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Ventilatory care in a selection of Ontario hospitals: bigger is not necessarily better!

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Abstract *Objective:* To determine whether there is variability in the structure and process of ventilatory care in intensive care units (ICUs) of the hospitals of Southwestern Ontario.
Design: Self-administered questionnaire-based survey.
Setting: ICUs of selected community and teaching hospitals of Southwestern Ontario.
Participants: Head of respiratory therapy service of respective hospitals; in those hospitals without respiratory therapists, the ICU nurse manager.
Intervention: Self-administered questionnaire.
Outcome measure(s): The availability of different models of ventilators and respiratory therapist and physician coverage were assessed. In addition, the use of clinical practice guidelines, respiratory therapists, and the nursing role in ventilatory care were determined.
Results: In general, the structure of ventilatory care, including availability of different modes of ventilation, and coverage by respiratory therapists and physicians was more comprehensive in larger hospitals. However, the availability of some modes of ventilation varied more than expected among hospitals of comparable size. Similarly, variability in the process of ventilatory care, defined by the availability of clinical practice guidelines and the roles of respiratory therapists varied both within and among hospitals of different size.
Conclusions: The structure and process of ventilatory care in this sample of Southwestern Ontario ICUs was found to be variable. Not all this variability could be accounted for by hospital size, suggesting a potential for improvement in overall ventilatory care. Further study is required before any specific recommendations can be considered.

Key words Intensive care · Critical care · Intensive care unit/organization and administration · Respiration, artificial/method · Human · Organizational policy · Data collection · Health care survey · Questionnaire · Length of stay

Introduction

The past two decades have witnessed dramatic advances in the technology of mechanical ventilation, paralleling the continuing evolution in the understanding of the pathophysiology of acute respiratory failure [1–6]. New therapies to improve gas exchange have been developed and adopted into clinical practice based upon pathophysiologic rationale without rigorous clinical evaluation of their effect upon either outcome or cost [4–11]. The sparse research findings available to guide practice contributes to the potentially overwhelming options avail-

able to healthcare workers, in terms of both types of ventilators and modes of ventilation [1–11].

As the resources available to support health care decrease, greater emphasis has been placed upon maximizing the efficiency of delivering health services. In order to achieve this goal, methodologies such as "benchmarking" have become increasingly popularized [12, 13]. Benchmarking begins with determining what process you wish to study and then collecting data to describe the process of interest. These steps allow us to determine what we are doing now. To determine a potential for improvement, we compare our performance with that of others to identify those factors that drive superior performance. Once this is completed and factors identified, we can combine this new knowledge with information in the literature to develop evidence-based clinical practice guidelines [14–21]. Finally, these guidelines are implemented, using strategies to optimize compliance, and evaluated to determine their impact on both practice and patient outcome. Practice should be determined for each specific setting as generalizability from academic to community settings cannot be assumed to be valid [22].

There is currently a paucity of data describing ventilatory care in community hospitals. Therefore, the first step in achieving optimal care is to ask: "What are we doing now?" To answer this question, three approaches can be used: (1) retrospective analysis of data on ventilatory practice generally collected for other purposes, (2) conduct surveys of practitioners to determine what they believe they are doing, or (3) prospectively collect data to describe the process of interest. Unfortunately, databases do not exist to describe the process of ventilatory care adequately for most community hospitals. While data collection provides a more accurate reflection of practice, it is also more time consuming and expensive than conducting surveys.

We hypothesized that there is variability in both the structure and process of ventilatory care among community hospitals. Structure is the fixed resources available to provide a healthcare service which, in the case of ventilatory care, would include the number and type of ventilators, the degree of coverage by the respiratory therapist and physicians, and the availability of monitoring. Process of care describes how a healthcare service is delivered with the fixed resources available and would include the designated responsibilities of caregivers and the degree of organization used to deliver the service of interest (including the use of guidelines and care maps). Variability in practice infers potential problems with decision makers' access to and/or interpretation of relevant research findings [23]. In addition, it can be explained by differences in the structure available and the organization of the process. The objective of this self-administered questionnaire was to determine the structure and process of ventilatory care in a selected group of intensive care units (ICUs) in Southwestern Ontario. While three of these units were in teaching centers, the majority were in community hospitals.

Materials and methods

Population

The Critical Care Research Network (CCR-Net) is a network of ICUs within Ontario established to conduct evidence-based research within both teaching and community hospitals and to facilitate research transfer to the decision makers within these settings [24]. As an initial step towards these goals, collection of data to understand current practice within different areas of critical care was initiated [24]. Information gathered from this process allows hospitals to benchmark themselves against their peers as well as assess their own process of care over time [23, 24]. Currently, there are 20 member hospitals gathering baseline data on all admissions and a larger number that are affiliated with the network in other ways. At the time, of this survey, 36 regional hospitals – 3 teaching and 33 community hospitals – were sent questionnaires. The surveys were addressed either to the head of the respiratory therapy department, if one existed, or to the ICU nurse manager. The target population was, therefore, the head of respiratory therapy or ICU nurse managers of all Ontario hospitals. Our sampling frame was all hospitals within CCR-Net and our sample population was the entire sampling frame.

Questionnaire

Development

The initial survey tool was developed during a workshop with representatives of five hospitals from CCR-Net. The survey was then piloted locally to ensure content validity and clarity of language, and revisions were conducted where necessary. The final draft was then mailed to the member hospitals. The follow-up strategy used to maximize response rate consisted of three telephone reminders.

Content

Baseline information included: number of hospital and ICU beds, number of patients admitted to the ICU over the year, average length of ICU stay, the presence of a respiratory therapy department; the number of respiratory therapists and hospital coverage; and the ability of the hospitals to ventilate patients. For those hospitals that offered mechanical ventilation, further data were collected regarding the development of guidelines, the role of respiratory therapists and nurses in ventilator-associated activities, and the availability of different modes of ventilation.

Data management and analysis

All data were entered into Microsoft ACCESS. Data consistency checks were performed on each returned survey, and inconsistencies in data were resolved by reviewing the original questionnaires. The data were exported to a statistical program, Statistical Analysis System 6.0 (SAS Institute, Cary, N.C., USA, 1987) where descriptive and statistical data analysis were conducted, grouping

Table 1 Description of hospital and ICU structure of participating institutions

	< 100 beds	100–200 beds	> 200 beds
Number of hospitals	11	10	9
Number of ICU beds (mean ± SD)	4.3 ± 1.7	9.1 ± 8.0	17.0 ± 6.8*
Proportion of ICUs that provide mechanical ventilation (%)	6/11 (54.5)	10/10 (100)	9/9 (100)
Proportion of patients receiving mechanical ventilation (%) (mean ± SD [range])	7.2 ± 5.1 (1–12)	15.2 ± 7.0 (6–30)	43.4 ± 33.2** (4–89)
Length of ICU stay (days) (mean ± SD)	3.1 ± 1.1	3.3 ± 0.9	3.8 ± 1.1
Length of stay in ICUs that ventilate (mean ± SD)	2.7 ± 1.0	3.3 ± 0.9	3.8 ± 1.1***
Duration of ventilation (days) (mean ± SD)	2.0 ± 1.0	3.4 ± 1.3	4.4 ± 1.9****

Asterisks refer to the following p values arising from the comparison of the three hospital groups using the appropriate statistical tests (see Materials and methods): * $p = 0.0005$; ** $p = 0.024$; *** $p = 0.154$; **** $p = 0.062$

Table 2 Physician and respiratory therapist coverage in ICU by hospital size. Percentages in parentheses

	< 100 beds	100–200 beds	> 200 beds
Physician coverage			
24 h in ICU	1/6 (16.7)	3/10 (30)	5/9 (55.6)
Physician on call to ICU from home	5/6 (83.3)	7/10 (70)	4/9 (44.4)
Respiratory therapist coverage			
24 h in ICU	0	0	4/9 (44.4)
24 h in hospital	0	3/10 (30)	2/9 (22.2)
Call-back to hospital	1/3 (33.3)	2/10 (20)	3/9 (33.3)
Day coverage only	2/3 (66.7)	5/10 (50)	0

hospitals by their size as determined from number of hospital beds (< 100 beds, 100–200 beds, > 200 beds). As shown in Table 1, the average number of ICU beds for these three groups were 4.3, 9.1, and 17, respectively. When comparing the number of ICU beds, the proportion of patients receiving mechanical ventilation, the length of ICU stay, and the duration of ventilation between different sized hospitals, the nonparametric Wilcoxon rank sum test was used. Fisher's exact test was performed to compare frequencies between hospitals.

Results

Of the 36 member hospitals, 30 completed the self-administered questionnaire for an overall response rate of 83.3%. Of these 30 hospitals, 11 had fewer than 100 beds, 10 had 100–200 beds, and 9 had more than 200 beds (Table 1). The number of ICU beds was greater in hospitals of larger size ($p = 0.0005$), and the only hospitals that did not ventilate patients were those with less than 100 beds. The proportion of patients admitted to the ICU receiving mechanical ventilation increased with hospital size ($p = 0.024$). In addition, there was a trend toward a greater duration of mechanical ventilation and a greater length of stay in the ICU among ventilated patients in the larger hospitals ($p = 0.062$ and $p = 0.154$, respectively) (Table 1). Level of physician and respiratory therapist coverage varied in relation to the size of hospital (Table 2). Of the 6 hospitals with less than 100 beds that offer mechanical ventilation in their ICUs, only 3 employed respiratory therapist(s).

The availability of modes of ventilation varied by hospital size (Fig. 1). For example, the availability of both pressure-support and pressure-control modes of ventilation was greater in larger hospitals ($p = 0.009$ and $p = 0.021$, respectively). The greatest variability among groups of hospitals appeared to be due to the lack of availability of particular modes of ventilation in hospitals with less than 100 beds. From this figure we can also infer that variability within a group of hospitals of similar size would be least for those that either all offered, or did not offer, the modes of ventilation presented. Variability within hospital groups would increase as the proportion of ICUs offering a mode of ventilation within a group approaches 50%. While most of the variability occurred among hospitals with different numbers of beds, variability also occurred within these three hospital categories. Interestingly, while hospitals of medium and large size generally had the most common ventilatory modes available, such as assist-control and intermittent mandatory ventilation, the proportion of ICUs offering noninvasive ventilation was only 50% in medium-sized hospitals and 67% in large hospitals, respectively.

The use of at least one set of clinical practice guidelines related to ventilatory care appeared to be greater in larger hospitals upon inspection but this was not found to be statistically significant (Fig. 2). However, within the three hospital sizes, the use of guidelines for different aspects of ventilatory care was variable. The tasks related to ventilatory care performed by the respiratory therapists and nurses are summarized in Fig. 3 and 4. While respiratory therapists generally assisted with intubations and adjusted ventilator parameters,

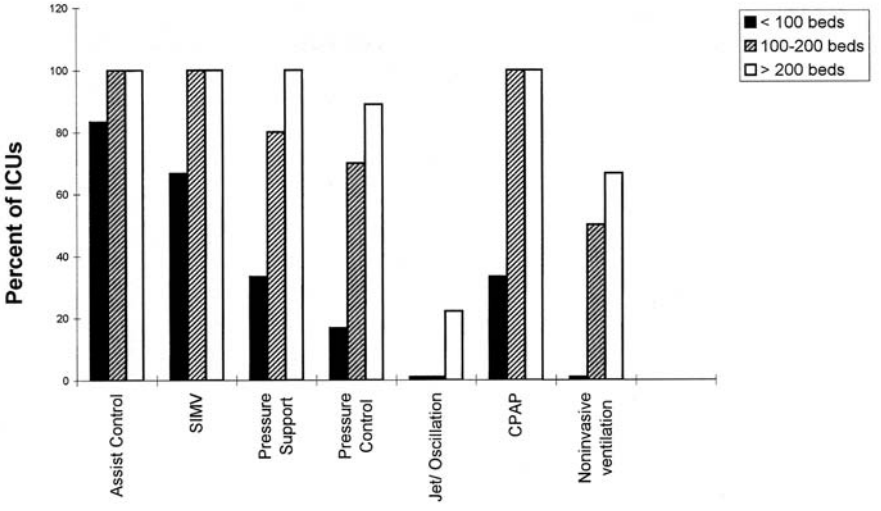

Fig. 1 This figure demonstrates the availability of different modes of ventilation by hospital size (< 100, 100–200, or > 200 beds). *SIMV* synchronized intermittent mandatory ventilation, *CPAP* continuous positive airway pressure, *Jet/ Oscillation* availability of jet ventilation or oscillation ventilation

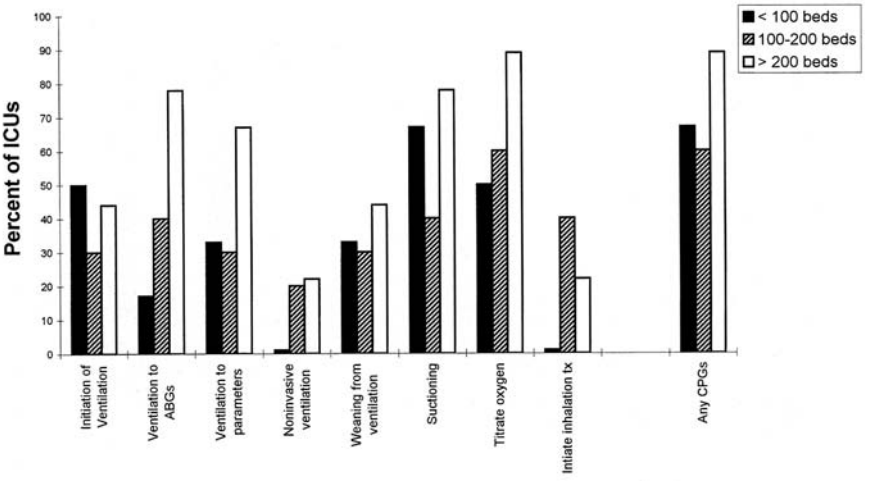

Fig. 2 This figure demonstrates the various clinical practice guidelines available at hospitals of different size. *Ventilation to ABGs* adjustments are made to ventilation parameters to maintain arterial blood gases within a specified range of values

other tasks were variably performed among different institutions. The responsibility of nurses for ventilator-related tasks also varied among institutions of similar size. The variability appeared to be independent of hospital size.

Discussion

In this self-administered questionnaire-based study we found that the structure and process of ventilatory care varied among hospitals, primarily in relation to the size of the institution. However, among hospitals of similar size, we did find variability in both structure (use of noninvasive ventilation) and process (availability of clinical practice guidelines and the roles of respiratory therapists and nurses in ventilatory care).

In Ontario, our healthcare system is under increasing scrutiny by the Government, and major restructuring of the process of delivering health services has been proposed. The impact of the accelerating costs of healthcare on provincial and federal deficits appears, at least to some, to be a major factor driving these reforms. Healthcare workers have become increasingly concerned about the potential negative effects on patient care arising from reductions in funding that are not based upon healthcare needs. Regardless of the reasons behind reduced spending, in order to continue to provide the best care possible to our patients we must maximize the efficiency with which we provide services.

The first step in the process of maximizing the efficiency with which we deliver specific health services is to obtain a clear understanding of how the process of interest is currently being conducted. To do this, we require data describing the process of delivering the health services of interest and their relevant outcomes. Benchmarking, originally used by industry, is increasingly advocated by workers in health services research

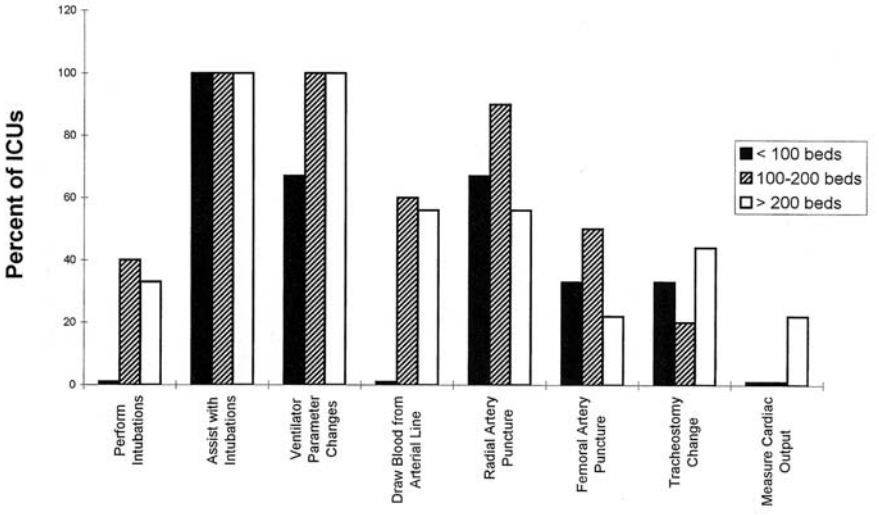

Fig. 3 This figure identifies the various ventilator-related tasks that the respiratory therapists are responsible for at hospitals of different sizes

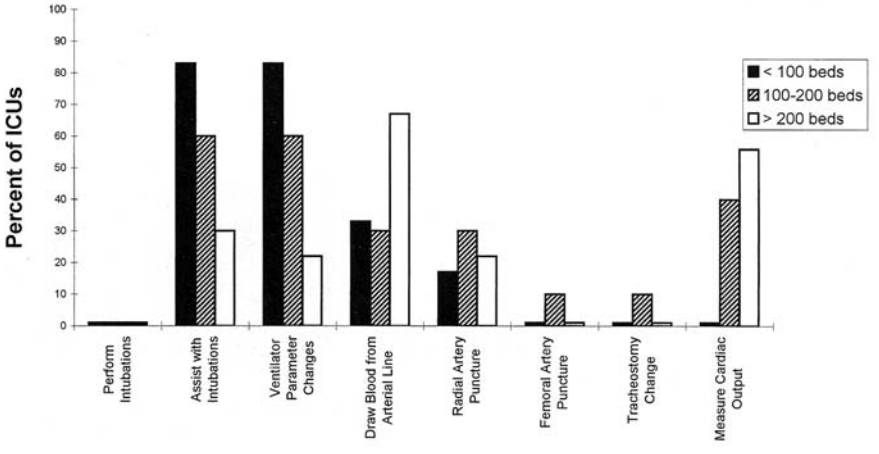

Fig. 4 This figure identifies the various ventilator-related tasks that the nursing staff are responsible for at hospitals of different sizes

as a preferred method to improve quality of care [12, 13]. Benchmarking includes: (1) identification of a process that requires assessment, (2) gathering of data to describe the process of interest as it is conducted not only at the index institution but also other institutions (especially those thought to have high standards), (3) comparing outcomes among institutions to identify those with superior performance, (4) identifying those factors that drive superior performance, (5) summarizing an approach to the process of care that includes those factors, (6) implementing this new approach to the process of care, and (7) evaluating the impact of implementing this new process. It is important to emphasize that this is an ongoing, dynamic process, requiring continuous re-evaluation of the process of care and modification of the approach used to ensure advances in healthcare technology and methodology are appropriately incorporated as they arise.

The current study was conducted as an initial step in understanding the structure and process of ventilatory care in a group of Southwestern Ontario hospitals. Together, these hospital ICUs represent a system of care for critically ill patients. In 1991, the Working Group on Critical Care emphasized the importance of developing a coordinated system of critical care in Ontario. They defined a system as a set of dynamically linked, interdependent components that create a whole entity, seeking to achieve a common goal [25].

The process of delivering healthcare services is generally affected by the structure within which this process operates. Differences in the number of ICU beds, extent of respiratory therapist and physician coverage, and availability of different modes of mechanical ventilation were demonstrated among hospitals surveyed. In general, the larger the hospital, the more extensive the structure was to support ventilatory care and the more integrated the process of ventilatory care appeared to be. The process of ventilatory care in this case being represented primarily by the use of clinical practice guidelines and also, to a lesser extent, the responsibil-

ities of the respiratory therapists and nurses in ventilatory care.

Ideally, one should expect that if a health care system is delivering services in an optimum manner, the structure and process of delivering these services would be similar for institutions of similar size. While we found the structure and process of ventilatory care to be generally related to hospital size, variability in both was identified. Variability in structure and process does not necessarily reflect variability in outcomes of importance. However, its presence suggests the potential for variability in quality of care, with some institutions providing superior delivery of services [23]. In addition, variability in process may reflect a real problem with knowledge of best practice in the area of interest arising from inadequate transfer of research results to the decision makers. For example, we found that the availability of noninvasive ventilation (a part of the structure of ventilatory care) varied among hospitals of similar size. The reason for this variability was not clear. The literature clearly supports the use of noninvasive ventilation for patients with acute exacerbations of chronic obstructive pulmonary disease by the end of 1995, suggesting the importance of uniform accessibility to this mode of ventilation [26]. Unfortunately, it has been found that relying upon published studies as the only form of transferring research to decision makers in both academic and community hospitals is ineffective [27]. While we suspect that this variability of structure may represent a problem with research transfer, other factors such as differences in funding available for ventilatory care could also explain this finding.

Variability in process of care among institutions of similar size was also identified. Specifically the use of guidelines differed, as did the tasks of respiratory therapists and nurses associated with ventilatory care. While the majority of institutions used clinical practice guidelines for some aspects of ventilatory care, we found variability in the use of guidelines among institutions. In general, respiratory therapists assumed greater responsibility in larger and medium-sized hospitals than the smaller hospitals. A pattern of increased responsibility in smaller institutions was more apparent in the ventilator-associated tasks of nurses, best demonstrated by the role of nurses in assisting intubation (83% in small, 60% in medium, and 30% in large institutions). This finding may reflect the absence of respiratory therapists in small hospitals and the presence of housestaff in some of the larger institutions.

The design of this study, a self-administered questionnaire, requires some comment. While the validity of all questionnaires remains open to scrutiny, efforts were made to review content validity thoroughly prior to administration of the questionnaire. Questionnaire-based studies, in contrast to prospective data collection, report what people say they do, which may not reflect actual practice. However, this type of study can generally be conducted more quickly and less expensively than prospective data collection and therefore is a valuable first step in identifying areas for further, more costly research. The question of how generalizable these findings are can be raised. While only 30 questionnaires were completed and the hospitals were chosen in a nonrandom fashion, we have accounted for 71% of the 42 hospitals in Southwestern Ontario.

In summary, this survey addressed the first two steps in the benchmarking process. A process of care was defined and data were collected to describe this process in the form of a self-administered questionnaire. While information was not collected on outcomes, the variability in practice found in this study suggests the need to determine whether practice differences impact upon either clinical or economic outcomes. Interestingly, while larger hospitals appeared to provide a more extensive structure and well-defined process for ventilatory care, the variability among hospitals leaves us with the conclusion that the organization of ventilatory care is not necessarily superior in larger hospitals (bigger is not necessarily better!). The next step would be to collect prospective patient-specific data to describe the process of ventilatory care and patient outcome. If variability persists, those factors associated with superior performance could be identified and clinical practice guidelines could then be developed (after a systematic review of the literature and consensus conference), implemented, and evaluated. The end result will be a more efficient delivery of ventilatory care to our patients.

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