Incidence of acute respiratory distress syndrome and acute lung injury in patients requiring prolonged mechanical ventilation

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rimarily affecting critical care patients, Acute Lung Injury (ALI) and its more severe variant, Acute Respiratory Distress Syndrome (ARDS) are devastating clinical syndromes, having long-term functional and neuropsychological consequences1,2,3. Further characterized by acute hypoxemia, bilateral pulmonary infiltrates on frontal chest radiography, and no clinical evidence of left atrial hypertension, ARDS/ALI are severe inflammatory conditions of the lung parenchyma4,5. The resulting severe hypoxemia combined with the extensive release of systemic inflammatory mediators often leads to multiple organ failure; responsible for high rates of morbidity and mortality in the population6. Despite many recent advances in our understanding of the pathophysiology, treatment, and long-term outcomes of ARDS/ALI, incidence and prevalence of these conditions remains uncertain6. The uncertainty in turn reflects the heterogeneity of the syndromes, the lack of definitions for the underlying disease processes, and failure to uniformly define the population within which patients with ARDS/ALI are identified5. The incidence of ARDS/ALI in the United States has been estimated to be around 300,000 cases per year, but this may be an underestimate6. A recent study, conducted by Rubenfeld et al. examined the general ICU population and found the incidence of ARDS/ALI to be somewhat higher, at approximately 58.7 and 78.9 per 100,000 respectively; giving an annual estimated incidence at around 141,500 and 190,600 cases of ARDS/ALI respectively in the United States per year6.

The purpose of the current study was to determine the incidence of ARDS/ALI in a pilot sample from a prospective multi-centre follow-up of critically ill patients mechanically ventilated for at least one week – the Towards RECOVER study7. The incidence of ARDS/ALI in patients requiring prolonged mechanical ventilation is not known. We hypothesized that the incidence of ARDS/ALI would exceed that found in general ICU patients, as cited above.

METHODS
As part of the Towards RECOVER study protocol7, patients were included if they were ≥ 16 years of age and mechanically ventilated for at least one week. (n= 82). Chest imaging was performed daily for the first ICU week and each Monday and Thursday thereafter. Investigators (PK, LC) underwent systematic training on Chest X-Ray (CXR) interpretation for ARDS/ALI by a standardized online educational tutorial8. CXRs were divided into 4 quadrants, each analyzed for the presence or absence of bilateral infiltrates consistent with non-cardiogenic pulmonary edema. Diagnosis of ARDS/ALI was based on American European Consensus Conference on ARDS (AECC) guidelines. Data was analyzed to determine the percentage of radiographs read independently as ARDS/ALI by each reader and interobserver variability was be calculated (kappa-statistic)9. All analyses were performed using appropriate software.

RESULTS
The study sample contained 82 patients. They had a median age 59 years, the male: female ratio was 1.4:1, and 45% of those sampled were found to have ≥ 2 comorbidities. The median APACHE II score of was 25 and a the median ICU LOS of was 37 days. In our study sample, 72% survived until ICU discharge.

To date, the records of 25/82 patients have been examined (by both co-authors) for the presence of ARDS/ALI. Of this sample, 21/25 (84%) had radiographic evidence of bilateral infiltrates and fulfilled AECC criteria for ARDS/ALI. Interobserver variability, measured by kappa score, was 0.60 (Figure 1).

DISCUSSION
In this limited sample, there were a high proportion of patients who fulfilled the criteria for ARDS/ALI. Although there was insufficient data to accurately calculate incidence at present, our preliminary proportion of 84%, suggest that the incidence of ARDS/ALI in those mechanically ventilated for at least 1 week, likely exceeds 58.7 and 78.9 per 100,000 person-years respectively as previously described by Rubenfeld et al. in their sample of general ICU patients6. Our results were strengthened by relatively good agreement between independent evaluators; we measured a kappa score of 0.60 (Figure 1).

Figure 1. The area of the circles is proportional to the number of subjects given a particular pair of ratings.
Taken together, our preliminary results suggest that ARDS/ALI are likely under recognized conditions, particularly in critically ill patients requiring prolonged mechanical ventilation. Earlier studies have estimated the mortality due to ARDS/ALI at around 133,500 deaths per year in the United States. Given the possible under recognition however, ARDS/ALI are conditions likely responsible for even more deaths in the population. Besides mortality, ARDS/ALI also leads to large amounts of costly and often debilitating morbidity in surviving patients and their caregivers. Outcomes studies have consistently found significant functional and neuropsychological derangements at both 1 year and 5 years post illness. Perhaps better identification of ARDS/ALI in the first place may help to more efficiently allocate health care resources – in turn potentially preventing some of the typical long-term sequelae currently experienced by survivors and their caregivers.

Before making any firm conclusions however, it should be noted that although the results of our preliminary study are suggestive of under recognition of ARDS/ALI, they are subject to a number of important limitations. Particularly, this study was not only limited by sample size, but also, data collected was subject to survivorship, selection, and ascertainment biases. Additionally, analysis of data collected was limited by the level of training of the independent evaluators (PK, LC). The independent evaluators were trained using an online standardized tutorial to assist in the determination of bilateral pulmonary infiltrates as per AECC guidelines. Although good agreement was measured between independent evaluators, the data remains to be formally evaluated by a trained physician. Therefore, larger future studies are needed to validate and confirm the preliminary results of this current study.

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