Basic and Advanced EMS Providers Are Equally Effective in Naloxone Administration for Opioid Overdose in Northern New England

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**BASIC AND ADVANCED EMS PROVIDERS ARE EQUALLY EFFECTIVE IN NALOXONE ADMINISTRATION FOR OPIOID OVERDOSE IN NORTHERN NEW ENGLAND**

Nazey Gulec, Joseph Lahey, James C. Suozzi, DO, NRP, Matthew Sholl, MD, Charles D. MacLean, MD, Daniel L. Wolfson, MD

**Abstract**

**Objective:** Overdose mortality from illicit and prescription opioids has reached epidemic proportions in the United States, especially in rural areas. Naloxone is a safe and effective agent that has been shown to successfully reverse the effects of opioid overdose in the prehospital setting. The National EMS Scope of Practice Model currently only recommends advanced life support (ALS) providers to administer naloxone; however, some individual states have expanded this scope of practice to include intranasal (IN) administration of naloxone by basic life support (BLS) providers, including the Northern New England states. This study compares the effectiveness and appropriateness of naloxone administration between BLS and ALS providers. **Methods:** All Vermont, New Hampshire, and Maine EMS patient encounters between April 1, 2014 and December 31, 2016 where naloxone was administered were examined and 3,219 patients were identified. The proportion of successful reversals of opioid overdose, based on improvement in the Glasgow Coma Scale (GCS), respiratory rate (RR), and provider global assessment (GA) of response to medication was compared between BLS and ALS providers using a Chi-Squared statistic, Fisher’s exact or Wilcoxon rank-sum test. **Results:** There was no significant difference in the percent improvement in GCS between BLS and ALS (64% and 64% P = 0.94). There was no significant difference in the percentage of improvement in RR between BLS and ALS (45% and 48% P = 0.43). There was a significant difference in the percentage of improvement of GA between BLS and ALS (80% and 67% P < 0.001). There was no significant difference in determining appropriate cases to administer naloxone where RR < 12 and GCS < 15 between BLS and ALS (42% and 43% P = 0.94).

**Conclusions:** BLS providers were as effective as ALS providers in improving patient outcome measures after naloxone administration and in identifying patients for whom administration of naloxone is appropriate. These findings support expanding the National EMS Scope of Practice Model to include BLS administration of intranasal naloxone for suspected opioid overdoses. **Key words:** naloxone; opiate; overdose; BLS; ALS

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**Introduction**

Overdose mortality from illicit and prescription opioids has surpassed mortality from motor vehicle accidents, and is now the leading cause of accidental death in the United States (1). Rural communities have been especially burdened by this epidemic; mortality rose by 159% in rural communities compared with 54% in metropolitan areas between 1999 and 2004 (2).

Naloxone reduces mortality rates by rapidly reversing respiratory depression and altered consciousness caused by opioid overdose (1, 3–5). Naloxone is a generally safe and effective medication with often few side effects. It has been administered in the prehospital setting by paramedics, firefighters, police officers, prison personnel, and laypeople (2, 6–10). Furthermore, despite reports of refusal of care following naloxone administration in the field, mortality rates and adverse outcomes are extremely rare at pre-defined follow-up times (11, 12).

The rural epidemic of opioid misuse is especially problematic since many rural communities have a 3:1 ratio in availability of basic life support (BLS) providers, including Emergency Medical Responder (EMR) and Emergency Medical Technician (EMT) versus advanced life support (ALS) providers, including Advanced EMT (AEMT) and Paramedic (13). The National EMS Scope of Practice Model recommends allowing ALS providers, but not BLS providers to...
administer naloxone (14). However, some firefighters and police officers, as well as bystanders and/or laypersons are now authorized to administer naloxone as first responders (7). The National EMS Scope of Practice Model is a consensus-based document without any regulatory authority that seeks to improve consistency among States of EMS personnel licensure levels. While States are encouraged to follow the model as closely as possible, individual states may choose to expand the scope of practice of EMS providers to meet special needs (14). As of November 1, 2013, only 13 states allowed BLS providers to administer naloxone (13). By 2014, this number had increased to 37 states and has been increasing rapidly (15).

Respiratory rate (RR) and Glasgow Coma Scale (GCS) (16), and Emergency Medical Services (EMS) personnel’s subjective global assessment (GA) of response to medication administration are common parameters used to measure the effectiveness of naloxone. GCS has been shown to correlate with RR in patients with opioid intoxication (16). Studies have demonstrated that intranasal (IN) naloxone is as effective as intravenous (IV) naloxone in reversing the effects of opioid overdose (17) and has a similar bioavailability compared to the IV route (18). A study conducted with healthy volunteers found different results where the bioavailability of IN naloxone was poor compared to IV or intramuscular, but the authors suggest that these results could be due to naloxone being swallowed by the awake volunteers and thereby undergoing gastrointestinal metabolism, which is known to be low, rather than remaining in the oropharynx where it would be available for mucosal absorption and higher bioavailability (19). Other studies show that IN naloxone can be administered more rapidly when compared to the IV route when one considers how long it takes to establish IV access (1, 20). Robertson et al. demonstrated that although the time from dose administration to clinical response was longer for IN compared to IV naloxone administration, the overall time from patient contact to clinical response was the same between IN and IV. They conclude that IN naloxone appears to be a useful and safe alternative to IV given the challenges and risks associated with establishing IV access in opioid overdose patients (17). The IN route has the added benefit of reducing the risk of needlestick injuries from a patient population with a greater likelihood of Hepatitis B, C, and HIV (21). Furthermore, IV access may be more difficult in this population due to poor venous access from repeated self-injections (5, 17, 22–24). Merlin et al. demonstrated that IN naloxone was as effective as IV naloxone in improving clinical measures of RR and GCS in opioid overdose patients while minimizing the risk for needle stick injuries (16).

Rapid reversal of opioid induced respiratory depression is critical. According to one study, it takes 5.9 minutes on average for BLS teams vs. 11.6 minutes on average for ALS teams to arrive on the scene (25). Extending IN naloxone administration to the BLS scope of practice may have the added benefit of an earlier intervention (7, 25). While prior studies evaluating the effectiveness of IN versus IV naloxone have demonstrated that the IN route is just as effective as the IV route (5, 17, 20, 22, 23), to our knowledge there have not been any studies comparing the effectiveness and appropriateness of naloxone administration between BLS and ALS providers. The goal of this study was to present evidence-based data to support a change in the National EMS Scope of Practice Model to expand the scope of practice of BLS providers to include naloxone administration for suspected opioid overdose. We sought to demonstrate that BLS providers are as effective as ALS providers in reversing the effects of an opioid overdose using naloxone.

Methods

Study Design

We used a retrospective study design evaluating patients during a 33 month study period from April 1, 2014 to December 31, 2016 who received prehospital naloxone from licensed EMS providers after activation of the 9-1-1 system. Prehospital statewide EMS records, maintained by the Departments of EMS of Vermont, New Hampshire and Maine were used in this study. All the Northern New England states utilize the same electronic prehospital medical record system provided by ImageTrend (Lakeville, MN). Data from all three states were combined to produce a comprehensive Northern New England EMS database. The “medication administered” field in the combined database was searched to identify all 9-1-1 patient encounters in which a patient received naloxone. All unique incidents where naloxone was administered were included in the study. The data extract included patient characteristics (sex, age), the route and amount of medication administered, transport times, vital signs, GCS, provider GA of response to medication, and the times of each medication administration or patient assessment.

Population and Setting

The study examined the population of Northern New England: Vermont, New Hampshire, and Maine. Vermont has a population of 624,594, with a land area of 9,217 square miles and a rural population percentage of 61.1%. Maine has a population of 1,331,479 with a land area of 30,843 square miles and a rural population percentage of 61.34%. New Hampshire has a popula-
tion of 1,334,795 with a land area of 8,953 square miles and a rural population of 39.7% (26–28). Vermont EMS licenses 83 ground transport agencies, 91 first response agencies, and one air transport agency. EMS personnel include approximately 342 Paramedics, 782 AEMTs, 1,371 EMTs, and 255 EMRs for a total of 2,750 providers (29). Maine EMS licenses 157 ground transporting EMS agencies, 111 non-transporting first responder agencies and two air transport agencies. EMS personnel include 1,148 paramedics, 879 AEMTs, 2,555 EMTs, 107 EMRs, and 546 EMDs (Emergency Medical Technician-defibrillation) for a total of 5,235 providers (30). New Hampshire EMS licenses 168 ground transport agencies, 137 first responder agencies, and one air transport agency. EMS personnel include approximately 1,055 Paramedics, 1,269 AEMTs, 2,746 EMTs, and 201 EMRs for a total of 5,271 providers (31).

Human Subject Committee Review

A data use agreement was completed with the Vermont, New Hampshire, and Maine Departments of EMS for receipt of de-identified data according to rules outlined by the Health Insurance Portability and Accountability Act privacy rules and the project was approved by the University of Vermont Institutional Review Board.

Measurements

We assessed response to naloxone using three patient outcome measures: (1) Change in initial RR from less than 12 breaths per minute (BPM) to greater than or equal to 12 BPM; (2) Improvement of GCS from initial to final value; and (3) Response to medication as per the global assessment (GA) documented by the EMS provider as “improved” or “not improved” after naloxone administration. GA is the subjective assessment of the patient’s clinical response to medication. EMS providers are asked to select “improved” or “not improved” from a drop down menu that is recorded in the prehospital electronic medical record. These measures were consistent with those used in other published naloxone studies (11, 16, 32–35). Outcome measures were analyzed within the categories of BLS providers and ALS providers, where BLS providers can only administer IN naloxone and ALS providers can administer either IN or IV naloxone. BLS were identified as EMRs, EMDs, and EMTs. ALS providers were identified as AEMTs and Paramedics. The outcome measures were examined to determine whether a patient improved after naloxone administration. Our goal was to demonstrate that BLS providers are as effective as ALS providers in reversing the effects of an opioid overdose using naloxone. Our secondary goal was to compare the ability of BLS and ALS providers to correctly identify patients for whom naloxone administration was appropriate as defined by the patient having a RR < 12 and GCS < 15 at the time of initial presentation.

Analytical Methods

Outcome measures were compared between provider levels (BLS vs. ALS) using a Chi-Squared, Fisher’s exact or Wilcoxon rank-sum test. All analyses were conducted using STATA version 14.1, with statistical significance set at P < .05.

RESULTS

All 9-1-1 EMS encounters (n = 1,258,705) in Northern New England during the study period were examined and those where naloxone was administered were identified (n = 3,219). Of these, 155 cases did not have a provider level and were excluded from further analysis. Ultimately, 231 BLS cases and 2,833 ALS cases were included in the study (Figure 1). In the BLS group, 29% of patients were female vs. 38% of patients in the ALS group, P = 0.005. Mean age of patients in the BLS provider group was 36 vs. 40 in the ALS provider group, P < 0.001. There were no other significant differences between the groups at baseline (see Table 1).

The three most common primary impressions for all patients receiving naloxone included drug overdose (54%), altered level of consciousness (23%), and cardiac arrest (11%). The average dose of naloxone administered was 2.6 mg for BLS vs. 2.1 mg for ALS, P < 0.001. BLS and ALS providers administered similar numbers of repeat doses of naloxone. Patients treated by BLS required a second dose of naloxone 20% of the time and a third dose 8% of the time, while patients treated by ALS required a second dose of naloxone 24% of the time and a third dose 8% of the time (Fisher exact 0.052). See Table 2.

Table 1. Characteristics and baseline measurements prior to administration of naloxone by EMS in Northern New England during study period of April 1, 2014 to December 31, 2016

<table>
<thead>
<tr>
<th>Variable†</th>
<th>BLS</th>
<th>ALS</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>N = 231</td>
<td>N = 2,833</td>
<td></td>
</tr>
<tr>
<td>Sex, female n (%)</td>
<td>66 (29%)</td>
<td>1,069 (38%)</td>
<td>0.005</td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>36 (13.7)</td>
<td>40 (17.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Respirations N = 167</td>
<td>N = 2,658</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RR baseline, median(IQR)</td>
<td>10 (4–16)</td>
<td>10 (4–16)</td>
<td>0.93</td>
</tr>
<tr>
<td>Glasgow Coma Scale N = 150</td>
<td>N = 2,228</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe (GCS 3–8) n (%)</td>
<td>109 (73%)</td>
<td>1,504 (68%)</td>
<td>0.42</td>
</tr>
<tr>
<td>Moderate (GCS 9–12) n (%)</td>
<td>12 (8%)</td>
<td>211 (9%)</td>
<td></td>
</tr>
<tr>
<td>Mild (GCS 13–15) n (%)</td>
<td>29 (19%)</td>
<td>513 (23%)</td>
<td></td>
</tr>
</tbody>
</table>

BLS: Basic Life Support; ALS: Advanced Life Support; GCS: Glasgow Coma Scale; RR: Respiratory Rate.
†Number of eligible cases with available data varies for each parameter.
*Chi squared, t-test, Wilcoxon rank-sum test as appropriate.
There was no significant difference in the percent improvement in GCS between BLS and ALS (64% and 64% P = 0.94). There was no significant difference in the percent improvement in RR between BLS and ALS (45% and 48% P = 0.43). There was a significant difference in the percent improvement of GA between BLS and ALS (80% and 67% P < 0.001). Naloxone administration is appropriate in cases where the RR is less than 12 and the GCS is < 15. We found that 42% of cases treated by BLS providers and 43% of cases treated by ALS providers met this criterion with no significant difference between the provider groups (P = 0.94). See Table 2.

**DISCUSSION**

We found that BLS providers were as effective as ALS providers in improving patient outcome measures after naloxone administration when comparing improvements in RR and GCS. In addition, BLS compared to ALS providers had similar rates of appropriateness of naloxone administration, with both groups notable for significantly overtreating patients; less than half of the treated patients for either group met the criteria for appropriate treatment with naloxone (RR < 12 and GCS < 15). We suspect that given the relative safety profile of naloxone, EMS providers were erring on
the side of caution and administering naloxone to a significant number of patients who did not meet the strict criteria for therapy. The only significant difference between BLS and ALS providers in the successful administration of naloxone to reverse the effects of opioid overdose was observed in the provider GA of response to medication, where the BLS group did better. The GA is the most subjective of treatment measures so it may be associated with variability of assessments by different provider levels. ALS providers may exhibit better judgment with respect to what constitutes clinical improvement, or BLS providers may be more generous with their assessments. BLS providers only administer naloxone IN, while ALS providers may administer naloxone IN or IV. Time required to establish an IV suggests that IN naloxone may be quicker to administer (1, 16, 20). IN naloxone is administered at 2–4 mg and IV naloxone is often titrated from 0.4 to 2 mg (16). BLS patients could have had quicker responses to the medication based on dosing and time to administration; thereby, demonstrating a higher improvement percentage with respect to medication response. Finally, some patients with a documented improvement in GA may have not met criteria for naloxone administration due to opioid overdose, but rather due to some other disease process, and may have demonstrated improved clinical status simply due to the passage of time rather than the naloxone therapy.

Studies have shown that multiple naloxone administrations to treat suspected opioid overdose patients have been increasing. A study of an inner-city EMS system between 2006–2012 of patients treated with IN naloxone by BLS found that 8.8% of patients required a second dose of naloxone upon arrival to the emergency department (36). Another study showed that patients with suspected opioid overdose who received IN naloxone by BLS required a second dose administered by ALS 9% of the time and a third dose 2% of the time (37). Faul et al. demonstrated that patients aged 20–29 required multiple naloxone administrations 21.1% of the time and that for all patients the number of multiple naloxone administrations has been increasing over time, from 14.5% in 2012 to 18.2% in 2015 (38). Our study found a similar incidence of multiple naloxone administrations and that there was no significant difference between the need for multiple naloxone administrations between BLS and ALS providers.

Previous studies laid the groundwork for this research (2, 13, 25, 39, 40) and our study strengthens the argument that the National EMS Scope of Practice Model should expand the scope of practice of BLS providers to include intranasal administration of naloxone. Prior research has demonstrated that naloxone is effective in the field as a first line agent in opioid overdose reversal (6, 33). One study examining naloxone administration by EMS providers indicates rural communities have a disproportionate rate of opioid drug overdose cases, yet these same communities are often staffed by BLS personnel who may not be allowed to administer naloxone under current National EMS Scope of Practice guidelines. The study offers data to support expanding BLS scope of practice to include naloxone administration which may in turn save lives and reduce complications associated with opioid overdose, especially in rural areas (2). A national review of naloxone use by EMS concluded that naloxone administration should be included as a basic psychomotor skill for BLS providers (13). Recently, the American Heart Association recommended naloxone use as part of its BLS training in response to the opioid epidemic (41). Allowing BLS providers to administer naloxone could also aid in accessing patients in certain urban areas where mostly BLS providers are staffed such as college campuses (40). Our research strengthens these recommendations by directly comparing patient outcome measures after naloxone administration between BLS and ALS providers and providing evidence-based data to support the use of naloxone by BLS.

To our knowledge, while there have been other studies comparing IV vs. IN naloxone, and studies that support administration of naloxone by BLS providers to curtail the opioid epidemic (2, 13, 39, 40), this is the first study to conduct a direct comparison between BLS and ALS provider groups. Our study is strengthened by including data from all three Northern New England states, a large population area that allows us to generalize our results to similar regions of the country. The Northern New England EMS system does have a relatively high number of ALS providers, so our findings may be even more valuable to other parts of the country where there are a higher number of BLS providers (2, 13).

For this study, we chose parameters based on previous research in the field as there are still no nationally accepted parameters with respect to RR and GCS values that warrant naloxone administration (2, 11, 32-35). Our hypothesis was that BLS providers would be as effective as ALS providers in reversing the effects of an opioid overdose with the administration of naloxone, and in determining when naloxone administration was appropriate in the prehospital setting. Our results confirmed this hypothesis as no significant differences were observed between the two groups with respect to improvements in RR or GCS, or in determining whether administration of naloxone was appropriate.

Limitations

Our study was limited by its retrospective nature. A prospective study would have allowed us to obtain more data fields to better describe the patient response to medication or adverse outcomes. For our purposes,
we relied on the providers global assessment (GA) of response to medication which represents a limitation due to the subjective nature of this variable. However, the GA was documented in a standardized way as a choice on a drop-down menu from the electronic medical record and is a data field that is routinely completed by EMS. We did not have a data field available to document any adverse response to naloxone administration which would have been useful and should be included in future prospective studies. Our study included data from three different states, which on the one hand is a strength in diversity, but may also represent a limitation in that the EMS systems from each state likely have small differences that could affect results in ways not immediately apparent. For example, training programs for the use of naloxone by BLS providers may vary state to state. Finally, even though there are more BLS than ALS providers, most of our data for administration of naloxone were by ALS. The smaller sample size of the BLS providers is a limitation, although we were able to show that there was no significant difference between BLS and ALS in the measured variables.

**Conclusion**

We found that BLS providers were as effective as ALS providers in improving patient outcome measures with naloxone administration and in identifying patients for whom administration of naloxone is appropriate. Individual states and The National Highway Traffic Safety Administration should consider expanding the **National EMS Scope of Practice Model** to include BLS administration of IN naloxone for suspected opioid overdose cases.

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