

Evaluation of prevention and control measures for ventilator-associated pneumonia

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This study aimed to evaluate the quality of health care delivered in an Intensive Care Unit, concerning the use of pneumonia prevention and control measures in high-risk patients on mechanical ventilation. In this descriptive and exploratory research, 839 observations of patients under invasive ventilation care were carried out, between November 2009 and January 2010, using the Indicator of Evaluation of Adherence to Prevention and Control Measures in High-risk Patients (IRPR). Some isolated measures that compose the mentioned indicator reached rates close to 100%, but the general compliance rate with all prevention and control measures of ventilator-associated pneumonia was 26.94%. It is concluded that, although the evaluated practices are accomplished at the unit, systematic evaluations of the interventions is needed so as to permit the discussion and practice of other educational strategies by the health team.

Descriptors: Quality Indicators, Health Care; Pneumonia, Ventilator-Associated; Nursing; Health Evaluation.

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Avaliação das medidas de prevenção e controle de pneumonia associada à ventilação mecânica

Neste estudo objetivou-se avaliar a qualidade da assistência à saúde prestada em uma unidade de terapia intensiva, quanto ao uso das medidas de prevenção e controle de pneumonia em pacientes de alto risco, submetidos a ventilação mecânica. Trata-se de pesquisa descritiva exploratória, na qual foram realizadas 839 observações de pacientes em assistência ventilatória invasiva, no período de novembro de 2009 a janeiro de 2010, utilizando-se o Indicador de Avaliação da Adesão às Medidas de Prevenção e Controle de Pneumonia em Pacientes de Alto Risco (IRPR). Algumas medidas isoladas que compõem o Indicador alcançaram índices próximos a 100%, porém, o índice da conformidade geral a todas as medidas de prevenção e controle de pneumonia, associada à ventilação mecânica, correspondeu a 26,94%. Conclui-se que, embora essas práticas avaliadas estejam instituídas na unidade, há necessidade de avaliações sistemáticas das intervenções para que outras estratégias educativas sejam discutidas e implementadas pela equipe de saúde.

Descritores: Indicadores de Qualidade em Assistência à Saúde; Pneumonia Associada a Ventilação Mecânica; Enfermagem; Avaliação em Saúde.

Evaluación de las medidas de prevención y control de neumonía asociada a ventilación mecánica

Este estudio objetivó evaluar la calidad de la asistencia a la salud prestada en una Unidad de Terapia Intensiva, en lo que se refiere al uso de medidas de prevención y control de neumonía en pacientes de alto riesgo sometidos a ventilación mecánica. Se trató de una investigación descriptiva exploratoria en la cual fueron realizadas 839 observaciones de pacientes en asistencia ventilatoria invasora, en el período de noviembre de 2009 a enero de 2010, utilizando el Indicador de Evaluación de la Adhesión a las Medidas de Prevención y Control de Neumonía en Pacientes de Alto Riesgo (IRPR). Algunas medidas aisladas que componen el Indicador alcanzaron índices próximos a 100%, sin embargo el índice de la conformidad general en todas las medidas de prevención y control de neumonía asociada a la ventilación mecánica correspondió a 26,94%. Se concluye que a pesar de que estas prácticas evaluadas estuviesen instituidas en la unidad, hay necesidad de realizar evaluaciones sistemáticas de las intervenciones para que otras estrategias educativas sean discutidas e implementadas por el equipo de salud.

Descriptorios: Indicadores de Calidad de la Atención de la Salud; Neumonía Asociada al Ventilador; Enfermería; Evaluación en Salud.

Introduction

Health institutions have adopted different strategies in recent years to assess services, with a view to obtaining a certification level according to the service quality they offer. According to one study⁽¹⁾, available activities to guarantee the accomplishment of this process can be divided in internal and external, particularly Internal Quality Assessment, Nursing Audit,

Hospital Infection Prevention and Control, Research Ethics, Risk Management, Internal Accident Prevention Commissions and Permanent Education, Client and Hospital Accreditation Services.

Thus, clinical indicators have been increasingly used as essential tools, defined as a continuous or periodical quantitative measure of a given process or system's

variables, characteristics or attributes, which permits recognizing wanted or unwanted results that can guide the establishment of the best health practices⁽²⁾.

Indicators can incorporate health quality assessment dimensions⁽³⁾, i.e. structure, process and outcome, which are mutually complementary to obtain a better quality and contribute to improve the results. The advantage of using one assessment type will depend on the event one intends to measure⁽²⁾.

Hospital infections (HI) raise morbidity and mortality rates, extend the duration of patients' hospital stay and, consequently, increase costs for health services. Various measures strongly based on scientific evidence exist for their prevention and control, but health professionals' use of these measures is still a great challenge⁽²⁾.

Regarding cost, three times higher costs have been reported for patients with infection when compared with uninfected patients. Despite the legislation in force in Brazil, HI rates remain high at 15.5%, corresponding to 1.18 infection episodes per patient hospitalized in Brazilian hospitals⁽⁴⁾.

Among the main nosocomial infections, pneumonia stands out, which figures among the five most frequent nosocomial infections in people older than 65 years in the USA and is still considered the main cause of death in developing countries⁽⁵⁾.

Pneumonia is the second main nosocomial infection and, at Intensive Care Units (ICU), when associated with mechanical ventilation, it is the infection that most affects hospitalized patients, with incidence rates ranging between 9% and 68%, depending on the diagnostic method used and the study population⁽⁶⁾. This information is in line with the findings of a study⁽⁷⁾ that determined HI incidence at a Brazilian adult ICU, in which pneumonias added up to 25.6%.

Therefore, accomplishing surveillance for mechanical ventilation-associated pneumonia (MVAP), using standardized ICU definitions, calculating MVAP rates and, mainly, associating these rates with pertinent prevention measures are strongly recommended actions. These indicators can turn into an important ally for care quality assessment⁽⁸⁾.

In view of the above, it was considered pertinent to accomplish this study, aimed at assessing the health care quality delivered at an ICU regarding the use of pneumonia prevention and control measures in patients under mechanical ventilation care, limited consciousness and/or nutrition through digestive tubes, and at calculating the adherence rate through a clinical indicator.

Methods

A descriptive and exploratory study with a quantitative approach was accomplished at two Intensive Care Units for adult patients at a large and high-complexity public teaching hospital in the interior of São Paulo state, which delivers care to patients in urgency and emergency situations.

Research subjects were patients hospitalized at these units who were undergoing invasive ventilation care, with a limited consciousness level and/or nutrition through digestive tubes, excluding patients diagnosed with pneumonia upon admission or within the first 24 hours of ICU hospitalization, as well as patients not included due to the family's refusal to participate in the study.

Two instruments were used for data collection. The first covered demographic and clinical data for eligible patients. The second, used as a clinical process indicator, was developed and content validated by a group of experts and made available in the Manual of Assessment Indicators for Hospital Infection Control Practices⁽²⁾. This instrument, called the Indicator of Evaluation of Adherence to Prevention and Control Measures in High-risk Patients (IRPR) is in the public domain and monitors the application of some hospital pneumonia control and prevention measures, which are: raised decubitus (between 30 and 45°), respiratory physiotherapy, use of sterile solutions on respiratory therapy equipment and adherence to the routine exchange of inhalers established at the institution. As recommended, other measures can also be incorporated, according to the assessment group.

This indicator contains a worksheet to register the assessments and an operational construct, which describes and orients the application of the assessment to the practice it corresponds to. It involves a concrete operation and indicates what is assessed and how information should be collected and measured, with a view to guaranteeing uniform assessment and legitimacy in empirical data representation, besides presenting the best practice available, scientifically founded, so that adherence rates can be calculated after the assessment⁽⁹⁾.

Data were collected between November 2009 and January 2010, at preset times (from 10 to 11h, 15 to 16h and 21 to 22h), involving direct observation and review of notes in the study participants' patient files. Thus, each patient was observed three times per day, from the moment of hospitalization until the case outcome due to discharge, transfer or death.

With a view to checking the inclination angle of the headrest, a goniometer fixed to the headrests was used, available at the units.

It is highlighted that, due to the practices and responsibility for the type of activities assessed, only the nursing and physiotherapy teams' activities were observed.

To calculate the general adherence rate, according to the IRPR indicator's formula, the total number of

observations was considered in which all measures were conforming for the same patient. Thus, it was enough for one of the four measures not to be correctly applied for adherence not to be obtained in that patient.

To calculate the adherence rates for the practices included in the indicator that was applied, the formula recommended in the operational construct was used, as described below, assessing the IRPR's general adherence, as well as adherence for each indicator component.

Total number of patients under ventilatory care and with limited consciousness and/or nutrition through digestive tubes in which all hospital pneumonia control components are correctly applied

Total number of patients assessed under the conditions described in the numerator

X 100

The researcher collected the data together with three nurses experienced in intensive care, who had been properly trained for assessment and data collection.

Approval for the research was obtained from the Institutional Review Board at the study institution (HCRP Process No 11193/2008).

Results

During the study period, 114 patients were hospitalized at the study hospital's ICU and 38 complied with the inclusion criteria. Male patients predominated (68.4%) and ages ranged from 19 to 82 years. As for origin, most patients came from the Surgical Unit, with 11 (28.95%) coming from the Recovery Room and five (13.16%) from the Operating Room, while eight (21.05%) came from the Care room for patients with multiple traumas. ICU time ranged between one and seven days in 44.74% of patients.

In total, 839 observations of MVAP prevention and control measures were accomplished according to the IRPR indicator, 277 during the morning and afternoon shifts and 285 at night. This difference was due to the hospitalization and discharge times after the established time for data collection, thus increasing observation opportunities during the night shift. Table 1 shows data for observations in each shift.

Table 1 – Distribution of patient observations in absolute figures and respective general adherence percentages, per work shift, for specific MVAP prevention and control measures, Ribeirão Preto, SP, Brazil, 2009-2010

Work Shift	Total	Adherence	
		n	%
Morning	277	64	23.10
Afternoon	277	36	13.00
Night	285	126	44.21
Total	839	226	26.94

General adherence to all MVAP prevention and control measures corresponded to 26.94%, with the highest rate (44.21%) found during the night shift.

Table 2 shows adherence and non-adherence to each specific MVAP prevention and control measure, per work shift. It is verified that each isolated measure always obtained a higher adherence rate than the general adherence rate (26.94%), which associated all measures per patient. Keeping the headrest raised and physiotherapy care were the measures that most negatively influenced the achievement of general adherence.

Table 3 presents the situations found that determined non-adherence to MVAP prevention and control measures in each work shift.

Table 2 – Total number of observations and adherence and non-adherence rates for each specific MVAP prevention and control measure, per work shift, Ribeirão Preto, SP, Brazil, 2009-2010

Variables	Total	Adherence		Non-Adherence	
		n	%	n	%
Morning					
Use of sterile solution	277	276	99.64	1	0.36
Respiratory therapy material change	277	261	94.22	16	5.78
Physiotherapy care	277	124	44.76	153	55.24
Headrest raised 30-45°	275	143	52.00	132	48.00
Subtotal morning	1106	804	72.69	302	27.31
Afternoon					
Use of sterile solution	277	277	100.00	0	0
Respiratory therapy material change	277	262	94.58	15	5.42
Physiotherapy care	277	86	31.05	191	68.95
Headrest raised 30-45°	269	127	47.21	142	52.79
Subtotal afternoon	1100	752	68.36	348	31.64
Night					
Use of sterile solution	285	284	99.65	1	0.35
Respiratory therapy material change	285	275	96.49	10	3.51
Physiotherapy care*		-	-	-	-
Headrest raised 30-45°	281	130	46.26	151	53.74
Subtotal night	851	689	80.96	162	19.04
Total	3057	2245	73.44	812	26.56

*No physiotherapy during the night period

Table 3 – Non-adherence rates to each specific MVAP prevention and control measure, according to work shift, Ribeirão Preto, SP, Brazil, 2009-2010

Variables	Work shift			
	Morning n (%)	Afternoon n (%)	Night n (%)	Total n (%)
Headrest raised 30-45°	132 (43.71)	142 (40.80)	151 (93.21)	424 (52.34)
Physiotherapy care*	153 (50.66)	191 (54.89)	-	344 (42.36)
Change of respiratory therapy material	16 (5.30)	15 (4.31)	10 (6.17)	41 (5.05)
Use of sterile solution	1 (0.33)	-	1 (0.62)	2 (0.25)
Total	302 (100)	348 (100)	162 (100)	812 (100)

*No physiotherapy during the night period

The raised headrest, the measured with the lowest adherence levels during the three shift, due to positioning below the recommended angle (30-45°), was the main responsible for the general non-adherence rate, mainly during the night shift (93.21%).

Respiratory physiotherapy, only accomplished during morning and afternoon shift, corresponded to the second highest non-adherence frequency (42.36%), which was higher during the afternoon shift (54.89%). As for respiratory therapy material change, the morning shift showed the highest non-adherence level (16 cases).

Discussion

HI represent a significant risk for users' health.

Hence, their prevention and control are extremely important and involve hospital care qualification measures through actions that result in a better quality of health care, reduce efforts, complications and resources. Intensive care services are priority units for the development and application of quality indicators, due to the demand for countless processes involving critical patients and who, in most cases, exclusively depend on team care to survive.

According to the Manual of Hospital Infection Control Practice Quality Assessment Indicators⁽²⁾, an assessment and qualification system for the control and prevention of infections caught in health services (ICHS) needs to be constantly updated, incorporating new practices and approaches that are able to handle

the dynamic nature of the clinical care and scientific evidence evolution. In that sense, the development of systems is encouraged which use process assessments to enhance ICHS prevention and control actions.

In this study, the assessments predominantly demanded direct observation to verify the maintenance of the measures raised headrest at 30-45°, use of sterile solution in the mechanical ventilators' humidifiers and implementation of the respiratory therapy material change routine, in which the mechanical ventilator circuits were observed which, according to the Hospital Infection Control Commission's (HICC) protocol at the institution, should only be changed in case of visible dirt, such as blood or secretions. Regarding the assessment of respiratory physiotherapy care, this measure involved verifying its records in the patient file.

The general adherence rate, which considers the sum of the four correct measures at the same time, corresponded to 26.94%. This rate varied among the shifts. This result differs from the rates found in a study at an adult ICU of a public teaching hospital, in which three process units were applied to assess the MVAP prevention and control practices, including the IRPR indicator, with a general adherence rate of 68%, below the rate the author expected (80%)⁽⁹⁾.

The calculation of isolated measures revealed that "keeping the headrest at 30-45°" and "respiratory physiotherapy care" were the main factors responsible for not achieving general adherence, ranging from 46.26% to 52% and from 31.05% to 44.76%, respectively. The measures that exceeded this adherence rate were the use of sterile solution, with 100% during the afternoon shift, and respiratory therapy material change (adherence rates between 94.22% and 96.49%), demonstrating that these recommendations are well established in care delivery to patients under mechanical ventilation.

As for low adherence to the recommended headrests at 30-45°, it is highlighted that most beds have a goniometer (instrument used for this measurement), and that moments when patients were undergoing procedures that demanded changes in headrest height were not taken into account. Besides, the 424 cases on non-adherence to the raised headrest referred to lower degrees than recommended and occurred across all periods, with heights bordering on 20-25°. This data was found in another study⁽⁹⁾, which identified non-adherence rates of 75% (morning shift), 77.4% (afternoon) and 82.2% (night). These results show that many professionals are not accustomed to checking the

headrest height with the goniometer, but merely restrict themselves to visual impression.

Critically ill patients frequently suffer from depressed consciousness levels and impaired vomiting reflex, so that contaminated secretion joins in the posterior part of the oropharynx⁽¹⁰⁾. Thus, keeping the headrest at 30- 45° represents benefits to reduce the risk of gastric content reflux and aspiration in patients undergoing mechanical ventilation⁽¹¹⁾. This measure is recommended in the guidelines of the Centers for Disease Control and Prevention (CDC), with evidence level II. Its application has been suggested in patients submitted to MV e/or enteral tube use since 2003⁽¹²⁻¹³⁾ and, although it represents a simple and low-cost non-pharmacological measure, it still lacks further incorporation by health professionals involved in care practice^(9,14-15).

A study that analyzed nurses' adherence to clinical guideline recommendations for the prevention of MVAP presents that 96.8% of professionals informed using protective gloves and gowns in view of the risk of contamination with biological material, 88.5% applied respiratory physiotherapy to patients, 84.3% followed the institution's routine regarding mechanical ventilator circuit change, 76.4% placed the headrest at 30-45°, among other measures mentioned⁽¹⁶⁾. The semi-recumbent position (30-45°) was also recommended in a systematic literature review⁽¹⁷⁾, because it showed a reduction in MVAP incidence and was a low cost-measure.

A study⁽¹⁸⁾ that directly observed MVAP prevention and control measures in care practice analyzed the introduction of three new prevention measures into the MVAP incidence reduction protocol at five ICU's in the same hospital, involving medical and nursing teams. Before assessing adherence, an educational program was set up to reinforce former and new recommendations regarding the headrest raised at 30-45° (with the help of an instrument to measure the headrest's degree of inclination), enteral (transpyloric) feeding, among other measures. Across a six-month period, a 51.3% reduction in MVAP rates was found, showing that the implementation and maintenance of an educational program, including audits and feedback to professionals on the collected information, contributed towards adherence to a new protocol.

As for ICU professionals' knowledge on intensive care based on clinical guidelines recommended for MVAP prevention, 49% of the interviewees referred that the respirator circuit should be changed between patients, and 13% that the humidifier of the ventilator

should be changed once per week in the same patient. As for patients' headrest positioning at 30-45°, 90% of participants reported that they knew the recommendation⁽¹⁹⁾.

The implementation of clinical MVAP guidelines published by the CDC was assessed in a study⁽¹⁰⁾ that involved 1200 nurses, who participated in two educational events in the United States. The results showed that 34% of the nurses affirmed that they kept the headrest raised at 30-45° during 75% of the day, and 52% the whole day.

An integrative literature review⁽²⁰⁾ on MVAP prevention measures showed that the semi-recumbent position seems to play a role in MVAP prevention, although the authors appoint the need for better designed studies to recommend this measure safely and effectively.

Besides keeping the headrest raised, another assessed measure that contributed to non-adherence was physiotherapy care. In controlled studies that assessed the importance of physiotherapy for pneumonia prevention, it was observed that thoracic physiotherapy was an independent factor associated with MVAP reduction, suggesting the benefit of this technique for MVAP prevention⁽²¹⁻²²⁾. Other authors⁽¹⁵⁾, however, appoint that there is no evidence on the efficacy of percussion and vibration techniques to prevent MVAP.

Research on adherence to physiotherapy care is scarce. In this study, the adherence rate of 57.64% remains below the rates found for the adoption and application of clinical guideline recommendations for MVAP prevention by nurses⁽¹⁶⁾, who appointed that respiratory physiotherapy was performed in 88.5% of cases. It should be highlighted that, in that study, the research population consisted of nurses and, among them, the authors found adherence to 19 non-pharmacological MVAP prevention measures.

Physiotherapy care was assessed based on patient file records, in line with IRPR orientations and, hence, procedures performed may not have been registered. Therefore, although it demands more time, direct observation is the most adequate technique to assess this item⁽⁹⁾.

The results obtained in this research appointed low adherence rates, mainly because the institution is a teaching hospital. Higher adherence levels were expected for specific MVAP prevention and control measures, as the HICC's activities at the research institution, and even more at the ICU under study, have been intense, mainly regarding professionals' training on adherence to infection prevention measures. It is highlighted that,

months before the start of data collection, the HICC organized a recycling course for the nursing team on the main health service-associated infection and their prevention measures, evidencing the magnitude of the research findings.

One limitation in this study was the fact that no other important measures were assessed, such as adherence to hand washing, oral hygiene, assessment of the presence of condensate in the respirator circuit and humidifying filter change, which can affect a reduction in infection density rates and MVAP.

Conclusions

The adherence rate in this study corresponded to 26.94%, although some isolated measures from the IRPR indicator reached rates bordering on 100%. Keeping the headrest at 30-45° showed the lowest adherence across all shifts assessed. Although this is a simple recommendation that demands little time, professionals' low adherence to this measure is evidenced.

Some measures analyzed are routine nursing activities inside the unit, appointing the need for systematic assessment. Besides the educative process, this involves issues related to supervision and care management at the unit, as standards, although established, have not always been incorporated into clinical practice. Thus, the health team at these units should discuss and put in practice other educative strategies.

The use of indicators can be incorporated as a useful measure to assess the quality of the services delivered, due to their easy application and reproduction.

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