A Critical Care Clinician Survey Comparing Attitudes and Perceived Barriers to Low Tidal Volume Ventilation with Actual Practice

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Abstract

Rationale: Low- V_T ventilation lowers mortality in patients with acute respiratory distress syndrome (ARDS) but is underused. Little is known about clinician attitudes toward and perceived barriers to low- V_T ventilation use and their association with actual low- V_T ventilation use.

Objectives: The objectives of this study were to assess clinicians' attitudes toward and perceived barriers to low- V_T ventilation (V_T <6.5 ml/kg predicted body weight) in patients with ARDS, to identify differences in attitudes and perceived barriers among clinician types, and to compare attitudes toward and perceived barriers to actual low- V_T ventilation use in patients with ARDS.

Methods: We conducted a survey of critical care physicians, nurses, and respiratory therapists at four non-ARDS Network hospitals in the Chicago region. We compared survey responses with performance in a cohort of 362 patients with ARDS.

Results: Survey responses included clinician attitudes toward and perceived barriers to low- V_T ventilation use. We also measured low- V_T ventilation initiation by these clinicians in 347 patients

with ARDS initiated after ARDS onset as well as correlation with clinician attitudes and perceived barriers. Of 674 clinicians surveyed, 467 (69.3%) responded. Clinicians had positive attitudes toward and perceived few process barriers to ARDS diagnosis or initiation of low- V_T ventilation. Physicians had more positive attitudes and perceived fewer barriers than nurses or respiratory therapists. However, use of low- V_T ventilation by all three clinician groups was low. For example, whereas physicians believed that 92.5% of their patients with ARDS warranted treatment with low- V_T ventilation, they initiated low- V_T ventilation for a median (interquartile range) of 7.4% (0 to 14.3%) of their eligible patients with ARDS. Clinician attitudes and perceived barriers were not correlated with low- V_T ventilation initiation.

Conclusions: Clinicians had positive attitudes toward low- V_T ventilation and perceived few barriers to using it, but attitudes and perceived process barriers were not correlated with actual low- V_T ventilation use, which was low. Implementation strategies should be focused on examining other issues, such as ARDS recognition and process solutions, to improve low- V_T ventilation use.

Keywords: acute respiratory distress syndrome; quality improvement; survey; intensive care unit

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Acute respiratory distress syndrome (ARDS) is common and associated with significant morbidity and mortality (1–3). Low- V_T ventilation lowers mortality resulting from ARDS (4–6). In previous surveys, researchers explored some of the barriers to low- V_T ventilation use by ARDS Network (ARDSNet) clinicians (physicians, nurses, and respiratory therapists [RTs]). They identified physician unwillingness to relinquish ventilator control; failure to recognize ARDS; perceptions of contraindications; and other organizational, attitudinal, and knowledge-related barriers to low- V_T ventilation use (7, 8). These previous researchers did not report the relationships between these potential barriers or perception of performance and actual use of low- V_T ventilation.

As previously shown, low- V_T ventilation is underused at four Chicago area hospitals (9). We conducted a survey among the critical care clinicians at these hospitals to identify attitudes toward and perceived barriers to use of low- V_T ventilation. In addition, we aimed to compare clinician attitudes and perceived barriers with actual use of low- V_T ventilation. We hypothesized that clinicians would have generally positive attitudes and perceive few barriers to low- V_T ventilation use, as well as that clinicians with the most positive attitudes and fewest perceived barriers would be correlated with increased initiation of low- V_T ventilation in actual practice.

Methods

Setting and Sampling Frame

The study was approved with a waiver of patient consent by the institutional review boards of Northwestern University and the participating hospitals. Clinicians provided consent during the survey process. The study was performed in nine adult intensive care units (ICUs) at four Chicago area hospitals: an academic, tertiary care hospital and three community hospitals. Physician staffing in eight ICUs included primary coverage or mandatory consultation by board-certified critical care physicians, and one ICU was staffed by cardiologists. In ICUs with dual coverage (e.g., a primary team and a mandatory consulting critical care physician), we surveyed only critical care physicians. All ICUs were staffed by specially trained ICU nurses and RTs. Academic hospital ICUs also included

fellows and residents. None of the sites had ARDS protocols.

Survey Development

The objectives of the survey were to identify clinician attitudes toward and perceived barriers to use of low- V_T ventilation. The low- V_T ventilation survey was part of a larger survey that also assessed clinician attitudes toward and perceived barriers to use of awake and breathing controlled ventilator weaning, as well as clinician social networks (10–12). The survey was conceptually based on the theory of planned behavior and the Consolidated Framework for Implementation Research (13, 14).

On the basis of the literature and expert opinion, we identified two topics important for understanding low- V_T ventilation use: clinician attitudes toward low- V_T ventilation and perceived process barriers affecting adoption of low- V_T ventilation. In addition, we sought to explore three additional topics: anticipated regret, clinician risk taking when making patient care decisions, and perceived communication among clinicians. We did not explicitly define low- V_T ventilation on the survey. Demographic questions were included. Individual items were based on existing surveys (Evidence-Based Practice Attitudes Survey, Survey of Ventilator Management in Acute Respiratory Distress Syndrome) and author opinion (8, 15, 16). We conducted multiple rounds of review of each item's context and stem construction, as well as response item wording and ordering.

We pretested the survey with five clinicians, interviewing them about item clarity and comprehension, style, formatting, and length. On the basis of pretesting, the survey underwent further revisions until the final versions were completed (*see the online supplement*). The final survey was pilot tested with 23 clinicians to establish administration procedures.

Survey Administration

All attending physicians and fellows who cared for the patients in a previously reported cohort of 362 patients with ARDS, which was developed in a retrospective cross-sectional study from June to December, 2013, were recruited to complete the survey (9). We obtained names and contact information of all ICU nurses and RTs at participating hospitals at the time of the survey. We sent a recruitment e-mail to eligible clinicians using SurveyMonkey

(SurveyMonkey, Inc., San Mateo, CA) (17). The e-mail contained a link allowing clinicians to complete the survey online. Clinicians who did not access the online survey within 7 days received a reminder e-mail. Upon completion, clinicians received a \$20 electronic gift card. We attempted to hand deliver a paper version of the survey with a stamped return envelope and a \$20 bill to clinicians who did not access the online survey. The survey was distributed and results were collected between October 2014 and June 2015.

ARDS Cohort

We previously reported the construction of the ARDS patient cohort in this study (9). We used the Berlin Definition to define ARDS (3). We developed criteria for identifying bilateral infiltrates, ARDS risk factors, and objective assessment of cardiac failure (9). We collected all ventilator settings. Consistent with the ARDSNet adherence threshold, we defined low- V_T ventilation as any V_T less than 6.5 ml/kg predicted body weight (PBW) occurring after ARDS onset (18). We did not consider a plateau pressure cutoff (e.g., >30 cm H_2O), because (1) it was not recorded at two hospitals; (2) some evidence shows low V_T improves outcomes regardless of a plateau pressure cutoff (19); and (3) the ARDSNet protocol requires initiating lower V_T first, which would be captured by the use variable we measured (4). We did not adjust for acidemia, because it did not predict low- V_T ventilation use (9).

Clinician Initiation of Low- V_T Ventilation

We identified the attending critical care physician for each patient-day by who wrote the attending critical care physician progress note for each patient on each date; to ensure accuracy, at two hospitals, we cross-checked these data with which critical care physician billed critical care services. At two hospitals, we identified nurses and RTs according to day and night shifts. The primary nurse was the nurse who entered the greatest number of oxygen saturation entries in the electronic health record during a patient-shift. The primary RT was the RT who entered the greatest number of ventilator settings in the electronic health record during a patient-shift.

We chose low- V_T ventilation initiation as the performance variable for the primary correlations in this study because

initiation requires an active change in care, and the survey questions are focused primarily on attitudes and perceived barriers toward the key components in initiating low- V_T ventilation (the diagnosis of ARDS and ordering/administering of low- V_T ventilation). We calculated each clinician's percentage of patients initiated as the number of patients initiated on low- V_T ventilation after ARDS onset divided by the number of patients eligible for initiation after ARDS onset. For each individual clinician, a patient was eligible for initiation only if he/she was not already receiving low- V_T ventilation at the time the clinician started taking care of him/her. We included each clinician/patient pairing only once in the denominator for each clinician.

Initiating low- V_T ventilation was defined as a patient achieving a V_T less than 6.5 ml/kg PBW after ARDS onset. Each clinician who was caring for a patient when low- V_T ventilation was initiated was credited with initiation. Five patients for whom low- V_T ventilation was initiated more than once after ARDS onset were included as eligible and initiated on each separate occasion. Additional details of these methods are included in the METHODS section of the online supplement.

Sensitivity Analysis

To determine whether our results were sensitive to a less restrictive definition of low- V_T ventilation, we linked attending physicians with the time frames in which each patient was initiated on a V_T less than 8 ml/kg PBW. This is a more lenient definition of low- V_T ventilation that includes the upper 95% confidence interval for the low- V_T arm of the ARDSNet study (4).

Statistical Analysis

Descriptive statistics were calculated for clinician characteristics and each survey question. Initiation of low- V_T ventilation was reported as the median (interquartile range [IQR]) percentage of patients who were initiated for each group of clinicians. We categorized clinicians as having 10 or fewer years of experience or 11 or more years of experience and compared survey questions, initiation of low- V_T ventilation, and initiation of V_T less than 8 ml/kg PBW (attending physicians) between experience categories using Fisher's exact test or the Wilcoxon rank-sum test. Pairwise comparisons of individual survey questions between clinician groups were

performed using Student's t test or the chi-square test. The Bonferroni correction was used to account for the three pairwise tests for each question; for these comparisons, $P < 0.017$ was considered significant.

The Spearman correlation was used to evaluate the association between each survey question and initiation of low- V_T ventilation. Also, we examined the correlations between attending physician survey responses and initiation of an alternate V_T cutoff of less than 8 ml/kg PBW. $P < 0.05$ was considered significant. We used SAS version 9.4 software for analyses (SAS Institute, Cary, NC).

Results

Six hundred seventy-four clinicians were eligible, and 467 (69.3%) consented and responded to at least one question. There were no differences in the response rates across clinician types (physicians, 68.0%; nurses, 70.7%; RTs, 65.3%). At the academic hospital, there was no difference in the percentage of physician survey responders who were attending physicians (as opposed to fellows) compared with nonresponders

(66.3% vs. 59.5%; $P = 0.46$). Participant characteristics are shown in Table 1.

Survey Results

For detailed survey results, see Table 2 as well as Tables E1 and E2 in the online supplement.

Attitudes toward low- V_T ventilation. The mean (SD) percentage of their patients with ARDS who physicians believed warranted treatment with low- V_T ventilation was 92.5% (15.3%), which was higher than among nurses (61.1% [29.5%]) and RTs (67.8% [26.8%]) ($P < 0.01$ for both comparisons with physicians). Nearly all physicians (96.4%) and majorities of nurses (66.6%) and RTs (77.9%) believed that the evidence for low- V_T ventilation was strong or very strong; physician belief was stronger ($P < 0.01$ for comparisons with nurses and RTs). Most clinicians believed that low- V_T ventilation provided a large or very large clinical benefit in reducing mortality. Physicians reported fewer patients with contraindications to low- V_T ventilation than nurses and RTs did.

Perceived process barriers to using low- V_T ventilation in ARDS. Most clinicians agreed or strongly agreed that it is easy to

Table 1. Survey respondent demographics

Characteristic	Physicians (n = 83)	Nurses (n = 307)	Respiratory Therapists (n = 77)	All Clinicians (n = 467)
Age, yr, n (%)				
Under 25	0	38 (13.5)	1 (1.3)	39 (8.9)
25–34	25 (30.9)	142 (50.4)	26 (34.2)	193 (44.0)
35–44	32 (39.5)	52 (18.4)	15 (19.7)	99 (22.6)
45–54	14 (17.3)	31 (11.0)	19 (25.0)	64 (14.6)
55–64	10 (12.4)	18 (6.4)	13 (17.1)	41 (9.3)
65 and older	0	1 (0.4)	2 (2.6)	3 (0.7)
No response	2	25	1	28
Female, n (%)	22 (26.8)	242 (86.4)	45 (60.0)	309 (70.7)
Physician level†				
Attending, n (%)	53 (66.3)			
Fellow, n (%)	27 (33.8)			
No response	3			
Years since training completion†				
Still in training	24 (30.0)	24 (8.6)	0	48 (11.1)
5 or fewer	22 (27.5)	156 (55.7)	17 (23.0)	195 (44.9)
6–10	8 (10.0)	33 (11.8)	23 (31.1)	64 (14.7)
11–15	9 (11.3)	30 (10.7)	4 (5.4)	43 (9.9)
16–20	5 (6.3)	6 (2.1)	8 (10.8)	19 (4.4)
21–25	5 (6.3)	8 (2.9)	6 (8.1)	19 (4.4)
26–30	4 (5.0)	12 (4.3)	5 (6.8)	21 (4.8)
31 or more	3 (3.8)	11 (3.9)	11 (14.9)	25 (5.8)
No response	3	27	3	33

*No response: 1 physician, 27 nurses, and 2 respiratory therapists.

†Physicians: time since fellowship completion. Nurses: time since critical care training/orientation completion. Respiratory therapists: time since respiratory therapy training completion.

Table 2. Survey results for attitude toward and perceived barriers to low-V_T ventilation

Item	Response	Physicians, Mean (SD)	Nurses, Mean (SD)	Respiratory Therapists, Mean (SD)
Attitude toward low-V _T ventilation				
What percentage of your patients with ARDS warrant treatment with LTVV based on the best available evidence?	Percentage as continuous variable	92.5% (15.3%)	61.1% (29.5%)*	67.8% (26.8%)*
What percentage of your patients with ARDS have contraindications to receiving LTVV?	Percentage as continuous variable	7.8% (9.6%)	24.8% (20.4%)*	20.5% (17.8%)*
	Response	Physicians (n [%])	Nurses (n [%])	Respiratory Therapists (n [%])
Attitude toward LTVV ventilation				
How strong do you believe the evidence is that your patients with ARDS will benefit from LTVV?	Very strong or strong	80 (96.4)	195 (66.6)*	60 (77.9)*
In your opinion, how large is the benefit of LTVV in reducing mortality for your ARDS patients?	Very large or large	56 (67.5)	146 (50.9)*	41 (54.0)
Level of agreement or disagreement: I will only order/administer [nurses/respiratory therapists: administer] LTVV if I am certain my patient has ARDS.	Strongly disagree or disagree	67 (80.7)	78 (26.7)*	28 (36.8)*
Perceived barriers to LTVV				
Level of agreement or disagreement: It is easy for me to obtain all the information I need to determine whether a patient has ARDS.	Strongly agree or agree	72 (87.8)	189 (66.3)*	63 (81.8) [†]
Level of agreement or disagreement: It is easy to make sure a patient is receiving LTVV.	Strongly agree or agree	70 (86.4)	230 (81.6)	68 (88.3)
Level of agreement or disagreement: It is easy to order [nurses/respiratory therapists: initiate and administer] LTVV.	Strongly agree or agree	75 (91.5)	214 (76.4)*	68 (89.5) [†]
How long does it usually take from the time a patient clinically develops ARDS to the time you receive all the information needed to make a diagnosis of ARDS?	Less than 6 h or 6 h to just under 12 h	71 (86.6)	189 (67.0)*	52 (68.4)*
How often issue delays diagnosis of ARDS or decision to treat with LTVV: obtaining a chest radiograph and being notified of the results.	Never or rarely	66 (80.5)	—	—
How often issue delays diagnosis of ARDS or decision to treat with LTVV: obtaining an arterial blood gas and being notified of the results.	Never or rarely	68 (82.9)	—	—
How often issue delays diagnosis of ARDS or decision to treat with LTVV: finding time to review all the patient's records and decide whether to make a diagnosis of ARDS.	Never or rarely	50 (61.0)	—	—
How often issue delays diagnosis of ARDS or decision to treat with LTVV: not promptly recognizing that a patient has ARDS even when all data are available and the criteria appear to be met.	Never or rarely	55 (67.1)	—	—
How often issue delays diagnosis of ARDS or decision to treat with LTVV: the time from ordering LTVV to your patient receiving it.	Never or rarely	53 (64.6)	—	—

Definition of abbreviations: ARDS = acute respiratory distress syndrome; LTVV = low-V_T ventilation.

* $P < 0.017$ for comparison with physicians.

[†] $P < 0.017$ for comparison with nurses.

obtain information needed to diagnose ARDS, make sure a patient is receiving low- V_T ventilation, and order or administer low- V_T ventilation. Most clinicians reported that it took less than 12 hours to receive the information needed to diagnose ARDS (physicians, 86.6%; nurses, 67.0%; RTs, 68.4%; $P < 0.01$ for physicians compared with nurses and RTs). Majorities of physicians said there rarely were delays in diagnosing ARDS due to obtaining a chest radiograph (80.5%), sending for arterial blood gas analysis (82.9%), reviewing patient records (61.0%), or recognizing that a patient has ARDS when all data are available (67.1%). Physicians did not report delays in initiating low- V_T ventilation due to delays between the time of ordering it and actually administering it (64.6%).

Initiation of low- V_T ventilation. There were 46 attending physicians, 171 nurses, and 51 RTs who were survey responders and also had performance data. The median (IQR) percentage of patients initiated on low- V_T ventilation by survey responders was low (physicians, 7.4% [0 to 14.3%]; nurses, 0 [0–0]; RTs, 0 [0 to 2.8%]) (Figure 1). Among clinicians who did not respond to the survey, low- V_T ventilation initiation was also low and not different from that of survey responders (Table E3). Low- V_T ventilation initiation did not differ when we compared clinicians with 10 or fewer versus 11 or more years in practice (Table E4).

Correlation between Survey Results and Low- V_T Ventilation Initiation

No significant correlation was found between any attending physician attitude or perceived process barrier question and initiation of low- V_T ventilation (Table 3). No significant correlation was found between any nurse or RT attitude or perceived process barrier question and initiation of low- V_T ventilation, except “What percentage of your patients with ARDS have contraindications to receiving low tidal volume ventilation?” For nurses, there was a small positive correlation, and for RTs a small negative correlation, between responses to this question and low- V_T ventilation initiation (Table 3), meaning that nurses who thought patients with ARDS were more likely to have contraindications to low- V_T ventilation had greater proportions treated with it, and the opposite was true for RTs.

Sensitivity Analysis

For attending physicians, the median (IQR) percentage of patients initiated on a V_T less than 8 ml/kg PBW was 16.7% (0 to 33.3%). Initiation of V_T less than 8 ml/kg PBW did not differ between physicians with 10 or fewer versus 11 or more years in practice (Table E5). No correlation was found between any attending physician attitude question and initiation of V_T less than 8 ml/kg PBW. There was a significant correlation for two perceived process barrier questions and initiation of V_T less

than 8 ml/kg PBW: (1) ease of ordering low- V_T ventilation and (2) length of time to receive information necessary to diagnose ARDS (both negatively correlated with initiation of $V_T < 8$ ml/kg PBW) (Table E6). Additional results are included in Tables E7–E10 and the RESULTS section of the online supplement.

Discussion

In this multicenter, multidisciplinary survey of 467 critical care clinicians at one academic and three community non-ARDSNet hospitals, clinicians had positive attitudes toward using low- V_T ventilation for ARDS and rarely perceived significant barriers to the diagnosis of ARDS or the use of low- V_T ventilation. In a group of hospitals where only 19.3% of patients with ARDS received low- V_T ventilation (9), clinicians reported that most patients with ARDS warrant treatment with low- V_T ventilation, including physicians who reported that 92.5% of their patients with ARDS warranted treatment with low- V_T ventilation. However, low- V_T ventilation use in patients with ARDS cared for by these clinicians was very low, and there were almost no significant correlations between attitudes toward or perceived process barriers to low- V_T ventilation and actual low- V_T ventilation initiation, suggesting a striking divergence between perceptions and observed practice.

Previous studies have suggested several potential barriers to low- V_T ventilation use, including negative clinician attitudes, perceived contraindications to low- V_T ventilation, and perceived process barriers (7, 8). In contrast, this study demonstrates that clinicians believe low- V_T ventilation should be used for their patients and do not identify significant barriers to its use; yet, they do not initiate it. Also, the lack of correlation between attitudes and practice suggests that a knowledge deficit is not the likely barrier to low- V_T ventilation use. These findings strongly suggest that other factors are at play.

Consistent with previous researchers, we believe that these factors fall into several other categories, including inappropriate ARDSNet low- V_T ventilation strategies and unperceived process barriers (8, 20). Inappropriate ARDSNet low- V_T ventilation strategies may include using actual body weight for V_T selection instead of

Figure 1. Initiation of low- V_T ventilation by survey responders ($n = 46$ for physicians; $n = 171$ for nurses; $n = 51$ for RTs). Box plots illustrate the median (interquartile range [IQR]). Whiskers illustrate upper and lower adjacent values (± 1.5 times the interquartile difference). Dots represent outliers.

Table 3. Correlation between attitude and perceived barriers survey items and initiation of low-V_T ventilation

Item	Attending Physicians		Nurses		Respiratory Therapists	
	Correlation Coefficient*	P Value	Correlation Coefficient*	P Value	Correlation Coefficient*	P Value
Attitude toward low-V _T ventilation						
What percentage of your patients with ARDS warrant treatment with LTVV based on the best available evidence?	−0.29	0.85	0.057	0.47	0.072	0.62
What percentage of your patients with ARDS have contraindications to receiving LTVV?	−0.28	0.058	0.17	0.031	−0.28	0.044
How strong do you believe the evidence is that your patients with ARDS will benefit from LTVV?	0.19	0.22	0.044	0.57	0.0045	0.98
In your opinion, how large is the benefit of LTVV in reducing mortality for your ARDS patients?	0.12	0.43	−0.033	0.67	0.0082	0.95
Level of agreement or disagreement: I will only order/administer LTVV if I am certain my patient has ARDS.	−0.0020	0.99	−0.13	0.086	−0.088	0.54
Perceived barriers to low-V _T ventilation						
Level of agreement or disagreement: It is easy for me to obtain all the information I need to determine whether a patient has ARDS.	−0.16	0.29	−0.034	0.66	−0.033	0.82
Level of agreement or disagreement: It is easy to make sure a patient is receiving LTVV.	−0.22	0.15	0.10	0.19	0.23	0.10
Level of agreement or disagreement: It is easy to order [nurses/respiratory therapists: initiate and administer] LTVV.	−0.22	0.14	0.025	0.75	0.16	0.26
How long does it usually take from the time a patient clinically develops ARDS to the time you receive all the information needed to make a diagnosis of ARDS?	−0.26	0.083	0.036	0.65	0.21	0.13
How often issue delays diagnosis of ARDS or decision to treat with LTVV: obtaining a chest radiograph and being notified of the results.	−0.17	0.28	—	—	—	—
How often issue delays diagnosis of ARDS or decision to treat with LTVV: obtaining an arterial blood gas and being notified of the results.	0.0086	0.96	—	—	—	—
How often issue delays diagnosis of ARDS or decision to treat with LTVV: finding time to review all the patient's records and decide whether to make a diagnosis of ARDS.	0.040	0.79	—	—	—	—
How often issue delays diagnosis of ARDS or decision to treat with LTVV: not promptly recognizing that a patient has ARDS even when all data are available and the criteria appear to be met.	0.13	0.39	—	—	—	—
How often issue delays diagnosis of ARDS or decision to treat with LTVV: the time from ordering LTVV to your patient receiving it.	−0.20	0.20	—	—	—	—

Definition of abbreviations: ARDS = acute respiratory distress syndrome; LTVV = low-V_T ventilation.

*Spearman correlation coefficient.

calculating PBW, basing ventilation decisions on plateau pressure instead of initially administering low-V_T ventilation, or believing that a higher V_T (e.g., <8 ml/kg PBW) constitutes low-V_T ventilation. Unperceived process barriers may include reluctance among RTs and/or nurses to initiate low-V_T ventilation despite a physician's order (e.g., due to concerns about patient comfort), leading to a physician's thinking it is being delivered

when it is not; low staffing ratios for managing patients with ARDS (7, 8); or role ambiguity, whereby clinician groups may not believe they have primary responsibility for ensuring low-V_T ventilation. One potential barrier, failing to recognize ARDS, could be due to not knowing the ARDS diagnostic criteria and an unperceived process barrier (not receiving the data needed to make the diagnosis). Although we did not assess ARDS recognition, the

researchers in the multinational Large observational study to UNDERstand the Global impact of Severe Acute respiratory Failure (LUNG SAFE) study found that ARDS was underrecognized across 459 ICUs in 50 countries (20). Studies in which researchers investigate potential barriers in the context of observed low-V_T ventilation delivery may be useful for understanding the role these barriers play in the actual delivery of low-V_T ventilation.

These potential barriers support the development of specific interventions—audit and feedback, clinician education, and clinical decision support to improve the recognition of ARDS (e.g., prompting or reminders) and overcome process barriers to the delivery of low- V_T ventilation. However, recent studies whose aim was to improve identification of or provide clinical decision support for ARDS, as well as sepsis, have shown mixed results in improving processes or patient outcomes (21–27), suggesting an urgent need for more investigation in this area.

Our study extends the existing literature in several ways. First, to our knowledge, our study is the first to contrast a broad range of front-line physician, nurse, and RT attitudes and perceived performance with observed use of low- V_T ventilation. By initially distributing the survey 10 months after the ARDS cohort was developed, we ensured that the clinicians who cared for the ARDS cohort and those who received the survey were mostly overlapping (for physicians, completely overlapping), while avoiding the risk of bias had the survey been rolled out as performance was being measured. Our findings are consistent with those from a previous study in which researchers surveyed ICU directors only. The authors of that report of ICU director-perceived use versus observed use of low- V_T ventilation found a discrepancy of 79.9% perceived use versus 2.6% observed use (28). Physician overestimation of clinical performance has been observed in several medical specialties (29–32). Furthermore, the rate of low- V_T ventilation initiation in this study is lower than low- V_T ventilation use in the LUNG SAFE study, which could be due to the geographic limitation of our study or a result of the specific training and prompting of LUNG SAFE clinicians to consider a diagnosis of ARDS, interventions that could increase ARDS recognition and lead to increased low- V_T ventilation initiation (20).

Second, we performed a sensitivity analysis using the higher V_T threshold of

8 ml/kg PBW, increasing the robustness of our comparison of perceived versus observed low- V_T ventilation use. Third, this study contained a larger sample size than previous similar studies, included both academic and community hospitals in socioeconomically diverse areas, and had a high response rate. Fourth, by not including ARDSNet sites, our results are more generalizable to the broad practice of critical care medicine, removed from the network that developed low- V_T ventilation (8). Fifth, we made direct comparisons between physicians, nurses, and RTs, reinforcing a previous study in which researchers found fewer attitudinal and perceived process barriers to low- V_T ventilation among physicians than among nurses or RTs (8). Finally, by not being accompanied by an ARDS-specific or low- V_T ventilation-specific intervention—such as a low- V_T ventilation protocol or an intervention that primes clinicians to look for ARDS—our results are not biased by the presence of strategies that simultaneously attempt to improve low- V_T ventilation use (8, 20).

Our study has several limitations. First, the clinicians in our study practice in a single geographic region, potentially limiting the generalizability of our findings. Second, although response rates were high, it is possible that responders differed from nonresponders, which could bias our findings. Third, nurse and RT use data were available at only two hospitals (albeit representing >80% of the ARDS patient cohort), and identification of the primary nurse and RT was potentially more prone to error compared with physician identification. Fourth, interpretation of nurse results may be limited because of differences in age and years in practice between nurse survey responders with and without use data. Fifth, we did not assess whether role ambiguity—each group of clinicians not understanding who had primary responsibility to deliver low- V_T ventilation, thus resulting in none of the

groups taking this responsibility—may be a process barrier. Finally, not explicitly defining low- V_T ventilation or assessing clinicians' knowledge of what constitutes low- V_T ventilation could affect the comparison of perceived versus observed performance because clinicians may have a different understanding of what constitutes low- V_T ventilation (e.g., believing a V_T <8 ml/kg PBW constitutes low- V_T ventilation). However, we demonstrated that a median of only 16.7% of patients cared for by attending physician survey responders were initiated on a V_T less than 8 ml/kg PBW, and this higher V_T threshold was not significantly correlated with attitudes or perceived process barriers. The two questions that were negatively correlated with initiation of V_T less than 8 ml/kg PBW could be a result of physicians who are more likely to use this V_T being more aware of potential barriers such as ease of ordering or the time it takes to diagnose ARDS. In general, however, there is still a wide discrepancy between perceived performance and low- V_T ventilation use at this higher V_T threshold.

In summary, in a large multihospital survey of critical care physicians, nurses, and RTs, clinicians had positive attitudes toward low- V_T ventilation use, and they did not perceive significant barriers to its use for patients with ARDS. Although clinicians believed that the great majority of their patients with ARDS warranted treatment with low- V_T ventilation, they initiated it for less than 1 in 10 patients. These results suggest that barriers to low- V_T ventilation use other than negative attitudes or perceived barriers exist. Implementation strategies should be focused on examining other issues, such as ARDS recognition and process solutions, to improve low- V_T ventilation use. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

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