Long-term Flight Planning at Ornge Using an Optimization Application

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Introduction

- Efficient deployment of air medical resources can enhance patient-access to these services and potential decrease costs.
- Unlike flight plans for the transfer of urgent or emergent patients (i.e., short-term plans or STPs), non-urgent patient transfers can be planned in advance (i.e., long-term plans or LTPs). The nature of LTPs makes them conducive to flight plan optimization.
- An optimization application ("the tool") was implemented at Ornge Transport Medicine. The intended purpose of the tool is to assist dispatchers to create efficient LTPs1,2.
- In certain situations, the LTP derived from the tool is modified manually by flight-planners, and sometimes it is not used at all. Here, we are interested in investigating the use and performance of the decision-support tool.

Objectives

This study aims to evaluate the use and performance of Ornge’s decision-support application. The study hypothesis is that use of the optimization application at Ornge has improved flight-planning outcomes for LTP, in terms of efficiency and cost.

Study Design

1.i  Non-Urgent Patient Transfer Request
- Manual LTP
- Non-Optimization Application
- Manual LTP
- Non-Optimization Application

1.ii  Decision Flowchart: The flights for non-urgent transfers were categorized according to 1) adherence to the plan determined by the tool and 2) by adherence to the long-term plan once created.

References:

Results

Figure 2. Flight Counts. Non-urgent transfers between May 31 and August 8, 2017 were categorized according to utilization of the optimization tool. The number in each category are summarized.

Figure 3. Cost per Distance. The average cost of the flights in each category were divided by the average distance of the flights within each category ($/km). Error bars represent standard deviation.

Figure 4. Efficiency. The efficiency of flights is represented by the average distance required for the flights in each category divided by the average distance flown within each category. Error bars represent standard deviation.

Figure 5. Reasons for Major Changes (STP). For each flight in the "Major Changes (STP)" category reasons for major deviations from the LTP were determined. The reasons were coded, categorized, and summarized here.

Conclusions

1. The long-term planners use the optimization tool more frequently than manual methods. Of 151 flights, only 33 were categorized as "LTP Manual"; the rest used the optimization tool to some degree.
2. There were significant differences in cost and efficiency for flights that followed the LTP compared to those deviated from the LTP.
3. The most common reason for a Major Change to the tool-derived LTP was a late transfer request.
4. To improve efficiencies, Ornge might consider creating policies to limit non-essential changes to next-day flight patterns after the LTP has been created, particularly in limiting late requests.
How Air Ambulance Services Can Improve Care Delivered to Remote Indigenous Communities

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BACKGROUND

• About 50% of Canada’s First Nations people reside in remote communities.
• Life expectancy is five to seven years shorter than in the rest of Canada.
• Barriers to health care include: low population density, long transportation and wait times, high rates of staff turnover, harsh weather climates, and inadequate human resources.
• Ornge is the air ambulance provider for the province of Ontario. Ornge operates 12 bases across the province, and employs a fleet of 8 Pilatus PC-12 fixed wing aircraft and 12 AW 139 rotor wing aircraft.

OBJECTIVE

• Primary: Air ambulance services have the medical, logistical, educational, and technological and data capabilities to improve access to care for remote Indigenous communities. Doing so will improve patient outcomes and expand the scope of work of air ambulance services.

METHODS

Ornge has developed a five-part strategy to help improve access to care for Indigenous communities.

Table 1: Strategies to Improve Access to Care for Remote Indigenous Communities

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical</td>
<td>Telemedicine</td>
</tr>
<tr>
<td>Logistical</td>
<td>POC Lab Tests</td>
</tr>
<tr>
<td>Education</td>
<td>Resident Rotations</td>
</tr>
<tr>
<td></td>
<td>Community programs</td>
</tr>
<tr>
<td>Outreach</td>
<td>First Aid/CPR</td>
</tr>
<tr>
<td></td>
<td>“Stop the Bleed”</td>
</tr>
<tr>
<td></td>
<td>“PARTY program”</td>
</tr>
<tr>
<td></td>
<td>“Opioid Dependence”</td>
</tr>
<tr>
<td>Data</td>
<td>Data for QI Projects</td>
</tr>
</tbody>
</table>

RESULTS

Table 2: Telemedicine

Table 3: Utilization of point-of-care Lab Tests: 4 months

Table 4: % Participants who found Program to be Useful

DISCUSSION

• Air Ambulance Services already provide access to emergency health services to remote Indigenous Communities.
• Air Ambulance Services have the logistical, medical and educational infrastructure to support enhanced programs to remote Indigenous Communities.
• Logistical Support for Point-of-Care Lab tests reduces unnecessary flights and improves care.
• Providing telemedicine expertise improves nursing satisfaction and improves the ability to triage calls.
• Public Health and Injury Prevention Programs are extremely well received and are deemed useful by participants, meeting an unmet need.

LIMITATIONS

• In-hospital outcomes unavailable.
• Long-term follow-up not available for outreach programs.

CONCLUSION

• Air ambulance services should expand their scope of work to include “access to care” for remote Indigenous Communities.
• Air ambulance services have the infrastructure to perform these tasks at small incremental costs but to potentially larger improvements to patient outcomes.

REFERENCES

The Ground and Air Medical Quality in Transport (GAMUT) Quality Improvement (QI) Collaborative:
• The GAMUT QI Collaborative is used to track, report, and analyze monthly critical care transport (CCT) performance for certain quality metrics by comparing institutions.
• The 4 exemplar metrics chosen were: blood glucose measurement, first attempt intubation success rates, tracheal tube place checks, and mechanical ventilation of advanced airways.
• These were dichotomous metrics and therefore were more objective and definitive.

Background:
• The time period for this study is January 2014 to December 2017.
• The initial reporting month for each institution prior to feedback and the corresponding month one year after feedback (+/- 3 months) were chosen to minimize seasonality.
• Institutions were self-paired to include both before and after monitoring to minimize patient population heterogeneity.
• The 4 exemplar metric values were weighed by denominator-number of transports - because of the varying institution size and opportunity to perform the metric task.

Study Purpose:
• We sought to describe the additive benefits of participation in GAMUT as determined by improved outcomes for measuring blood glucose as a percentage of CCTs involving altered mental status, first attempt intubation success rate, confirmation of tracheal tube placement rate, and mechanical ventilation rate per advanced airways.

Comparing Before & After:
• Each institution will improve due to natural learning and the Hawthorne Effect.
• Because of this, simply comparing before and after results for the institutions is insufficient.
• However, these results still supported the claim of improvement due to involvement in GAMUT QI Collaborative.

Primary Analysis:
• We performed an analysis of variance with an indicator for whether the metric value was before or after feedback, but added a time covariate to the model, so we could take into account natural learning throughout the study period.
• We also weighted the metric comparisons by the denominator since we had varying institutional sizes.

Conclusions:
• After time adjustment and one year of feedback from participation in GAMUT: glucose checks increased by over 9%; tracheal tube placement increased over 2%; first attempt intubation increased by over 5%; and mechanical ventilation increased by over 4%.

Supplemental Analysis:
• This study was still only over one year, so the Hawthorne Effect could still be valid.
• To discount the Hawthorne Effect, we took a subset of institutions that provided us complete, multi-year data, and performed a linear regression to estimate the average annual growth over the entire period.

Acknowledgments:
• Everyone who contributed to the GAMUT Database
• Dr. Mike Bigham for his support and expertise, and co-founding the GAMUT Database
Medical and economic effects by introducing a Helicopter Emergency Service in Toyama Prefecture, Japan

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3 Department of Healthcare Contents Production, Health Informatics and Management Professionals (HIMAP)

1 Introduction

The helicopter emergency medical services (HEMS) with a physician on board was introduced in Japan in 2001. Each prefecture runs its own HEMS.

As of 2018, HEMS was operating in 42 of the 47 prefectures in Japan, with 52 helicopters deployed at HEMS bases located on hospital grounds.

HEMS has improved the survival rates and patient outcome; however, the effectiveness of HEMS is still being debated.

To promote the operation of HEMS in Japan, it is necessary to demonstrate the medical and economic effects of HEMS within the prefecture.

Our study used the database of Toyama Prefecture covering about 19 months, from the introduction of the HEMS in August 2015 until the end of March 2017. Our study examined the following issues:

Study I: How much time does HEMS in Toyama save compared to ground emergency medical service (GEMS) for a doctor to start treatments, and if there are improvements in hospital outcome? What is the economic gain from a medical point of view when a patient is evacuated by HEMS?

Study II: Which factors affected the patient’s outcome?

2 HEMS Resources in Japan

HEMS is deployed in 23 prefectures, including 17 prefectures in Japan. The HEMS in Toyama Prefecture is driven by 10 medics and 2 doctors.

Data

Toyama HEMS database was used.

Data was collected from September 1, 2015 to March 31, 2017 (19 months).

Data was excluded for the following cases:
1. cancelation
2. condition not serious
3. CPA
4. request from hospital
5. request from Tateshina fire department

A total of 296 patients were included in this study.

Study I: Medical and economic effects

The number of patients who improved their outcome with HEMS

Compared patients’ outcome of HEMS with those of GEMS.

Compared patients’ outcome of the time from receiving emergency call to HEMS contacting the patient with the time from receiving in emergency call to GEMS contacting the hospital.

Outcome and transport time by GEMS were estimated if patients had not been transferred by the ambulance.

The economic effect was calculated for patients categorized by their discharge from the following formula: the cost of all the cases was summed up to calculate the overall economic effect of HEMS in Toyama Prefecture.

For example:

- Temporal difference:
  - Recovery: 20 year X $1 X $45,450 + $808,100 (adjust with the utility value $0.40)
  - Death: 20 year X $45,450 + $45,450

- Extra cost of hospital stay: $900 (20 year X $45,450 + $808,100)

- Extra cost of hospital stay: $900 (20 year X $45,450 + $45,450 + $45,450)

The Bayes HEMS in Toyama Prefecture was driven by 10 men and 8 women.

Study II: Factors affecting patients’ outcomes

Simple binary logistic regression was used to run a multivariate analysis.

The main outcome was survival (odds ratio = factors associated with higher mortality risk)

The confounding variables were gender, age, disease category, the differences of transport time between HEMS and GEMS, and treatments/medical examinations.

Disease categories were external diseases such as trauma, internal diseases such as stroke, and other diseases which especially required prompt treatment on scene.

4 Results

Study I

Comparison time of HEMS with GEMS

Time from receiving a call to a patient arrival contacting the patient

Time from receiving a call to hospital arrival for patient with surgical demand

Study II

Factors influencing the improvement of patient outcomes

- Gender difference (male, female)
- Age (34 year-old, 65 year-old)
- Other disease (different category, vs no other)
- Traumatic complicated (traumatic case, non-traumatic case)
- Drug side effect (nothing, side effect)
- Oxygen inhalation (nothing, side effect)
- Transport time (60, 90)
- Thrombolysis (4, 12.5)

5 Discussion and Conclusion

The Toyama HEMS demonstrated positive medical and economic effects in this study.

HEMS staff in Toyama was able to start patient treatments within 10.8 mins from dispatch time.

HEMS staff made a concerted effort to minimize the time on scene with optimal treatments according to the patients’ conditions.

These fast responses improved patient outcomes.

The study indicates that the medical and economic performance of the Toyama HEMS was effective.

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Background:
Healthcare has undergone significant regionalization over the past 20 years, necessitating high quality interhospital transport. Multiple studies have shown that the use of transport mechanical ventilators (MV) in lieu of manual ventilation during such transports provides more consistent ventilation and thus improved clinical outcomes.

Study Purpose:
By analyzing MV use during interhospital transport of patients with advanced airways among diverse neonatal/pediatric/adult transport teams, we sought to describe current practice, identify quality benchmarks, and describe associated performance in relation to other quality indicators.

Methods:
Data are contained in the Ground and Air Medical qUality Transport (GAMUT) database. Advanced airway utilization rate is calculated using the following:

**NUMERATOR** = Number of transport patient contacts during the calendar month involving patient with an advanced airway supported by a MV

**DENOMINATOR** = Number of transport patient contacts during calendar month involving a patient with an advanced airway

Advanced airway is defined as a tracheal tube, laryngeal mask airway, esophageal-tracheal Combitube, tracheostomy tube, King Airway, cricoidotomy tube, or equivalent.

The study period lasted from December 2016-December 2017 (12 months). Analyses included stratifying institutions by patient population, evaluation of mean and achievable benchmarks, and rank correlation to identify associations with other GAMUT quality metrics.

<table>
<thead>
<tr>
<th>Table 1- Summary Cohort Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>Total Patient Transports with Advanced Airways Data</td>
</tr>
<tr>
<td>Transports with Advanced Airways - n (%)</td>
</tr>
<tr>
<td>Advanced Airways Supported by Ventilator Use - n (%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2- Summary Stratified Cohort Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>Transports¹</td>
</tr>
<tr>
<td>Transports with Advanced Airways - n (%)</td>
</tr>
<tr>
<td>Advanced Airways Supported by Ventilator Use - n (%)</td>
</tr>
</tbody>
</table>

¹There was 1 institution that did not provide stratified transport data. Hence total transport volume is n=16519 transports.

²P-value via Pearson chi-square test. All strata values for transports with advanced airways are considered distinct via post-hoc Bonferroni adjusted z tests. For ventilator use only Pediatric ventilator use was significantly lower.

<table>
<thead>
<tr>
<th>Table 3- Summary Cohort Data, Associations by Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>Percentage of Advanced Airways with Mechanical Ventilation per Institution Mean (SD)</td>
</tr>
<tr>
<td>Median</td>
</tr>
<tr>
<td>Min - Max</td>
</tr>
<tr>
<td>Correlation (Rs) of Percentage of Mechanically Ventilated Advanced Airways with¹</td>
</tr>
<tr>
<td>Transport Volume</td>
</tr>
<tr>
<td>CPR Percentage</td>
</tr>
<tr>
<td>Intubation Success Rate</td>
</tr>
<tr>
<td>Waveform Capnography Use</td>
</tr>
<tr>
<td>Mean Mobilization Time</td>
</tr>
<tr>
<td>Spearmans rs rank correlation was tested for equality to zero.</td>
</tr>
</tbody>
</table>

Conclusions:
Amongst GAMUT quality improvement collaborative participants, pediatric programs transported patients with advanced airways less commonly and used MV in those advanced airway patients less frequently. Neonatal programs more commonly transported patients with advanced airways. Associations with other GAMUT quality metric performance provide foundation for further investigation. This analysis provides clarity regarding the use of MV in transport and permits targeted interventions for improved performance and ultimately best practice in this important quality measure.

References:
BACKGROUND

• The use of rotor and fixed-wing resources to facilitate interfacility transfer has been associated with improved mortality [1-2].

• Sometimes the closest aircraft or most optimal resource for transport is unavailable resulting in a delay to patients transporting [3].

• Critically ill patients may deteriorate as a result of this delay.

• The Rapid Emergency Medicine Score (REMS) is a clinical index that can predict mortality and clinical status in the prehospital setting [4].

OBJECTIVE

• Primary: To identify risk factors associated with non-optimal resource utilization for adult patients undergoing emergent interfacility transport by air ambulance in Ontario.

• Secondary: To determine if non-optimal resource utilization is associated with deterioration in clinical status by measuring a delta REMS.

METHODS

Study Design

Study Participants

• All emergent, adult (age >18 years) interfacility transfers between January 1, 2013 to December 31, 2017 (Figure 1).

• Exclusion criteria: age <18 years, urgent or non-urgent priority, missing age or vital signs, resource was mobile at the time of request or optional resource was land resource.

Data Sources

• Data included sending/receiving facility names, dispatch times, vital signs at time of request to transport, reason for transport, patient age, sex, vital signs and paramedic interventions.

Primary Objective: Risk Factors for Non-optimal Resource Utilization

• Defining optimal resource utilization is outlined in Figure 2.

• Patient, institutional and paramedic characteristics were examined to assess risk factors for non-optimal resource use.

• Generalized estimating equation logistic regression model accounting for clustering by sending facility was performed.

Secondary Objective: Effect of Non-optimal Resource Utilization on REMS

• Generalized linear model, adjusting for other variables of interest and accounting for clustering by sending facility.

RESULTS

Figure 1: Study flow diagram

Figure 2: Algorithm for defining optimal resource utilization

Table 1: Baseline characteristics of study cohort

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total cohort (n = 9687)</th>
<th>Optimal transfer strategy (n = 4984)</th>
<th>Non-optimal transfer strategy (n = 4703)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>9,687</td>
<td>4,984</td>
<td>4,703</td>
<td></td>
</tr>
<tr>
<td>Male (%)</td>
<td>53.97%</td>
<td>54.95%</td>
<td>53.05%</td>
<td></td>
</tr>
<tr>
<td>Female (%)</td>
<td>46.03%</td>
<td>45.05%</td>
<td>47.05%</td>
<td></td>
</tr>
<tr>
<td>Median age</td>
<td>56 (IQR: 36.5-74.5)</td>
<td>56 (IQR: 36.5-74.5)</td>
<td>56 (IQR: 36.5-74.5)</td>
<td></td>
</tr>
<tr>
<td>Age &lt;50 (%)</td>
<td>41.37%</td>
<td>42.13%</td>
<td>40.53%</td>
<td></td>
</tr>
<tr>
<td>Age ≥50 (%)</td>
<td>58.63%</td>
<td>57.87%</td>
<td>59.47%</td>
<td></td>
</tr>
<tr>
<td>GCS &lt;8 (%)</td>
<td>7.32%</td>
<td>4.69%</td>
<td>11.62%</td>
<td></td>
</tr>
<tr>
<td>GCS ≥8 (%)</td>
<td>92.68%</td>
<td>95.31%</td>
<td>88.38%</td>
<td></td>
</tr>
<tr>
<td>Median ABG</td>
<td>104 (IQR: 93-114)</td>
<td>104 (IQR: 93-114)</td>
<td>104 (IQR: 93-114)</td>
<td></td>
</tr>
<tr>
<td>ABG &lt;70 (%)</td>
<td>9.52%</td>
<td>6.12%</td>
<td>13.40%</td>
<td></td>
</tr>
<tr>
<td>ABG ≥70 (%)</td>
<td>90.48%</td>
<td>93.88%</td>
<td>86.60%</td>
<td></td>
</tr>
<tr>
<td>Median oxygen</td>
<td>96 (IQR: 89-100)</td>
<td>97 (IQR: 92-100)</td>
<td>95 (IQR: 89-100)</td>
<td></td>
</tr>
<tr>
<td>Oxygen &lt;90 (%)</td>
<td>9.76%</td>
<td>3.91%</td>
<td>13.15%</td>
<td></td>
</tr>
<tr>
<td>Oxygen ≥90 (%)</td>
<td>90.24%</td>
<td>96.09%</td>
<td>86.85%</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Generalized estimating equation logistic regression model of odds of having non-optimal resource accounting for clustering by sending facility

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Odds Ratio (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1.01 (0.99, 1.03)</td>
<td>0.30</td>
</tr>
<tr>
<td>Female</td>
<td>0.99 (0.97, 1.02)</td>
<td>0.83</td>
</tr>
<tr>
<td>Median age</td>
<td>0.99 (0.98, 1.00)</td>
<td>0.17</td>
</tr>
<tr>
<td>Age &lt;50</td>
<td>1.00 (0.98, 1.02)</td>
<td>0.73</td>
</tr>
<tr>
<td>Age ≥50</td>
<td>0.99 (0.97, 1.02)</td>
<td>0.63</td>
</tr>
<tr>
<td>Median GCS</td>
<td>1.00 (0.99, 1.01)</td>
<td>0.46</td>
</tr>
<tr>
<td>GCS &lt;8</td>
<td>0.62 (0.42, 0.90)</td>
<td>0.03</td>
</tr>
<tr>
<td>GCS ≥8</td>
<td>1.60 (1.00, 2.58)</td>
<td>0.05</td>
</tr>
<tr>
<td>Median ABG</td>
<td>1.00 (0.99, 1.02)</td>
<td>0.31</td>
</tr>
<tr>
<td>ABG &lt;70</td>
<td>0.53 (0.34, 0.86)</td>
<td>0.008</td>
</tr>
<tr>
<td>ABG ≥70</td>
<td>1.00 (0.78, 1.27)</td>
<td>0.96</td>
</tr>
<tr>
<td>Median oxygen</td>
<td>1.00 (0.99, 1.01)</td>
<td>0.28</td>
</tr>
<tr>
<td>Oxygen &lt;90</td>
<td>0.59 (0.42, 0.83)</td>
<td>0.005</td>
</tr>
<tr>
<td>Oxygen ≥90</td>
<td>1.00 (0.78, 1.27)</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Table 3: Adjusted generalized linear model of variables of interest on delta REMS score

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Adjusted Mean (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>Female</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>Median age</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>Age &lt;50</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>Age ≥50</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>Median GCS</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>GCS &lt;8</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>GCS ≥8</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>Median ABG</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>ABG &lt;70</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>ABG ≥70</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>Median oxygen</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>Oxygen &lt;90</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
<tr>
<td>Oxygen ≥90</td>
<td>0.00 (0.00, 0.00)</td>
<td>0.34</td>
</tr>
</tbody>
</table>

DISCUSSION

• Patients being required mechanical ventilation or being transferred out of a nursing station had higher odds of non-optimal patient transfer.

• Nursing station transfers are both remote and have long transport distances which may explain this finding.

• Mechanically ventilated patients need higher level of care and take longer to transport, causing strain on optimal resource availability.

• Patients requiring higher level of care have lower odds of non-optimal resource use, suggesting importance of agreements with contracted air medical providers for primary care transports in our system.

• Non-optimal resource utilization did not result in clinical deterioration as measured by delta REMS.

• This may be a result of how clinically “well” the study population was and median time delay of 35 minutes is unlikely to affect stable patients.

LIMITATIONS

• Large amount of missing data.

• In-hospital outcomes unavailable.

• C-statistic 0.62, likely other important variables not measured.

CONCLUSION

• Patients mechanically ventilated and being transferred out from a nursing station had higher odds of non-optimal resource utilization while patients requiring advanced or critical care level of care and spring season had lower odds of non-optimal resource use.

REFERENCES


CONTACT INFORMATION

Brodie Nolan brodie.nolan@mail.utoronto.ca
Achieving Health System Wide 90 Minute Door-to-balloon Times for STEMI Transfers

Abigail S. Brown, Elizabeth Smith, Chetan P. Huded, Kathleen Kravitz, Umesh N. Khot, Fredric M. Hustey, Damon M. Kralovic, Andrew P. Reimer

Critical Care Transport, Emergency Services Institute, Heart and Vascular Institute, Cleveland Clinic

Background

- Most patients experiencing STEMI present to facilities that lack interventional cardiology services
- The national D2B goal time for patients requiring interfacility transfer is 120 minutes or less.
- Our previous work achieved that goal by implementing a STEMI autolaunch process

Methods

- To further improve D2B times for transfer patients we took a systems level approach to develop a high reliability STEMI transfer system.
- This was a quality improvement project that entailed a collaboration between the Emergency Services Institute, Heart and Vascular Institute, Critical Care Transport, health system community hospitals and local emergency medical services throughout our region.
- Over 18 months, system changes were developed by the interdisciplinary team (Table 1), implemented, and evaluated with feedback provided to all involved on a monthly basis.

Quality Improvement Interventions

- ED physician activation of the Cath Lab – not required to consult Cardiology
- EMS pre notification of the EDs when transporting STEMI patients and Direct to Cath Lab
- Interventional Cardiology providers determining standard care paths, including medications, doses and other interventions to be done in the ED
- Creation of ED Acute Care Teams based on trauma care methodologies to provide the most efficient evaluation of EMS and “walk-in” STEMI patients
- Created a STEMI Safe Handoff Checklist to ensure that all components of care were completed prior to leaving the ED
- Collaboration with Critical Care Transport teams – autolaunch for STEMI patients, additional collaboration with local EMS providers to share critical information as soon as possible, and CCT crew consistently educating, demonstrating and following the checklist
- Critical Care transport also worked with local EMS, especially LifeNet, on shared early activation. This allows EMS to transmit directly to CCT putting the transport crews on standby even before the patient arrives in the ED.
- STEMI Rendezvous – regional set up specific transfer points and processes close to the helipads so that all caregivers, both transport and ED, are following standardized steps
- Dripless STEMI transfers

Conclusions

Our results show that improving and maintaining D2B times for patients needing interfacility transfer requires a systems level approach that must encompass the entire healthcare system from initial patient activation through to discharge. The interventions developed can be adapted and applied in other settings.
Conclusion/Relevance to Practice

Findings suggest younger nurses and nurses working in critical care areas have higher levels of compassion fatigue and burnout.

Improving recognition and awareness of compassion satisfaction, compassion fatigue, and burnout may help to increase retention and identify interventions aimed at decreasing burnout and compassion fatigue.

Different generation-specific strategies may be necessary to address the issues of compassion satisfaction, burnout, and secondary traumatic stress.

Discussion

- Previous studies suggested younger nurses have higher job expectations and are at risk for compassion fatigue.
- Findings from this study are in alignment with other studies in which younger nurses are at higher risk for burnout as opposed to older nurses. This is hypothesized to be due to developmental resilience as nurses mature.
- Consider compassion fatigue prevention and screening programs for high-risk areas.

Conclusion/Relevance to Practice

Findings suggest younger nurses and nurses working in critical care areas have higher levels of compassion fatigue and burnout.

Improving recognition and awareness of compassion satisfaction, compassion fatigue, and burnout may help to increase retention and identify interventions aimed at decreasing burnout and compassion fatigue.

Different generation-specific strategies may be necessary to address the issues of compassion satisfaction, burnout, and secondary traumatic stress.


Problem/Background

- Nurses caring for critically ill or dying children are frequently exposed to highly stressful and emotional situations.
- Over time and with repeated exposures, nurses can develop compassion fatigue and burnout.
- In addition to placing nurses at increased risk for significant emotional and physical health issues, compassion fatigue also contributes to nurse burnout, medical errors and low patient satisfaction.

Research Questions

The study aimed to answer two research questions:

- What is the prevalence of compassion fatigue, burnout, and compassion satisfaction among registered nurses at a large academic pediatric health care facility located in the Midwest?
- Is there an association between compassion fatigue, burnout, and compassion satisfaction and age, years of nursing experience, and nursing specialty?

Method & Study Design

- Design: Cross-sectional descriptive design
- Sampling: Convenience sampling used to recruit participants
- Setting: Large academic pediatric health care facility located in the Midwest
- Data Collection: Data were collected via computer using the Professional Quality of Life Scale (ProQOL), a 30-item instrument designed to assess professional quality of life for those in helping professions.
- The ProQOL is comprised of three subscales, each comprised of 10 items and measured using a 5-point Likert type scale.
- Reliability for each subscale is as follows: compassion fatigue a = .81, burnout a = .65, and compassion satisfaction a = .88.
- Data Analysis: Descriptive and frequency summaries were computed for all study variables. The effect of demographic factors on the study outcomes was studied using univariate analysis and multivariate analysis.

Results

A total of 503 RNs participated

Demographics

<table>
<thead>
<tr>
<th>Years of Experience as RN</th>
<th>n=502</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2 years</td>
<td>14%</td>
<td>71</td>
</tr>
<tr>
<td>3 to 5 years</td>
<td>22%</td>
<td>108</td>
</tr>
<tr>
<td>6 to 10 years</td>
<td>21%</td>
<td>107</td>
</tr>
<tr>
<td>11 to 20 years</td>
<td>22%</td>
<td>109</td>
</tr>
<tr>
<td>Greater than 21 years</td>
<td>21%</td>
<td>107</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary Work Area, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulatory</td>
</tr>
<tr>
<td>Perioperative</td>
</tr>
<tr>
<td>Medical/Surgical</td>
</tr>
<tr>
<td>Critical Care</td>
</tr>
<tr>
<td>Emergency</td>
</tr>
<tr>
<td>Home Care</td>
</tr>
<tr>
<td>Psychiatry</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

Findings

- Overall low to average levels of compassion fatigue and burnout and generally average to high levels of compassion satisfaction
- Nurses aged 20-29 had statistically significant higher burnout (p=0.04) and compassion fatigue scores (p=0.01) and lower compassion satisfaction scores (p = 0.01) compared to nurses aged 40 years or older
- Nurses in Critical Care and Emergency had statistically significantly higher burnout scores than those in Ambulatory (p=0.0384, p=0.0081), Perioperative (p=0.0309, p=0.0062) and Medical/Surgical (p=0.0016, p=0.0002)
- Nurses in Emergency had significantly higher compassion fatigue scores than those in Ambulatory (p=0.0098), Perioperative (p=0.0110), and Medical/Surgical (p=0.0001)
- Preceptors had significantly higher burnout score than those who were not (p=0.019)
A Pediatric Neonatal Critical Care Transport Team's Standard of Care for Suspected Stroke of a Pediatric Patient

Lisa Pruitt BSN, RN-CNPT; Jennifer Flint, MD; Brian Olsen, MD; Sherry McCool MHA, RRT-NPS, CMTE

Background

The World Health Organization estimates 1-2/210,000 children will have a stroke. Mortality is up to 11% and neurological deficit will occur in 68-73%. Pediatric Acute Ischemic Strokes (AIS) differ from adult strokes in etiology, physiology and natural history. Additionally, imaging features of AIS may be missed, symptoms may be more subtle and risk factors are different. Transport to a pediatric stroke center with pediatric neurologists and pediatric radiologists where rapid identification and treatment is initiated, can be lifesaving and/or potentially improve neurologic outcomes.

Objectives

To provide the Children’s Mercy Critical Care Transport Team (CMCCT) training, job aides and standardization for the recognition and management of a pediatric patient with stroke symptoms requiring transport to a pediatric stroke center.

• Identify pediatric patients with symptoms concerning for stroke
• Initiate a “Stroke Alert” if the child has focal neurologic deficit and has potential to meet criteria for a “Stroke Activation”
• Aid in the triage process and stroke evaluation
• Provide rapid assessment, stabilization, and transport of children with stroke-like symptoms to pediatric stroke center
• Initiate neuroprotective measures designed to minimize secondary neurologic injury

Implementation

If a pediatric ischemic stroke is suspected by a referral and/or the transport team, our collaborative team of medical control physicians (MCP), transport personnel, referral physicians and emergency room physicians are all specially trained to activate our stroke protocol.

1. Pediatric Stroke Clinical Practice Guideline
2. Suspected Stroke Checklist
3. tPA Administration and Monitoring Guidelines

Data

<table>
<thead>
<tr>
<th></th>
<th>2016-current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number Stroke activations made at CMH</td>
<td>54</td>
</tr>
<tr>
<td>Total number stroke activations that utilized transport services</td>
<td>21</td>
</tr>
<tr>
<td>Total number ischemic process/stroke identified</td>
<td>10</td>
</tr>
<tr>
<td>Total number of patients transported for neuro IR</td>
<td>3</td>
</tr>
<tr>
<td>Total number patients transported with tPA</td>
<td>1</td>
</tr>
</tbody>
</table>

Results

Since implementation CMCCT has transported and treated 2 patients with basilar artery stroke. Both patients had successful clot retrieval and the transport team utilized the tPA Guidelines for one of the patients. Both patients had successful clot retrieval and full neurological recovery! 1 additional patient was transported for middle cerebral artery (MCA) clot retrieval and also had a positive outcome. The 7 other patients that had a confirmed ischemic process did not meet criteria for tPA or neuro interventional radiology (IR). Several other critical diagnosis was made during the stroke alert and/or stroke activation procedure including brain tumor, HSV encephalitis, brain abscess, Schwannoma and Moyamoya disease.

Conclusion

There has been an increase in rapid diagnosis, early recognition and treatment of pediatric patients with acute ischemic stroke and other stroke mimickers that required emergent intervention following implementation of our Stroke Alert Protocol, Clinical Practice Guideline, Suspected Stroke Checklist and tPA Administration and Monitoring Guidelines.

References

Fullerton et al. Neuro 2015; 85: 1459-1466
HEMS Guidelines Utilization
Lenz T. MD, Kossyreva E. MD, Colella R. DO
Medical College of Wisconsin
Flight For Life

OBJECTIVES
❖ To determine if requests for HEMS align with recently published utilization guidelines.

BACKGROUND
❖ Debates exist on the benefits of Helicopter EMS (HEMS), with safety, cost, and outcome implications often cited. The decision to utilize HEMS is a complex process that involves many considerations. Professional associations and agencies have published guidelines to assist providers with decision making for the utilization of helicopter transport.

METHODS
❖ Retrospective chart review
❖ Data collected June 2014 to December 2014
❖ Three flight bases included in data collection
❖ Inclusion criteria were adult and pediatric patients, including those not transported due to instability or death
❖ Exclusions included flights aborted or canceled due to other reasons, including, weather, maintenance, inadequate crew, and unavailable aircraft

RESULTS

❖ 514 charts reviewed. 369 adult and 70 pediatric patients included.
❖ CAMTS guidelines were satisfied 85.4%, NAEMSP guidelines 83.4%, and WI HEMS guidelines 53.1% of the time.
❖ Chi-Square analysis suggests statistically significant difference amongst the three guidelines.

DISCUSSION
❖ Slightly more than 50% of transports met WI HEMS guidelines.
❖ Statistically significant differences existed between WI HEMS and CAMTS, as well as WI HEMS and NAEMSP guidelines.
❖ No statistical difference exists between CAMTS and NAEMSP guidelines.
❖ The only category where no statistical difference exists between all three guidelines is STEMI.

CONCLUSION
❖ Statistical significance exists amongst CAMTS, NAESMP, and WI HEMS guidelines in all categories except time-sensitive STEMI.
Direct vs. Video Laryngoscopy in a Helicopter Emergency Medical Service (HEMS) Setting: A retrospective comparison

Olsen, J. MD, and Lenz, T. MD, EMT-P, FACEP
MCWAH and Flight For Life

Aims

Aim 1: Investigate if either Direct Laryngoscopy (DL) or Video Laryngoscopy (VL) has a higher first pass orotracheal intubation success rate when directly compared.

Aim 2: Investigate if either DL or VL has a higher overall success rate in obtaining successful intubations.

Aim 3: Determine if there is a difference in the number of complications with use of VL and DL.

Aim 4: Determine what factors influenced provider’s decision to attempt DL vs VL.

Exclusion Criteria

226 intubated/mechanically ventilated patients were transferred by HEMS providers

27 cases excluded due to patient <16 yrs

17 cases excluded due to intubation performed by non-HEMS provider

4 cases excluded due to incomplete data in chart (bladed used)

1 case excluded due to no intubation attempt (surgical airway was 1st attempt)

216 cases reviewed and analyzed

Methods

A retrospective chart review was performed of all intubated patients transported by HEMS providers from January 2015 to July 2017.

Inclusion Criteria

Adult patients transported by HEMS providers that required orotracheal intubation and underwent at least one attempt at orotracheal intubation.

Intro

In the prehospital setting, when caring for critically ill patients, the ability to quickly and effectively secure a definitive airway can be a matter of life or death. As such, all helicopter emergency medical service (HEMS) providers must be able to safely perform this procedure with speed and efficiency. Video laryngoscopy (VL) was introduced as an improved technique for performing orotracheal intubation, and its use has become widespread among pre-hospital and HEMS organizations. There is now data to suggest improved rates of successful intubation when utilizing video laryngoscopy. Still, there is significant variation in provider practice regarding which modality to use when attempting to secure the airway of a critically ill patient.

Provider preference often comes into play in this situation. In a preliminary survey, Nolen and Pokorney found that while the majority of HEMS providers choose VL, variation does exist between providers in regards to VL vs DL preference. Self-reported success rates by providers suggested 100% first pass success with DL and 87.5% for success with VL. This survey relied on provider recall, and further review of records is required to evaluate the accuracy of these reports.

Currently, there is no protocol regarding which laryngoscopy modality to employ in the HEMS setting. This research aims to improve the quality of care received by patients who require orotracheal intubation by HEMS providers. To do this, we investigate whether the use of VL or DL increases successful orotracheal intubations by HEMS providers.

We hypothesized that the first pass and overall success would be greater with VL, and the overall complications would be less with VL, when compared to DL.

Results

Success Rates (%)

<table>
<thead>
<tr>
<th></th>
<th>DL (n=15)</th>
<th>VL (n=210)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>90.5 (92.7)</td>
<td>94.8 (93.1)</td>
<td>0.382</td>
</tr>
<tr>
<td>1st pass</td>
<td>90.5</td>
<td>94.8</td>
<td>0.382</td>
</tr>
</tbody>
</table>

Trauma Type (%)

<table>
<thead>
<tr>
<th></th>
<th>DL (n=15)</th>
<th>VL (n=210)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVC/Polytrauma</td>
<td>33.3 (30.1)</td>
<td>42.7 (41.2)</td>
<td>0.282</td>
</tr>
<tr>
<td>MC/Pol</td>
<td>21.4 (20.0)</td>
<td>22 (20.0)</td>
<td>0.547</td>
</tr>
<tr>
<td>Facial trauma</td>
<td>14.3 (13.0)</td>
<td>12 (10.9)</td>
<td>0.500</td>
</tr>
<tr>
<td>GSW</td>
<td>9.5 (9.1)</td>
<td>13 (11.9)</td>
<td>0.226</td>
</tr>
<tr>
<td>Burn</td>
<td>9.5 (9.1)</td>
<td>2 (1.9)</td>
<td>0.110</td>
</tr>
<tr>
<td>Medical</td>
<td>0 (0)</td>
<td>8 (8.6)</td>
<td>0.187</td>
</tr>
</tbody>
</table>

Initial GCS

5.7 (5.8) vs 7.3 (7.1), p=0.051

Complications (%)

<table>
<thead>
<tr>
<th>Reasons for intubation</th>
<th>DL (n=15)</th>
<th>VL (n=210)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unresponsive</td>
<td>28.3 (28.3)</td>
<td>64.7 (64.7)</td>
<td>0.772</td>
</tr>
<tr>
<td>Airway Protection</td>
<td>13.3 (13.3)</td>
<td>36.7 (36.7)</td>
<td>0.479</td>
</tr>
<tr>
<td>Airway Compromise</td>
<td>9.5 (9.5)</td>
<td>7.8 (7.8)</td>
<td>0.600</td>
</tr>
<tr>
<td>Facilitate Transport</td>
<td>4.8 (4.8)</td>
<td>6 (6)</td>
<td>0.500</td>
</tr>
<tr>
<td>Respiratory Failure</td>
<td>19.5 (19.5)</td>
<td>4.7 (4.7)</td>
<td>0.003</td>
</tr>
<tr>
<td>Equipment Failure</td>
<td>0.0 (0)</td>
<td>0.7 (0.7)</td>
<td>0.500</td>
</tr>
</tbody>
</table>

Influencing Factors

No statistically significant difference was found between the two modalities. However, there was notably no difference between first pass and overall success rate in the DL group while the overall success improved over fast pass in the VL group. While not statistically significant, there was demonstrated a trend towards more attempts and alterations by those performing VL prior to resorting to a rescue airway. The most common modification made was change in VL blade size, followed by changing from VL to DL.

Discussion

When comparing the survey results to our chart review, we found similar rates of DL and VL attempts (15 reported and 21 on chart review vs 104 reported and 120 on review). First pass success rates were overall similar for both modalities (100% reported and 90.5% on review vs 87.5% reported and 84.8% on review).

First Pass Success Rate

No statistically significant difference was found in first pass success rate. The top reported reason for failed DL attempts was inability to pass tube while the top reported reason for failed VL attempts include blood/secretions on camera, followed by inability to pass tube.

Overall Success Rate

No statistically significant difference was found between the two modalities. However, there was notably no difference between first pass and overall success rate in the DL group while the overall success improved over fast pass in the VL group. While not statistically significant, there was observed a trend toward more attempts and alterations by those performing VL prior to resorting to a rescue airway. The most common modification made was change in VL blade size, followed by changing from VL to DL.

Complications

DV and VL groups had nearly identical complication rates. In both groups, the primary complication was hypoxia, so BVM ventilation was utilized. There was no cardiac arrest in the DL group.

Limitations

Study size was a major limitation of this retrospective chart review. Additionally, some limitation existed from the variability in documentation.

Conclusion

In the data reviewed, no significant differences were found in first pass or overall success rates for direct and video laryngoscopy. Additionally, no significant difference was observed in the complication rates and no factors were found that influenced the decision to perform DL vs VL.
Over the past decade, the health care industry has witnessed an unparalleled reporting of hospital-specific comparative outcomes. However, differences in patient selection (selection bias), case mix, data quality, geography, and other factors inherent to different injured populations likely contribute in part to observed differences in outcome. Risk-adjustment is a methodology used to ensure that "like" patients are being compared, so that differences in outcome can be attributed solely to differences in the processes and quality of care provided.

Transport services are beginning to use performance metrics to analyze for variations between ambulance and transport services in order to improve quality of care during transport. The "Ground Air Medical Quality Transport Quality Improvement" (GAMUT) Collaborative collects transport data and analyzes performance on transport-specific quality metrics and compares results to other programs. Arguably, the only transport-related definitive outcome that GAMUT reports is rate of cardiac arrest during transport (Rate of CPR performed during transport). However, this rate is reported as an unadjusted rate.

We propose a simple methodology to allow for risk-adjustment of CPR rate during transport.

**METHODS**

- Ornge provides Air Ambulance and Critical Care Transport Service to the province of Ontario, Canada.
- Ornge operates a fleet of Pilatus Next Generation PC-12 airplanes, Leonardo AW-139 helicopters, and Crestline Commander land ambulances, staffed with Critical Care and Advanced Care Paramedics.
- For low acuity patients, Standing Agreement (SA) charter carriers are used.
- For interfacility transfer patients, we propose to compare CPR rates year over year for Ornge (2013-2017). SA transports will not be included, as they represent a very low-risk group.
- Risk adjustment will be done by adjusting for mechanical ventilation (yes/no), use of infusion(s) of vasopressors (yes/no), mechanical ventilation and pressors (yes/no), or none.
- Rates will be standardized to the distribution of cases during the reference year of 2013-14, and reported per thousand hours.

**RESULTS**

<table>
<thead>
<tr>
<th>Category</th>
<th>FY13/14</th>
<th>FY14/15</th>
<th>FY15/16</th>
<th>FY16/17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilated only</td>
<td>3.83</td>
<td>3.71</td>
<td>2</td>
<td>0.54</td>
</tr>
<tr>
<td>Pressure only</td>
<td>0.29</td>
<td>0.33</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Ventilated and pressure</td>
<td>0.71</td>
<td>0.83</td>
<td>2</td>
<td>2.61</td>
</tr>
<tr>
<td>No pressors</td>
<td>11.87</td>
<td>8.45</td>
<td>3.12</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>15.89</td>
<td>14</td>
<td>7.86</td>
<td>7.4</td>
</tr>
</tbody>
</table>

*ORANGE, GCA and TPS Heart/CVCs.*

**DISCUSSION**

- Comparing variability in outcomes is helpful in improving quality of care.
- High performing centres can share their best practices to improve quality of care throughout the system.
- Risk adjustment is a methodology used to ensure that "apples" are being compared to "apples", and that case selection is not affecting the analysis.
- Transport agencies are now reporting CPR rates during transports as an outcome measure.
- Air ambulances transport many different types of patients, such that standard risk adjustment may not apply.
- Risk adjustment for trauma patients is completely different than for post STEMI patients.
- As well, transport agencies only care for patients for a short period of time.

We presented a methodology of risk-adjustment for CPR rates during interfacility transports:

- It has correlational validity with our changes in our quality processes over time.