severity of their illness and this information has been used as a basis for prognostic and nursing workforce planning (Adomat & Hewison 2004:302). Adomat and Hewison (2004) further state that to measure the patients' prognosis, a variety of scoring systems have been developed based on basic homeostatic values focusing on severity of illness. These systems include Acute Physiological and Chronic Health Evaluation (APACHE) and Simplified Acute Physiology Score (SAPS) (Le Gall, Lemeshow & Saulnier, 1993:2957; Moreno & Matos, 2000:158; Adomat & Hewison, 2004:303).

A review by Adomat and Hewison (2004:302) indicates that nurse managers have used some of the severity of illness scoring systems to calculate nursing dependency and overall nursing workload. These scoring systems are based on physiological or therapeutic measures. The scores can therefore allow comparisons to be made between the severity of illness or therapeutic interventions and outcomes in different ICUs. This in turn is used as a basis to estimate the number of nurses required for specific patients as indicated by Adomat and Hewison (2004:303).

Although SAPS II has been found to be more practical in predicting hospital mortality than APACHE II or III, it has been clearly shown that SAPS II is not a suitable tool for calculating patient dependency in terms of nursing requirement or nursing workload measures since it may result in simplifying assessments of nursing need (Adomat & Hewison, 2004:304). According to Adomat and Hewison (2004), calculations based on physiological scoring systems can result in a 'false' demand for nurses and underestimates of the number of nurses required when patient demand is high. For example, if a patient is admitted with severe head injury resulting in brain stem death, the patient will score highly in terms of severity of illness but may only require minimal nursing care (Adomat & Hewison, 2004:304).

2.9 SUMMARY

The literature indicates that a shortage of ICU nurses as a major crisis facing South Africa coupled with cost constraints has led to placement of sub-professional nurses so as to ensure continuity of patient care. This in turn is considered as a factor that carries a risk of dilution of highly specialised nursing care and ultimately impacts on patient outcomes.

Experience and knowledge of the ICU nurse is also a necessity in dealing with complexity and changing situations of patients. This therefore raises a need to use an objective valid and reliable instrument to score ICU patients in order to calculate the amount of nursing workload required by each patient and the skills required depending on the nature of the patients' condition i.e. severely ill patient requiring more complex interventions will need ICU trained nurse with the ability to deal with arising problems the patient faces.

Despite the fact that TISS has been criticized that it does not score all nursing activities in the ICU, it still remains a very important instrument in measuring nursing workload in the ICU as compared to the other nursing workload scoring systems. From the intensive care nursing point of view, the core of intensive care nursing work does not consist exclusively of assessment activities or directed nursing interventions as highlighted by other instruments that were developed later. Pyykko et al. (2001:17) state that the TISS-28 consists of assessments and treatments which focus especially on the patients' vital function whereas the other scores focus mainly on nursing activities e.g. bed bathing and support to relatives thus rarely focusing on interventions that are vital to patients' function such as ventilatory support among the many as does the TISS-28.

Compared to the development of the other scoring systems, the TISS-28 was developed by content and component principal analysis whereas the other scoring systems were developed based on a panel of expert opinions whereby items might have been selected based on the experts interests hence affecting their ability to score most important activities.

Studies conducted overseas suggest that the TISS provides an objective measurement of staffing requirements and use of resources. Most ICUs still employ the subjective ways of measurement which may not ideally reflect the amount of nursing workload and the staffing ratios. Three of these methods (census based, patient dependency classification and severity of illness) were discussed in this chapter.

This chapter described the ICU nurses' shortage, cost constraints and skill-mix as factors necessary to consider during staff allocation and patient care. Development of three

versions of TISS and its importance as an objective measure of nursing workload and staffing requirements over and above the other nursing activities scoring systems developed after its criticism were also discussed. Some of the subjective methods that are currently in practice such as patient dependency classification, census based, and severity of illness methods have been discussed including their limitations as instruments for measuring nursing workload and staffing requirements.

The following chapter will address the research methodology used in this study.