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Managing Staff Levels: A Prerequisite to Control Rate and Appropriateness of ICU Resource Use

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Professor Iapichino and his colleagues have designed a tool to measure the rate and appropriateness of nursing coverage in intensive care units (ICU), as a proxy for total use of resources. This fast and simple method for use within the ICU computes the optimal use of resources, based on fixed human resources or a fixed number of beds.

Introduction

Intensive Care Units (ICUs) are not all equivalent. One important difference between them concerns the severity of illness of patients and consequently the complexity of treatments and use of resources. As the provision of intensive care depends mainly on the availability of nurses, figures for this resource serve as a proxy for overall resource consumption.

Historically, the nursing workload at patient level has been measured based on level of clinical assistance (TISS, TISS 28, NEMS) (Cullen et al. 1974; Miranda et al. 1996; Miranda et al. 1997) resulting in cumulative points, such as 40-50 points representing 24 h of nursing workload (Cullen et al. 1974; Iapichino 1991; Miranda et al. 1996; Miranda et al. 1997) or in minutes of workload (TOSS, NAS) (Iapichino 1991; Miranda et al. 2003). Quantifying nursing workload and defining the average number of patients that a nurse can manage defines the average complexity of care required by patients under treatment. Four levels of care were first defined by the Bethesda Consensus Conference in 1981 (Consensus Conference: Critical Care Medicine 1983). Miranda and Langrehr revised these to define three levels of intensive care (1990), and these levels were later endorsed by a task force of the European Society of Intensive Care Medicine (Ferdinande 1997).

Recent studies have shown that use of resources in European ICUs is often inefficient. A major reason is the "waste" of nursing manpower (Iapichino et al. 2000; Moreno & Miranda 1998), which constitutes the largest part of resources allocated to the ICU. "Waste" is measured by comparing the capacity for delivering nursing work with work actually delivered (Moreno and Miranda 1998). "Annual delivery" is calculated based on a therapeutic index (Miranda et al. 1997) summing the scores obtained daily at patient level; "annual capacity" is derived from the total number of nurses in the ICU, taking into account the amount of work (total index score) possible in a year by one full-time nurse (Miranda and Langrehr 1990). Originally designed for research purposes, this method is time-consuming and laborious, and therefore demands more than the normal efforts expected for management purposes in ICUs. However, assuming that such studies might enable ICU managers to monitor practice patterns and determine the rate and appropriateness of human and fixed resource use, we have designed a new approach to quantify the provision of and demand for nursing manpower on a daily basis (Iapichino et al. 2004).

Description of the Tool

The approach quantifies the mean “actual nurse assistance” devoted to the patients over a defined period of time. Recording the number of occupied beds and classifying the use of nurses at patient level (provided level of care) is mandatory for each day of the test period. To offer a real-time and friendly-to-use instrument for the frequent appraisal and guidance of resource allocation in the unit, we propose only two levels of care.

We used six out of nine NEMS items (Miranda et al. 1997) to define two grades of intensity/complexity of care at patient level (Iapichino et al. 2001). The level is defined as highly-intensive/complex (HLC) if monitoring is coupled with active respiratory support, and/or multiple vasoactive drugs, or less active support of at least two organs (e.g. supplementary ventilatory care, single vasoactive drug, dialysis). All other combinations are classified as low-level care (LLC). LLC corresponds to level of care I and HLC includes levels II and III from the classification of ICUs (Miranda and Langrehr 1990; Ferdinande 1997).

Method

a) The instrument is devoted to medium-high level ICUs, with HLC beds sometimes used for LLC, even if only before patients are discharged from ICU (Iapichino et al. 2002). It might also be used to evaluate a single organisation/ performance or for benchmarking to audit several ICUs (Iapichino et al. 2004).

b) Data can be cross-sectionally collected on certain days in the week (e.g. Monday, Tuesday, Thursday and Saturday) to sample the weekly patterns of the case mix during a 2-3 month period or year to capture seasonal variations.

c) The application of the tool requires some basic assumptions which need to be defined at ICU level:

• the list of the equipment necessary to provide active and attributes the appropriate assistance (number of nurses) as defined by the ICU staff, i.e. the “theoretical appropriate patient/nurse ratio”.

c) The “theoretical nurse assistance” is computed by dividing the overall actual delivered patient treatment days by the theoretical number of nursing days needed to manage the actual HLC and LLC patient treatment days delivered during the test-period (see table 1).

d) The “nursing resource use” in the test period is calculated as the difference between the actual and theoretical nurse assistance (delivered patient treatment days/ nurse ratios). A positive difference indicates a higher number of patient treatment days delivered than appropriate for the nursing resources, i.e. over-utilization, and a negative difference indicates a lower number of patient treatment days than appropriate with the available nursing resources, i.e. under-utilization.

Calculating Appropriateness of Resource Use

Records of the delivered patient treatment days as HLC or LLC allows a separate calculation of utilisation rate.

a) The “theoretical maximum number of HLC patient treatment days” is computed as if all members of the nursing staff were devoted to HLC (see table 1).

b) Knowing the total number of delivered HLC days and the theoretical maximum number of HLC days, the percentage of “resources used for HLC” can be calculated.

c) For nursing days not used for HLC, due to empty beds or beds dedicated to LLC, it is possible to calculate from the remainder (i.e. the patient treatment days without HLC), the “theoretical maximum availability of LLC life-support (monitoring, ventilation, titrated infusion capacity); the theoretical “appropriate patient to nurse ratio” for HLC (e.g. 1, or 1.5 or 2), and for LLC (e.g.

3). This can be defined at the unit level according to case mix, therapeutic strategies and nursing workload.

• the need for care is constant around the clock. This assumption limits the nurse to patient ratio used to that of the lower staffed shift (usually the night shift) to provide a constant value for the whole day. This number multiplied by the number of days during the test-period provides the “available nursing-days” during the test period: available nursing days = night-nurse to patient ratio x days in test period.

• per day each bed can only serve one patient with only one level of care. If a bed is used within the same day by more than one patient with different levels of care, or by a single patient with modification of the level of care, the highest level is selected. This provides the number of patients treated each day or “delivered treatment days” during the test period. Delivered patient treatment days are recorded separately as HLC or LLC.

Calculating Rate of Resource Use at ICU Level

a) The “actual nurse assistance” is computed by dividing the total number of delivered patient treatment days by the total number of available nursing days in the period: actual nurse assistance = delivered patient treatment days/ available nursing days.

b) The “theoretical number of nurses” required to manage the treatment days delivered incorporates the level of care for each patient treatment day (HLC and LLC) patient treatment days”: (patient treatment days without HLC/theoretical number of HLC patients per nurse) x theoretical number of LLC patients per nurse.

d) Knowing the total number of delivered LLC days and the theoretical maximum number of LLC days the percentage of “resources used for LLC” can be calculated.

Application of the Method in the Field

In table 1 we present three hypothetical scenarios of nurse (resource) use and appropriateness. ICU A is an example of under-utilization of (nursing) resources, as shown by the remarkable negative difference between actual and theoretical nurse assistance.

The ICU uses 81% of the overall resources: only 63% of the resources were completely devoted to HLC, and only 49% of the residual nursing time remaining from under HLC utilisation were devoted to LLC. This is an oversized or overstaffed ICU, even if some HLC/LLC patients required higher nurse assistance than reported by the ICU team during the test period. In any event, the method allows the ICU director to quantify this possibility.

ICU B is an example of resource over-utilization as shown by the positive difference between actual and theoretical nurse assistance. It is a small unit delivering 10% more treatment-days than expected. In detail it utilizes only 89% of the overall resources devoted to HLC. However, considering the residual nursing availability, it provides an excessive number of LLC days. This suggests a possibly unsafe environment of care for all HLC or LLC patients. This unit may need more resources (nurses) to cope with the demand for LLC. Finally, in Unit C, the management, reallocating the available manpower according to the assumed patient/nurse ratio, is able to adjust the HLC/LLC mix to use all the available resources in a quantitatively and perhaps qualitatively appropriate way. This kind of flexible organisation avoids a recovering critical patient needing to be prematurely discharged to the ward, without limiting the admission of new HLC patients.

Comments

If the theoretical patient to nurse ratio is standardized, this method identifies the optimal adjustment of resources in ICU management. If the number of ICU beds is fixed, the number of nurses should vary according to the levels of care required, with maximum staffing when all treatments are HLC. The reverse is true with a fixed number of ICU nurses: the number of active beds should be established according to the intensity and complexity of patients, from a minimum if all patients require HLC to a maximum if all patients require LLC.

Obviously, ICUs require the actual space in order to increase the number of beds to admit additional, less complex patients. This is the rational basis of the solution to intermediate unit availability proposed in Italy (Gattinoni et al. 1966) and in Europe (Vincent & Burchardi 1999). Finally, overall bed occupancy rates are not a sensitive marker of ICU resource usage. ICUs whose beds are designed to serve HLC are serving well, even if all are occupied by LLC patients, without any increase in their operative number. The appropriateness of ICU personnel and resource usage can only be assessed on the basis of both HLC and LLC utilization.

We tested this new method on a group of general nonspecialist ICUs without assistance of an intermediate unit, using the same agreed theoretical patient/nurse ratios (Iapichino et al. 2004). In this sample, the method was powerful enough to adequately distinguish between “over” and “under-utilization” and to identify all the theoretical scenarios of nurse/resource utilization.

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