

Contributions of Respiratory Care Practitioners to Intensive Care: A Review

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Abstract

Through the years, the professional practice of respiratory care has continually evolved to include management of critically ill patients. Although the functions and duties of respiratory care practitioners (RCPs) in this setting may vary across different institutions, it is widely recognised throughout the United States that RCPs contribute importantly to intensive care unit (ICU) outcomes. The American Association for Respiratory Care (AARC) has painstakingly established guidelines to more precisely define the role of RCPs in performing procedures in the ICU. Published studies demonstrate the added value of RCPs' collaboration in several ICU activities, including placement of arterial catheters, sampling of arterial blood gases, endotracheal intubation, and management of and weaning from mechanical ventilation.

Other ICU activities in which RCPs participate include assisting with bronchoscopy, obtaining haemodynamic measurement, and indirect calorimetry and supporting specialised techniques such as extracorporeal membrane oxygenation (ECMO) and continuous veno-venous haemofiltration and/or haemodiafiltration (CVVH/CVVHD). Based on the demonstrated impact of RCPs and their technical and cognitive training, a continuing role expansion for RCPs in the ICU is expected.

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Introduction

The intensive care unit (ICU) is a complex environment in which multidisciplinary expertise has been shown to enhance clinical outcomes. For example, the availability of full-time intensivists has been associated with improved survival. Similarly, many studies demonstrate the "value added" role of respiratory care practitioners' (RCPs) participation in ICU care as part of a multidisciplinary team. Indeed, in the United States and other countries where the role of respiratory therapy is well-established, many responsibilities are assumed by respiratory therapists in the ICU.¹

The purpose of this paper was to review the available evidence regarding RCPs' contributions to patient care in the ICU. In addressing this topic, we consider the performance of RCPs in each of the following activities:

- arterial blood gas (ABG) sampling and arterial catheter placement,
- endotracheal intubation and airway management,
- ventilator management and weaning,
- intra- and inter-hospital transport,
- assistance with ICU procedures (e.g. bronchoscopy,

haemodynamic measurements, indirect calorimetry), and

- support of specialised techniques (e.g. extracorporeal life support techniques and continuous veno-venous haemofiltration/haemodiafiltration).

As shown in Table I, these roles may be shared with physicians or assumed solely by RCPs.

TABLE I: HEALTHCARE ROLES ASSUMED BY RESPIRATORY CARE PRACTITIONERS (RCPs) SOLELY VERSUS ROLES SHARED WITH PHYSICIANS

RCPs' specific roles	RCPs' shared roles with physicians
Set-up incubators and tents	Arterial puncture and arterial catheter placement
CPAP, IPPB	Endotracheal intubation
Administration of exotic gases	Respiratory management of mechanically-ventilated patients
Oxygen set-up	Intra-hospital and inter-hospital transport of ventilated patients
Chest physiotherapy	Management of extracorporeal life support
Suctioning	Weaning from mechanical ventilation

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Respiratory Care Practitioners' Roles in Sampling Arterial Blood Gases and Arterial Line Placement

Respiratory care practitioners have demonstrated skill in both placing arterial catheters and in applying guidelines to assure appropriate ABG sampling. In many ICUs as in the Medical ICU at the Cleveland Clinic Foundation, RCPs carry the responsibility of placing arterial lines. Complementing our own observations that RCPs perform this task skillfully, Grombeck and Miller² reported their experience with RCPs placing 500 arterial catheters. In keeping with high practice standards, superficial infection was reported in only 5% of placements and only a single serious complication was documented.

Respiratory care practitioners have also demonstrated skill in applying clinical guidelines to assure appropriate sampling of ABGs. In a series by Browning et al³ in the Surgical ICU at the University of Virginia, the appropriateness of ABG sampling was evaluated before and then again after the implementation of guidelines. Prior to the availability of guidelines, the rate of inappropriately sampled ABGs was 42.7% (although the specific reasons for the inappropriate rating were not described in the published report). One and four months after the guidelines were distributed to ICU healthcare providers, the overall rate of inappropriately sampled ABGs decreased to 32.9% and 30.8%, respectively. Furthermore, when the rate of inappropriately sampled ABGs was stratified by the healthcare provider ordering the sample, RCPs were far less likely to draw a sample inappropriately (3% to 15%) than others (37% to 45%), suggesting that RCPs were likeliest to follow guidelines. To the extent that RCPs were more likely to apply these guidelines, this experience endorses their carrying responsibility for respiratory care activities in the ICU.

Respiratory Care Practitioners' Roles in Intubation and Airway Management

Two series have addressed the activity of RCPs in performing intubation in the ICU and both studies support their competence in this role. Thalman et al⁴ documented a 92% intubation success rate within ≤ 3 attempts by RCPs at Duke University Medical Center after they underwent an 8-hour training programme consisting of Advanced Cardiac Life Support (ACLS) training and clinical performance of intubation under supervision. Similarly, Zyla and Carlson⁵ reported that therapists who serve on a secondary intubation service at the Butterworth Hospital were 90% successful after failed intubation attempts by other professionals, e.g. interns, residents and anaesthesiologists. Thus, available studies endorse this role for RCPs who have received adequate training.

Respiratory Care Practitioners' Roles in Ventilator Management

Mechanical ventilation is a complex task that requires the caregiver to understand the technical and physiological components of the patient-ventilator interaction. Due to RCPs' in-depth training and expertise in this area, the care of patients requiring mechanical ventilation for life support probably represents the highest level of ICU service provided by RCPs.

According to the American Association for Respiratory Care (AARC) Clinical Practice Guideline on patient-ventilator system checks,⁶ persons performing this task should have demonstrated ability to make clinical observations regarding the patients' response. In this context, RCPs, like nurses, are an especially appropriate group of healthcare providers to assume the responsibility of instituting and assessing the impact of prescribed ventilator changes.

Respiratory Care Practitioners' Roles in Supervising Weaning From Mechanical Ventilation

Weaning from mechanical ventilation requires dedicated attention and skillful decision-making to which RCPs are especially disposed. Cohen et al⁷ illustrated the value of a dedicated weaning team in the ICU at Ellis Hospital where implementation of a ventilator management team comprised of a physician, nurse, and RCP was associated with a 32% decrease in the number of days on mechanical ventilation, with an estimated cost savings of US\$1,303 per episode of mechanical ventilation. Several series have shown that weaning directed by respiratory care protocols implemented by RCPs achieved equal success rates with shortened durations of mechanical ventilation.^{8,9}

Most recently, two randomised controlled trials have demonstrated the value of systematic weaning trials conducted by RCPs and other ICU healthcare providers. Ely et al¹⁰ showed that a daily trial of spontaneous breathing with notification of responsible physicians by the RCPs and nurses conducting the breathing trial allowed a 67% reduction in weaning duration. Similarly, a randomised controlled trial comparing weaning outcomes with a protocol implemented by nurses and RCPs versus usual physician care showed that protocol-directed weaning was more rapid and cost-saving. Particularly, the 179 patients weaned by protocols overseen by RCPs and nurses demonstrated significantly shorter median duration of mechanical ventilation (35 versus 44 hours) than the control group ($n = 178$) weaned by usual physician care, allowing a hospital cost savings of US\$42,960.¹¹ Since RCPs incur lower costs than physicians but can conduct weaning with equal efficacy and lower cost, their contribution to this important ICU activity is invaluable.

Respiratory Care Practitioners' Roles in Intra-hospital and Inter-hospital Transports

Transporting ventilator-dependent critically ill patients out of the ICU for diagnostic studies and therapeutic procedures is a frequent activity and has consistently been associated with a significant rate of complications in available reports.¹²⁻¹⁴ Because of this, optimizing safety during the transport process is essential.

For example, Braman et al¹⁵ observed both overzealous manual ventilation or inadvertent underventilation during transport with resultant changes in the patient's acid-base status, haemodynamic complications such as systemic hypotension, and development of new cardiac arrhythmias.

In the context of transport-related risks, RCPs are often useful members of the transport team. Indeed, the AARC Clinical Practice Guideline regarding transport of the mechanically-ventilated patient¹⁶ specifies the necessity of RCPs' presence during transport to assure adequate ventilation and airway management. For the same reasons, RCPs' presence on inter-hospital transport is advocated.

Respiratory Care Practitioners' Roles in Assisting with ICU Procedures: Bronchoscopy Assisting, Haemodynamic Monitoring and Indirect Calorimetry

In some hospitals, RCPs commonly assist the physician with bronchoscopy of ventilated patients in the ICU. The AARC Clinical Practice Guideline lists healthcare professionals holding the credentials of a Certified Respiratory Therapy Technician (CRTT) or a Registered Respiratory Therapist (RRT) among the personnel qualified to perform the task of assisting fiberoptic bronchoscopy.¹⁷ An appropriate role for the RCP in this context includes set-up of monitoring devices, administration of medications, specimen retrieval and handling, postprocedural care of the patient and maintenance of bronchoscopy equipment.

RCPs are highly trained in the technical aspects of haemodynamic monitoring as part of their standard curriculum, justifying their role in performing haemodynamic measurements. Also, because there is a close interaction between respiratory management (e.g. institution of ventilator prescriptions) and haemodynamic changes, an expanded role for RCPs is recommended along with the need for studies examining this function.

For mechanically ventilated patients, metabolic measurement using indirect calorimetry is often performed to determine the amount of oxygen consumption, carbon dioxide production and the oxygen cost incurred during the work of breathing. These data are then utilized to assess patient outcome parameters such as nutritional status, weaning potential and oxygen delivery. The AARC Clinical Practice Guideline

recommends a relevant credential (e.g. CRTT, RRT) because of the level of technical and patient assessment skills required.¹⁸

Respiratory Care Practitioners' Roles in Support of Specialized Techniques: Extracorporeal Life Support and Haemodialysis/Haemofiltration Procedures

Because of their physiologic and technologic expertise, RCPs have assumed the role of technically supervising such specialised techniques as the extracorporeal life support (ECLS) and continuous veno-venous haemofiltration/haemodiafiltration (CVVH/CVVHD). For example, at the Massachusetts General Hospital, RCPs are solely responsible for management of ECLS provided to patients of all ages.¹⁹ Similarly, at the Cleveland Clinic, RCPs assist in managing extracorporeal membrane oxygenation (ECMO) and in administering inhaled nitric oxide to paediatric ICU patients.

In the ICU, CVVH or CVVHD is an increasingly utilised approach in treating critically ill patients with acute renal and multiple organ failure.^{19,20} Again, the technical and cognitive expertise of RCPs recommends them for assisting with these techniques.

Conclusions

Overall, in the cost-attentive environment of current healthcare where clinical roles are defined by the "value added" of each provider's role, available studies show that RCPs have been highly desirable collaborators in the ICU. In ventilator management and weaning, RCPs are often among the most knowledgeable healthcare providers on the ICU team. Indeed, randomised controlled trials support their value in accelerating weaning from mechanical ventilation. Though their roles in other aspects of ICU management are less well defined, RCPs' expertise in technical issues and cardiopulmonary physiology recommends them as important contributors to intensive care.

Although available studies strongly support the contributions of RCPs to intensive care, several concerns are noteworthy. Firstly, the experience cited in this report is confined to North American institutions where respiratory care is a well-developed discipline. As such, this experience may not generalise to institutions or countries where trained, capable RCPs are not available. Secondly, even in North American literature, available studies of RCPs' contributions to intensive care, though favourable, are sparse. Further studies are required to more thoroughly examine the impact of RCPs on ICU outcomes and costs, as well as to replicate available findings in other institutions across the full spectrum of care (e.g. teaching hospitals and community-based private institutions, large and small facilities). Thirdly, possible disadvantages of RCPs' participation should be considered. For example, one concern might be that

RCPs' participation in ICU care detracts from the educational experience of physicians-in-training. Preliminary studies on the educational impact of respiratory care protocols however suggest otherwise (i.e. a favourable effect on physician trainees' knowledge of respiratory care).²¹ Another concern is that because available data regarding the cost impact of RCPs' participation are sparse, increased costs attributable to RCPs' involvement are possible, e.g. by encouraging more test-ordering.

Indeed, a balanced view of RCPs' involvement in intensive care requires that we recognise the shortcomings of available studies, but that promising findings from available studies suggest the need for a more complete examination of RCPs' involvement in intensive care. If the experience in leading American institutions such as the Massachusetts General Hospital, Barnes Hospital, and the Cleveland Clinic Foundation holds true in other settings, an expanded role for RCPs is anticipated.

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