The Cost of Mechanical Ventilation: Reductions Due to the Use of a Simple Endotracheal Tube Fastener

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Abstract

Introduction. Patients on mechanical ventilation are at high risk of complications; in particular unplanned extubations, lip pressure ulcers, and ventilator-associated pneumonia (VAP).[1-9] Hospitals recognize this and, to mitigate potential risk, can use a commercially-available endotracheal tube holder. A Medicare claims analysis was used to compare ventilated patients in hospitals using the Anchor Fast oral endotracheal tube fastener to matched hospitals that did not, to assess for differences in the cost of care in these patients.

Methods. Medicare 2008 standard analytic files were used. 543 hospitals known to have purchased the Anchor Fast oral endotracheal tube fastener in 2008 were identified and matched to an equal number of hospitals that did not. Inpatient stays with mechanical ventilation longer than one day were identified by ICD-9 codes, and hospital costs for each were estimated by multiplying the hospital's Medicare cost-to-charge ratio by the hospital's charges. Length of stay (LOS) and frequency of complications (VAP, reintubation, chest X-rays, pressure ulcers and lacerations) were tallied. LOS and LN(cost) were analyzed using Tobit (left-censored) and multiple linear regression, respectively; regressors included patient characteristics.

Results. The study identified 97,360 patients. The average cost of ventilated patients in hospitals not using the Anchor Fast oral endotracheal tube fastener was $30,643 while the average cost in hospitals using the Anchor Fast oral endotracheal tube fastener was $30,510, a reduction of $132 (p=0.032) per patient. The average LOS in hospitals using the Anchor Fast oral endotracheal tube fastener was 20.1 days versus 20.3 days in hospitals not using the product, a difference of 0.2 days (p=0.007).

Conclusions. The use of the Anchor Fast oral endotracheal tube fastener may be associated with a statistically significant and financially important reduction in average costs for the patients studied. The average savings of $132 per patient includes the purchase of the device.

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Introduction

Patients on mechanical ventilation are at high risk for complications, including pressure ulcers on the face and lips[1], lacerations about the head and neck, and most importantly, ventilator-associated pneumonia (VAP).[2,3,4,5,6] Minimizing this risk includes frequently repositioning the endotracheal tube side-to-side and cleaning the patient's mouth and oral cavity area. This frequent activity can expose the patient to the risk of unplanned extubation of the ventilation tube, and reintubation is itself a risk factor for VAP.[3,7] Chest X-rays to confirm tube placement, reintubation, and complications all contribute to the hospital's cost of care for these patients.[3,8,9]

Hollister Incorporated has developed the Anchor Fast oral endotracheal tube fastener to help mitigate many of the problems associated with endotracheal tubes. The design minimizes pressure around the mouth and its latex-free adhesive provides long-lasting wear while reducing skin stripping. It permits stable movement of the tube clamp, allowing easy access for oral care.

To determine whether these design features were effective in reducing the cost of care, LOS, or frequency of complications among patients receiving mechanical ventilation, we used Medicare claims data to compare patients in hospitals using the Anchor Fast tube fastener to those in matched hospitals that did not.

Methods

The perspective of this analysis was the hospital. Hospital costs were estimated by multiplying the hospital's charges for an inpatient hospitalization by the Medicare-reported cost-to-charge ratio. We used 2008 Medicare standard analytic files to identify inpatient hospital stays. These data included the nearly 13 million hospital stays experienced by approximately 45 million people who were enrolled in the Medicare Part A plan for that year.

Hospitals in the Medicare data that used the Anchor Fast tube fastener in 2008 were matched with a control hospital that did not use the Anchor Fast tube fastener using the following characteristics: the annual number of long-term ventilations, the wage index, disproportionate share, and teaching-hospital status. Wage index, disproportionate share, and teaching status are the major criteria that CMS uses to adjust Medicare payments so that they are in line with a hospital's costs.

Inpatient hospitalizations from these hospitals were initially included if they had at least one claim in 2008 with a long-term (ICD-9 96.72) mechanical ventilation (defined by Medicare as 96 hours or more) or short-term (ICD-9 96.71) mechanical ventilation. Patient stays were then excluded from this set for any of the following conditions:

1. The patient had a tracheostomy because such patients would not receive a fastening device such as the Anchor Fast tube fastener.
2. The patient had been admitted prior to 2008 because portions of the data would be missing.
3. The patient had a mechanical ventilation of a single day because it was possible that ventilation was used only during surgery.
4. The ventilation was reported as long-term, but due to a reporting error the time period was less than 96 hours.

With the resultant population of 97,360 patients the LOS, cost of hospitalization, and frequency of complications (VAP, reintubation, chest X-rays, pressure ulcers, and lacerations) were assessed.

LOS and cost were analyzed using multiple linear regression with covariate adjustments for whether or not the hospital used the Anchor Fast tube fastener.

Results

The analysis included 543 hospitals that used the Anchor Fast tube fastener matched to 543 hospitals that did not. The total number of patients was 97,360, of which 48,198 (49.5%) were in hospitals using the Anchor Fast tube fastener.

Complications: The frequency of VAP (0.17%), reintubation (2.4%), chest X-rays (0.64%), pressure ulcers, and lacerations (0.15%) was extremely low in the claims data. Because of this, it was not possible to distinguish statistically between two groups with extremely low complication rates. No further analyses were performed on these data.

Length of Stay: The average LOS for ventilated patients in hospitals that used the Anchor Fast tube fastener was 20.1 days and in hospitals that did not was 20.3 days, a reduction of 0.16 days (p=0.007); see Figure 1.

Costs: The average cost of ventilated patients in hospitals using the Anchor Fast tube fastener was $30,510; the average cost in hospitals not using the Anchor Fast tube fastener was $30,643, a reduction of $132 (p=0.032); see Figure 2.

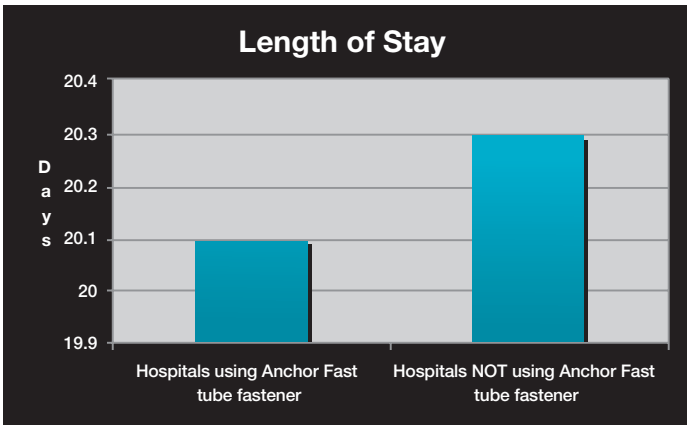

Figure 1
Hospital LOS for patients in hospitals using the Anchor Fast tube fastener and hospitals that do not

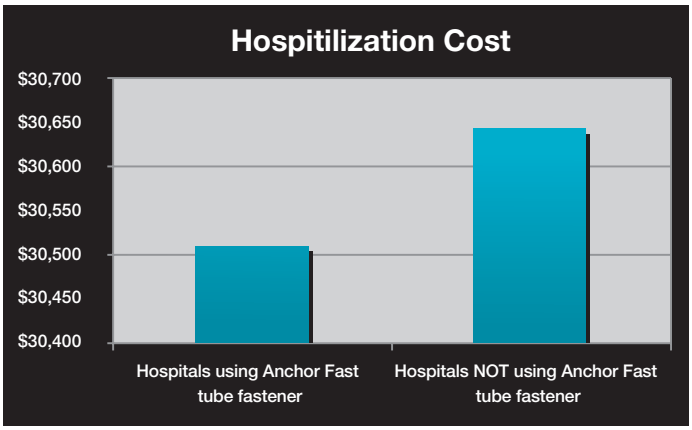

Figure 2
Hospitalization costs for patients in hospitals using the Anchor Fast tube fastener and hospitals that do not

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Conclusions

The use of the Anchor Fast oral endotracheal tube fastener may be associated with a statistically significant and financially important reduction in average costs for the patients studied. The average savings of $132 per patient includes the purchase of the device, which is usually less than $10 in the United States. Although the absolute differences were not large per individual patient, the cumulative effect over many ventilated patients can be significant to a hospital, and the return on investment may be approximately 13 to 1; a considerable benefit to the hospital.

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Precautions

- The oral endotracheal tube fastener has been evaluated in an adult population. This product is not intended for use with pediatric (paediatric) patients.
- Use caution in patients with full or swollen lips, dental appliances, facial swelling and/or protruding teeth.
- Patients without front upper teeth or unable to wear upper dentures may lack the maxillary support required to use the oral endotracheal tube fastener.
- Patients with facial hair may lack the necessary support to anchor the skin barrier pads.
- After application of the oral endotracheal tube fastener, check the patient frequently to ensure that both the oral endotracheal tube fastener and the endotracheal tube are secure and correctly positioned.
- To minimize the risk of pressure injury, inspect the patient's lips and skin at least every two hours[1,2] or more frequently if the patient's condition dictates.
- Discontinue use of the device if redness or skin irritation occurs.
- Repeated adjustment of the endotracheal tube in a distal or proximal direction may affect the performance of the ET tube wrap.
- Care should be taken to avoid aligning the inflation lumen directly under the non-slip grippers when securing the tube.
- The oral endotracheal tube fastener is indicated for single use. **To help ensure proper adhesion, do not re-use.**

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