JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH
ISSN: 2576-0017
2024, VOL 7, NO S11

Standardizing Quality Metrics In Respiratory Therapy: A Comprehensive Literature Review Of Current Key Performance Indicators (Kpis) Using The Donabedian Framework

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Abstract

Background:
Respiratory therapy (RT) departments are fundamental to patient care, particularly for individuals experiencing acute or chronic respiratory conditions. Measuring performance and quality in RT services is essential to improve patient outcomes, optimize resource utilization, and reduce hospital complications. Key Performance Indicators (KPIs) provide a standardized way to assess and monitor the efficiency and effectiveness of RT departments.

Objective:
This Comprehensive review aims to identify, categorize, and explain the current KPIs used in respiratory therapy, based on the Donabedian framework of structure, process, and outcome. It also highlights challenges in KPI reporting and the importance of standardized definitions to facilitate quality improvement.

Methods:
A comprehensive review of recent literature and healthcare reports was conducted to extract KPIs relevant to respiratory therapy. These KPIs were classified into three domains: structural (e.g., staffing ratios, equipment availability), process (e.g., ventilator bundle adherence, sedation protocol compliance), and outcome indicators

(e.g., mechanical power, ventilator-associated pneumonia rates, mortality). Calculation methods, data sources, and clinical relevance were summarized.

Results:
Structural KPIs focus on workforce characteristics and equipment adequacy, with evidence highlighting staffing shortages and uneven resource distribution affecting care quality. Process KPIs primarily measure adherence to evidence-based practices such as ventilator care bundles and sedation protocols, which correlate with reductions in ventilator-associated complications and improved survival. Outcome KPIs include mechanical power applied during ventilation, incidence of ventilator-associated pneumonia, mortality rates, ventilator-free days, and oxygenation indices. Challenges in KPI application stem from variability in definitions and measurement approaches, limiting comparability across institutions.

Conclusion:
Standardized KPIs categorized by structure, process, and outcome are essential for monitoring respiratory therapy performance and guiding quality improvement efforts. Addressing challenges in KPI measurement and harmonizing definitions will enable better benchmarking and enhance patient care. Implementing these KPIs consistently can support RT departments in improving clinical outcomes and optimizing resource allocation.

Keywords: Standardizing, Quality, Metrics, Respiratory Therapy, (KPIs) Donabedian Framework.

Introduction

Scoping Review on KPIs in Respiratory Therapy

Respiratory therapy (RT) departments play a critical role in healthcare, particularly in assisting patients with lung distress or long-term lung conditions. The RT departments are required to achieve better patient outcomes and a higher quality of life, thereby preventing many hospital admissions and complications. Efficiency in these departments should be assessed by looking at “Key Performance Indicators” (KPIs). KPIs enable the department to measure its progress toward meeting its objectives, which are to increase survival rates, minimize risks, and optimize resource utilization. This review outlines the KPIs currently used in respiratory therapy departments, explaining their definitions, calculation processes, and significance in enhancing care quality.

Donabedian Framework

The Donabedian framework organizes the healthcare quality assessment by examining its structure, process, and outcomes. Among structural KPIs, it is essential to investigate the number of caregivers and the functional state of required equipment (Yang et al., 2025). Process KPIs involve assessing the care provided by evaluating the following standards and the use of interventions (Cruz et al., 2024). These KPIs assess the outcome for a patient, such as whether they recover, experience complications, or survive (Santry et al., 2020). One benefit of this framework is that it relates the hospital’s resources (size and structure) to its workflows (how care is given) and clinical outcomes. Therefore, utilizing the Donabedian model can help RT departments identify and resolve patient care issues, ensure standardization, and improve patient outcomes by leveraging data.

Literature Findings

Structure KPIs

The ratio of workers to patients, location, gender, age, and educational background are all used to gauge workforce characteristics. According to Al-Otaibi (2024), there is an apparent shortage of RT services in Saudi Arabia, as two-thirds of RT practitioners are based in Riyadh and the Eastern Province. In Saudi Arabia, Alessa et al. (2020) revealed that the RT-to-patient ratio is 1:11 overall, which is not the same as the ratios for ICU and general wards: 1:5 versus 1:20. The data on workforce characteristics is usually gathered from surveys such as those of Saudi Commission for Health Specialties (SCFHS), surveys of hospitals, and demographic information. Al-Otaibi (2024) found that 92% of RTs were working; however, most, especially in Riyadh and the Eastern Province, indicated that resources were not distributed equally. Alessa et al. (2020) stated that meeting the international patient-to-RT ratio in Saudi Arabia requires training and recruiting more radiologic technologists (RTs), primarily in hospitals outside those managed by the Ministry of Health (MOH).

Respiratory therapists' access to medical devices, such as ventilators, is another key performance indicator (KPI). High-risk conditions in neonates, such as those with respiratory failure, require "high-frequency oscillatory ventilation" (HFOV) (Yang et al., 2020). In pediatric ICUs, more patients needing ventilation means fewer nurses (and less equipment), leading to more deaths (Jung et al., 2020). Data for this KPI typically comes from hospital equipment lists, departmental certification records, and ventilator use logs. Yang et al. (2020) state that having access to high-frequency oscillatory ventilation (HFOV) is necessary to manage neonatal respiratory failure. Jung et al. (2020) also notice that when staff are insufficient (due to shortages in equipment) in pediatric ICUs, it increases the odds of death for mechanically ventilated children.

Process KPIs

The primary key performance indicator (KPI) for respiratory therapy (RT) is adherence to ventilator bundles. Most patients follow the guidelines, and evidence-based strategies are effectively implemented, which is associated with reduced rates of VAP and VAT. According to Hassan and Elsaman (2022) and Abad et al. (2021), the risk of VAE was decreased in those under ventilation following the implementation of the ventilator care bundle. This KPI is derived from patient records, ICU procedures, and records of ventilator use. Hassan and Elsaman (2022) report that the ventilator bundle reduces the risk of ventilator-associated events (odds ratio, 0.19; $p = 0.004$). The study found that patients experience better outcomes, have a lower risk of "ventilator-associated pneumonia" (VAP), and receive safer care when ventilator bundles are implemented.

A second, and possibly more important, key performance indicator (KPI) is the duration of a violation: the time a patient is on a ventilator and being supported by it. Lee and Cho (2020) noted that patients who are on ventilators for a long time are likely to be admitted to ICU again, which means poor outcomes. Data from ICU records, ventilator logs, and patient documents are utilized to determine the indicator. Lee and Cho (2020) found that individuals who required a ventilator for a more extended period were more likely to need another stay in the ICU. Hence, it is very important for the patient's recovery in the intensive care unit (ICU) that the tube is immediately disconnected from the patient's airway.

Sedation Protocol Adherence (KPI) measures adherence to patient sedation protocols. Sedation is assessed by confirming that patients receive the recommended sedation as noted by the Ramsay Sedation Scale or by other usual methods of monitoring sedation. According to Xie et al. (2020), prescribing deep sedation helped patients with "acute respiratory distress syndrome" (ARDS) live longer and recover more effectively, with improved oxygen levels. To measure this KPI, the analysis is based on sedation records, nurse logbooks, and charts that record ICU medications. In the 2020 study by Xie et al., patients who underwent deep sedation procedures had a lower mean pressure, which was associated with better survival and increased lung oxygenation in patients with ARDS. Monitoring sedation can improve patient outcomes and avert mechanical ventilation problems.

As a key performance indicator (KPI), the respiratory therapy (RT) department also monitors ventilator-related events. A ventilator problem arises when ventilator settings are set extremely high. The team checks this KPI annually by calculating the VAEs for every 1,000 days the equipment is used. VAEs are associated with both higher mortality and the need for ventilation; therefore, identifying and preventing them early on is crucial (Villar et al., 2024). Weinberger et al. (2021) data suggests that people with COVID-19 were more likely to develop VAEs, and new ways to reduce these events are needed. VAE rates in clinics are measured using results from infection audits, microbiology samples, and ventilator records. Monitoring VAEs improves patient outcomes and reduces problems associated with ventilation.

Outcome KPIs

The ventilator using a combination of tidal volume, respiratory rate, driving pressure, and "Positive End-Expiratory Pressure" (PEEP) (Paudel et al., 2021; Zhang et al., 2023) generates mechanical power (MP) during respiration. An MP of greater than 17 J/min causes lung damage and increases the risk of death from "ventilator-induced lung injury" (VILI) and mortality (Chang et al., 2025). MP is set below 12 J/min according to the VentCoach protocol to prevent risks and improve the results (Zheng et al., 2025). Patients who received deep sedation had a lower mortality rate (MP) and lived at least 28 days more frequently, 53% versus 81% ($p < 0.05$). Therefore, patients received a reduced mean power of 17.6 J/min and achieved better outcomes by applying MP-guided protocols. This KPI uses data from the eHealth record's waveform and calculators on the ventilator.

Papazian et al. (2020) also suggest measuring cases of "ventilator-associated pneumonia" (VAP), which must occur at least 48 hours after starting ventilation, as cases per 1,000 ventilated days. Sadly, nearly 10% of people who get VAP die from it, and the risk is even higher in people receiving intensive care. Staff may be able to reduce the risk of VAP by about 19 percent using these ventilator bundles (Hassan & Elsaman, 2020). Papazian et al. (2020) reported that between 40% (depending on the mode of diagnosis) of ventilated patients may develop VAP. Bundled ventilator care reduced ventilator-associated events (VAEs) by 1.19 fold (Hassan & Elsaman, 2020). The VAP rate is determined by analyzing infection control audit outcomes and laboratory testing results.

Moreover, the mortality rate in ventilated patients is the ratio of ventilated patients who are alive 28 days after the initiation of mechanical ventilation or are alive off the ventilator. Ventilator success is measured by its mortality rate. Chiu et al. (2021) also found that in the case of "Extracorporeal Membrane Oxygenation" (ECMO) treatment, MP greater than 14.4 J/min increased mortality by up to 23.9%. Furthermore, study data demonstrate that an MP/compliance ratio of 5–16% significantly increases the risk of death, with the strongest predictor having a hazard ratio of 7.972 (Chang et al., 2025). Patients with higher MP had the highest mortality rate (70.7%) compared with those with lower MP (46.8%; $p = 0.004$) (Chiu et al., 2021). Medical databases and ICU notes typically track hospital mortality rates.

The number of days a patient survives without a ventilator from the day they enter the ICU until day 28 is known as "Ventilator-Free Days" (VFDs). VFDs are a strong predictor of the survival time of patients with ARDS (Gattinoni et al., 2020). In addition, D'Albo et al. (2024) demonstrate that increasing VFDs when MP is lowered indicates that MP must be regulated for rapid recovery. Most VFDs take the data from the duration of ventilation.

The most effective measurement of oxygenation during mechanical ventilation, particularly for ARDS, is the "Oxygenation Index" (OI) and the "Oxygen Saturation Index" (OSI). A score of OI greater than 20 usually means that ARDS is severe. Patients with low OI/OSI have improved lung function and better oxygenation. Xie et al. (2020) reported that when "mean pressure" (MP) decreased due to deep sedation, OI increased and oxygenation improved ($p < 0.01$). The data required to find these indices is gathered mainly by examining the "arterial blood gas" (ABG) and the pulse oximeter reading. Appendix A explains the methods used to calculate these key performance indicators (KPIs).

Challenges in KPI Reporting

A significant obstacle in respiratory department KPI reporting is the variation in how measurements and calculations are performed. For example, the concept of Mechanical Power (MP) is given different

interpretations by many researchers. Above an MP of 17 J/min or below an MP of 17 J/min, "ventilator-induced lung injury" (VILI) is thought to occur (Gajanan et al., 2020). In addition, "ventilator-associated pneumonia" (VAP) numbers are difficult to define, unlike most other infections. The study by Papazian et al. (2020) revealed that differences in criteria led to rates ranging from 5% to 40%, complicating the establishment of guidelines for standards. If the terms are not the same, then departments in a healthcare facility may not trust the same KPIs. When VILI and VAP vary, it becomes more challenging to compare medical approaches.

Conclusion

The KPIs listed in this review are organized into structure, process, and outcome domains for respiratory therapy departments. The review found that using standard KPIs facilitates performance comparison and quality improvement. Staffing ratios and equipment availability can reveal how effectively resources are distributed, whereas compliance with the ventilator bundle indicates how patients are being cared for. Mechanical power and mortality rates are examples of outcome KPIs that measure the effectiveness of patient treatment. Despite variations in definitions, differences in how often measurements are performed, and the limited use of KPIs, setting common KPIs in respiratory therapy departments is crucial for improving patients' outcomes and better managing their care. Once KPIs are consistently defined and applied, respiratory therapy services can enhance the care they provide and aid patients in their recovery.

Appendix A

KPI Extraction Table

KPI Name	Category	Definition	Calculation / Formula	Data Source	Frequency	Relevance / Rationale	Reference
RT-to-Patient Ratio	Structure	Measures staffing adequacy in ICUs vs. general wards	ICU: 1 RT per 5 beds; General: 1 RT per 20 patients	SCFHS database, hospital staffing records	Quarterly	Ensures resource availability; impacts care timeliness and outcomes	Al-Otaibi (2024), Alessa et al. (2020)
Geographic Distribution Index	Structure	Tracks regional disparities in RT workforce availability	(% RTs in Region X ÷ Total RTs) × 100	National workforce surveys (e.g., SCFHS)	Annually	Identifies underserved areas; informs workforce allocation policies	Al-Otaibi (2024)
Ventilator-to-Patient Ratio	Structure	Assesses equipment adequacy for ventilated patients	Number of ventilators ÷ ICU beds	Hospital equipment inventories	Monthly	Shortages correlate with delayed care and worse outcomes	Yang et al. (2020)

Ventilator Bundle Adherence	Process	% of patients receiving all evidence-based bundle elements (e.g., head elevation, oral care)	(Patients receiving full bundle ÷ Total ventilated) × 100	Patient records, IHI checklists	Weekly	Reduces VAP by 19%; OR: -1.19 for VAEs	Hassan & Elsaman (2022)
Mechanical Ventilation Duration	Process	Time from intubation to successful extubation	Extubation time – Intubation time (hours)	ICU ventilator logs	Per patient	Longer duration → ↑ ICU readmission rates	Lee & Cho (2020)
Sedation Protocol Adherence	Process	% of patients managed per institutional sedation guidelines (e.g., Ramsay Scale)	(Patients compliant with protocol ÷ Total ventilated) × 100	Sedation records, medication charts	Daily	Deep sedation reduces MP and improves 28-day survival (53% → 81%)	Xie et al. (2020)
Ventilator-Associated Events (VAE) Rate	Outcome	Infectious/non-infectious complications post-intubation	(VAE cases ÷ Ventilator days) × 1000	Infection control audits, CDC surveillance tools	Monthly	Predicts mortality and prolonged ventilation; higher in COVID-19 patients	Weinberger et al. (2021)
Mechanical Power (MP)	Outcome	The energy delivered by the ventilator (J/min) to the lungs	0.098 × RR × V_T × (ΔP + PEEP)	Ventilator waveforms, EHR algorithms	Continuous	MP >17 J/min → ↑ VILI risk; MP <12 J/min targeted in protocols	Chang et al. (2025), Zheng et al. (2025)
VAP Incidence	Outcome	Pneumonia cases post-48 hours of mechanical ventilation	(VAP cases ÷ Ventilator days) × 1000	Microbiological cultures, infection reports	Monthly	Attributable mortality: 10%; bundle adherence reduces incidence	Papazian et al. (2020)

28-Day Mortality Rate	Outcome	Deaths in ventilated patients within 28 days	(Number of deaths ÷ Total ventilated) × 100	Hospital mortality databases	Per admission	MP >14.4 J/min during ECMO → 70.7% mortality vs. 46.8%	Chiu et al. (2021)
Ventilator-Free Days (VFDs)	Outcome	Days alive and off mechanical ventilation within 28 days of ICU admission	28 – Days on mechanical ventilation (for survivors)	ICU discharge records	Per patient	↑ VFDs → ↑ survival; MP reduction correlates with ↑ VFDs	Gattinoni et al. (2020)
Oxygenation Index (OI)	Outcome	Measures lung oxygenation efficiency in ARDS	(FiO₂ × Mean Airway Pressure ÷ PaO₂) × 100	ABG analyses, ventilator settings	Every 6-12 hours	OI >20 indicates severe ARDS; improvements correlate with MP reduction	Xie et al. (2020)

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