Research Square

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Airway Management Strategies during Out-of-Hospital Cardiac Arrest in a South African Private Emergency Medical Service: A Retrospective Review

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Research Article

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Abstract

Background

Out-of-Hospital Cardiac Arrest (OHCA) remains a major cause of mortality globally, with survival dependent on early, high-quality resuscitation. While airway management is a critical component of care, no single strategy has demonstrated clear superiority in improving outcomes. In South Africa, limited data exist describing real-world airway practices in the prehospital setting. This study aimed to describe airway management practices used during OHCA by a private emergency medical service (EMS) in South Africa (SA).

Methods

A retrospective descriptive review was conducted using electronic patient report forms from a national private EMS between January 2022 and June 2025. Cases involving OHCA with at least one documented airway intervention were included. Airway strategies were categorised as basic airway manoeuvres, supraglottic airway (SGA) devices, and endotracheal intubation (ETI). Data was analysed using descriptive statistics, with frequencies and percentages reported for categorical variables and means for continuous variables.

Results

A total of 991 OHCA cases met the inclusion criteria. Supraglottic airway devices were the most frequently used intervention (44%), followed by endotracheal intubation (26%), and basic airway manoeuvres (22%). All ETI procedures were performed by Emergency Care Practitioners (ECPs), while SGAs were used exclusively by Paramedics (ANTs), demonstrating adherence to the scope of practice. Basic airway manoeuvres were performed across multiple prehospital provider levels. The mean dispatch-to-scene response times ranged between 12 and 14 minutes across all airway categories.

Conclusion

Airway management practices within this private South African EMS align with global trends, with a preference for simpler, faster, and less-interruptive airway techniques during OHCA. The findings highlight the importance of context-specific, competence-driven airway selection and provide valuable insight into prehospital resuscitation practices in a resource-limited setting. Further research incorporating patient outcomes is recommended to better understand the clinical impact of these strategies.

Background

Out-of-hospital cardiac arrest (OHCA) remains a major global health challenge and a leading cause of unexpected mortality. The annual incidence ranges from 55 to 113 per 100,000 population, and survival to hospital discharge is generally reported as less than 12% worldwide (1, 2). Survival depends on early recognition, prompt cardiopulmonary resuscitation (CPR), timely defibrillation, and uninterrupted high-quality chest compressions. Although these core interventions consistently improve outcomes, airway management remains an essential supportive component of resuscitation, aimed at maintaining oxygenation, preventing aspiration, and limiting the harmful effects of hypoxia (3, 4). Untreated hypoxia during cardiac arrest rapidly results in cellular injury and contributes to hypoxic-ischemic brain injury, arrhythmias, myocardial dysfunction, lactic acidosis, and multi-organ failure(3–6). Effective ventilation and oxygen delivery are, therefore, critical during resuscitation. However, unlike defibrillation and chest compressions, no single airway strategy has demonstrated clear superiority in improving survival in OHCA (7, 8). Consequently, airway management remains debated, particularly in the prehospital setting where procedural complexity, provider skill, and environmental constraints influence decision-making.

Prehospital airway options during OHCA include bag-valve-mask (BVM) ventilation, supraglottic airway (SGA) devices, and endotracheal intubation (ETI). These strategies differ in complexity, requiring training and associated risks. BVM ventilation is widely used as a first-line intervention due to its simplicity and immediate availability (3, 6, 9). It can be rapidly implemented without interrupting chest compressions and forms part of basic life support training. Evidence suggests that survival outcomes with BVM are not consistently inferior to advanced airway techniques, particularly in the early phases of resuscitation (8, 10). However, BVM is operator-dependent. Achieving an effective mask seal may be challenging, increasing the risk of gastric insufflation and aspiration (11). Prolonged manual ventilation may also result in provider fatigue and inconsistent tidal volumes, and BVM does not provide definitive airway protection (5, 12).

SGA devices have gained prominence because they can be inserted quickly with minimal interruption to chest compressions (5, 8, 13). Large multicentre trials such as AIRWAYS-2 and PART demonstrated high first-pass success rates and comparable survival outcomes to ETI (13–15). Second-generation SGAs incorporate improved sealing and gastric drainage mechanisms. Nevertheless, SGAs provide less definitive airway protection than ETI and may become displaced during patient movement or ongoing CPR (13, 16). ETI has traditionally been regarded as the definitive airway technique, offering secure airway protection, controlled ventilation, and the ability to suction contaminated airway (12, 17). A recent study by Nakai-Uchida *et al.* reported that endotracheal intubation resulted in improved outcomes in witnessed OHCA compared with supraglottic airways.(18) However, ETI requires advanced training, regular exposure, and favourable working conditions (10, 19). In the prehospital setting, which is often characterised by confined spaces, poor lighting, and ongoing chest compressions, successful intubation may be technically challenging (13, 17, 20, 21). Prolonged or failed attempts risk interrupting CPR and worsening hypoxia (13, 21). These considerations have influenced evolving guideline recommendations.

International resuscitation guidelines reflect the absence of clear superiority among airway strategies. The International Liaison Committee on Resuscitation (ILCOR) and its Consensus on Science with

Treatment Recommendations support the use of BVM, SGA, or ETI during OHCA, provided that advanced airway placement does not interrupt high-quality chest compressions (9, 22, 23). The European Resuscitation Council and the American Heart Association recommend that ETI be performed only by clinicians with demonstrated competence and high success rates (9, 23). Emerging evidence suggests that minimising interruption to CPR and ensuring procedural reliability may be more important than the specific airway selected (9, 22). In South Africa, airway management is guided by the Health Professions Council of South Africa (HPCSA) Clinical Practice Guidelines, the Emergency Medicine Society of South Africa (EMSSA), and the Resuscitation Council of South Africa (RCSA) (9, 22, 24). These frameworks define airway interventions within the scope of practice across different cadres of emergency care providers. Despite these established guidelines, published data are limited on how airway strategies are implemented during OHCA within South African prehospital systems (9, 22, 25).

In the South African context, this evidence gap is important, as the variability in practitioner training, procedural exposure, equipment availability, and operational context may influence real-world airway decision-making (13, 17, 20). Differences between EMS systems, including private and public services, may further shape practice patterns. Without local data, it remains unclear whether airway management during OHCA aligns with national and international recommendations. The study by Nokai-Uchida et al. is but one of the very recent studies demonstrating that ETI improves survival in OHCA and that substantial variability exists across EMS systems worldwide (8, 18, 26). This study, although recent and limited to witnessed OHCA, reported higher ROSC incidences in patients when ETI was used to secure the airway. In South Africa, despite comprehensive regulatory guidance, there is a paucity of data describing how airway interventions are applied in the field. Generating local evidence is essential to evaluate alignment with guidelines, identify practice patterns, and inform improvements in prehospital resuscitation care. The aim of this study was to describe the airway management strategies used during OHCA resuscitation by a private emergency medical service provider in South Africa between the 1st of January 2026, and the 30th of June 2026.

Methods

Aim

The aim of this study was to describe the airway management strategies used during Out-of-Hospital Cardiac Arrest in a South African private emergency medical service, with a focus on the intervention patterns, provider-level utilisation, and the alignment with evidence-based recommendations.

Study Design and Setting

This retrospective record review was conducted using electronic patient report forms (ePRFs) from a national private emergency medical service operating across South Africa. Data analysis was performed at the University of Johannesburg.

The study period was from the 1st of January 2022 to the 30th of June 2025. Records from 2020 and 2021 were excluded due to the substantial impact of the COVID-19 pandemic on airway management practices. Limiting the review to the post-pandemic period aimed to reflect stabilised, routine operational practices.

Study Population

The study population comprised all ePRFs recorded during the study period involving patients who experienced OHCA. A total population sampling strategy was applied. The sample included cases in which at least one airway intervention was performed during resuscitation. The study included documented OHCA cases attended during the study period, at least one recorded airway intervention during resuscitation, and complete and readable ePRF documentation. Exclusion criteria consisted of records outside the defined study period, cases not involving OHCA, incomplete or missing airway management data, and duplicate records. Airway interventions were categorised as bag-valve-mask (BVM) ventilation, supraglottic airway devices, and endotracheal intubation (ETI). Provider qualifications were categorised according to the South African prehospital emergency care

Data Collection and Analysis

Following approval from the University of Johannesburg and the private emergency medical service, a formal request for data extraction was submitted. A designated data officer within the private emergency medical service identified eligible cases in accordance with the predefined inclusion criteria. Only de-identified data was extracted. No patient names, identification numbers, or practitioners' identifiers were included in the dataset. The following variables were extracted: date of incident, time of dispatch, time of arrival on scene, type of airway intervention performed, time of airway intervention, and the practitioner's qualification. The dataset was compiled into Microsoft Excel and securely transferred via encrypted electronic methods. Access to the dataset was restricted to the researcher. Data was analysed descriptively. The analysis was structured to address the research question: "*What airway management strategies are currently being used during resuscitation in an out-of-hospital environment by a private emergency medical service in South Africa?"* Categorical variables, including airway device type and provider qualification, were summarised using frequencies and percentages. Continuous variables, including dispatch-to-scene time intervals, were summarised using means and standard deviations. Implausible extreme outliers exceeding 30 minutes for dispatch-to-scene intervals were excluded to improve data reliability and consistency.

Results

Figure 1 shows that 1180 OHCA electronic patient report forms were obtained during the study period. Of these, 991 (84%) records met the inclusion criteria and were included in the final analysis. A total of 189 records (16%) were excluded from the study due to being incomplete. Of these, 142 (12%) records

explicitly documented no airway intervention. An additional 47 (4%) records documented “no airway intervention” despite ventilation being recorded under breathing assessment. Due to this documentation inconsistency and uncertainty, these 47 (4%) cases were also excluded.

Frequency of Airway Strategies

Among the 991 cases, supraglottic airway devices were the most frequently recorded intervention, followed by endotracheal intubation and basic airway manoeuvres. Table 1 summarises these findings.

Table 1
Highest Airway Intervention Recorded (n=%)

Airway Strategy	n	%
Supraglottic Airway	431	43,5
Endotracheal Intubation	257	25,9
Basic Airway Manoeuvre	214	21,6
Airway Positioning	10	1,0
Other Advanced Airway	7	0,7

Practitioner Qualification Distribution

Practitioner qualification was analysed according to the highest airway intervention recorded. All endotracheal intubations (n = 257) were performed by Emergency Care Practitioners (ECPs) in accordance with South African scope-of-practice regulations. All supraglottic airway insertions (n = 431) were recorded under Advanced Life Support (ALS). Overall, advanced airway interventions were predominantly performed by ALS-level practitioners. The results are further summarised in Table 2.

Table 2
Practitioner Qualification by Highest Airway Intervention

Airway Strategy	BLS	ILS	ALS	ECP
Airway Positioning	0	2	8	-
Basic Airway Manoeuvre	19	79	116	-
Supraglottic Airway	0	0	431	-
Endotracheal Intubation	0	0	0	257
Other Advanced Airway	0	0	0	7

Scene and Response Times

Response time analysis was limited to cases with dispatch-to-scene intervals between 3 and 30 minutes. The lower threshold of 3 minutes was applied to exclude implausibly short intervals likely due to data-entry errors. The upper threshold of 30 minutes was applied to minimise the influence of extreme outliers. The mean response time ranges from roughly 12 to 14 minutes across all the airway categories.

Discussion

This retrospective review described airway management strategies used during OHCA by a private emergency medical service in South Africa between January 2022 and June 2025. Of the 1180 records identified, 991 met the inclusion criteria. The findings demonstrate that supraglottic airway (SGA) devices were the most frequently used advanced airway intervention, followed by endotracheal intubation (ETI) and basic airway manoeuvres. These results reflect an evolving pattern in prehospital airway management that aligns with contemporary international recommendations prioritising uninterrupted chest compressions, procedural efficiency, and provider competence over routine reliance on invasive airway techniques (1, 3, 5, 6, 23).

The Health Professions Council of South Africa (HPCSA) Clinical Practice Guidelines, under the Professional Board of Emergency Care (PBEC), define airway management responsibilities by qualification level (9). BLS providers are limited to non-invasive airway management and BVM ventilation; ILS practitioners may insert airway adjuncts, ALS may perform SGA insertion, and ECPs may perform ETI. The findings demonstrate clear adherence to their scope. No out-of-scope airway procedures were recorded. All ETI and other invasive procedures were performed exclusively by ECPs, while SGAs were limited to ALS-level providers. These results proved structured regulatory compliance and professional accountability within the EMS system studied. International evidence supports competence-based airway practice. Studies by Dyson *et al.* and Wang *et al.* demonstrate that intubation success is strongly associated with provider experience and procedural frequency (19, 20). These findings reinforce the importance of adherence to scope and procedural exposure in maintaining safe airway practice.

The Resuscitation Council of South Africa recommends a progressive airway approach during OHCA, beginning with basic airway techniques and escalating to advanced devices only when clinically indicated and when interruptions to chest compressions can be minimised (24). Similar principles are highlighted in the 2020 International Liaison Committee on Resuscitation Consensus on Science and Treatment Recommendations and the 2021 European Resuscitation Council Guidelines (5, 6, 23). These guidelines emphasise that high-quality cardiopulmonary resuscitation (CPR) and early defibrillation are more strongly associated with survival than the specific airway device selected (1, 3, 5). Meaney *et al.* and Kiguchi *et al.* demonstrated that chest compression quality is a critical determinant of survival outcomes in OHCA (1, 3). Although this dataset did not capture the stepwise progression of airway escalation, the distribution of interventions suggests alignment with this structured model. SGAs were the most frequently used advanced airway device, reflecting global trends toward minimally disruptive airway management strategies.

Historically, ETI was regarded as the definitive airway during cardiac arrest. However, evidence challenges the assumption that intubation improves survival compared with SGAs. The AIRWAYS-2 trial and the Pragmatic Airway Resuscitation Trial (PART) demonstrated no significant difference in functional survival between ETI and SGA use during OHCA (13, 20, 21). SGAs were associated with higher first-pass success rates and fewer interruptions to chest compressions (13, 20). These findings support the increased reliance on SGA observed in this study. The predominance of SGA over ETI in the present dataset likely reflects an intentional evidence-based shift rather than a deviation from best practice. In dynamic prehospital environments, SGA insertion may improve procedural efficiency, facilitate faster ventilation establishment, and reduce cognitive load. Notably, a substantial number of ALS providers performed basic airway manoeuvres without escalation to advanced devices. This may represent appropriate clinical judgement, particularly in early arrest scenarios where rapid BVM ventilation may be preferable to device preparation. Such practice aligns with recommendations that emphasise performing basic manoeuvres before escalating to invasive interventions (3, 24).

While alignment with international recommendations is evident, airway management patterns must also be interpreted within the South African EMS context. Variability in procedural exposure, training frequency, and resource availability may influence device selection. ILCOR recommends that airway choice should prioritise provider competence rather than device hierarchy (6, 23). In systems with low intubation rates, SGA may be a safer and more reliable option. However, decreased ETI frequency may contribute to skill erosion over time. Dyson *et al.* demonstrated that intubation success declines when procedural exposure is infrequent (19). This raises important system-level considerations regarding ongoing training, simulation exposure, and structured maintenance skills for ECPs. While SGA dominance aligns with contemporary evidence, ensuring continued ETI competence remains essential in cases where intubation is clinically indicated.

Response times were also analysed within a 3–30-minute subset to exclude any implausible and extreme outliers. The mean response times ranged between 12 and 14 minutes across airway categories. These intervals were consistent with urban and peri-urban EMS benchmarks described in the literature (27, 28). The similarity in response times across airway management groups suggests that device selection was not strongly influenced by dispatch-to-scene interval. Moderate standard deviation values indicated relatively stable operational performance. However, prolonged prehospital intervals have been associated with lower survival rates in prior research (1, 2). This study did not include outcome measures such as Return of Spontaneous Circulation (ROSC) or neurological recovery, limiting inference about the clinical impact of the interaction between response time and airway strategy.

Limitations

This study was based on a retrospective review of electronic patient report forms, which limits the control over data quality and completeness. The analysis depended on the accuracy and consistency of practitioners' documentation. A proportion of cases were excluded due to missing or inconsistent documentation relating to airway interventions. The study did not include clinical outcomes such as

return of spontaneous circulation or survival to hospital discharge. As a result, the effectiveness or clinical impact of the airway strategies used could not be assessed, limiting the ability to draw conclusions. Furthermore, the dataset captured only the highest level of airway intervention performed and did not reflect the sequence or progression of airway management. This limited insight into clinical decision-making and adherence to a step-by-step airway-escalation approach. Lastly, the study was conducted within a single private EMS system, which may limit generalisability to other settings, particularly the public sector.

Conclusion

This retrospective analysis explored airway management strategies used during OHCA within a private South African emergency medical service (EMS) from 2022 to 2025. The findings revealed that the overall airway intervention strategies during OHCA align with global trends reported in the literature. It further highlighted the growing use of safe, fast, basic airway manoeuvres and lower-technical-complexity SGAs during OHCA. Proving a potential shift in focus of the South African prehospital providers to minimise interruptions during chest compressions to improve OHCA outcomes.

Overall, this study highlights the dynamic balance between provider skill, operational context, and patient needs in determining airway management strategies during OHCA. The data suggest that private EMS providers in South Africa are pragmatically adopting evidence-based principles, favouring simplicity, speed, and competence over procedural hierarchy, while still operating within defined professional scopes and guidelines. Furthermore, this study demonstrated that the provider-specific intervention aligned with international guidelines and South African regulatory requirements. It is believed that this research provides valuable insight into a South African EMS provider's airway intervention strategy and its alignment with international best practice and makes a valuable contribution to the current body of evidence on airway intervention strategies in OHCA. Suggested further research, specifically examining the timing, type of airway intervention, and patient outcomes, compared with qualification level, may provide valuable insight into the appropriateness of more complex interventions in OHCA. A potential specific area to investigate further may be the number of trained crew members present during an OHCA. In the South African context, resource limitations are common. The number of crew members present may greatly affect the type and time of intervention, and the possible outcome of the OHCA.

Abbreviations

ALS
Advanced Life Support (Registered as a Paramedic with the HPCSA)
BLS
Basic Life Support
BVM
Bag-Valve-Mask
CPR

Cardio-Pulmonary Resuscitation
EMS
Emergency Medical Services
ECP
Emergency Care Practitioner
ETI
Endotracheal Intubation
OHCA
Out-of-Hospital Cardiac Arrest
ILCOR
International Liaison Committee on Resuscitation
ILS
Intermediate Life Support
ROSC
Return of Spontaneous Circulation
SGA
Supraglottic Airway

Declarations

Ethical Approval and Consent to Participate

Ethical approval was obtained from the University of Johannesburg Research Ethics Committee (REC-3722-2025). Institutional permission was granted by the participating private emergency medical service (NTC-01-2025; NTC-02-2025). All data was de-identified prior to release to ensure compliance with the Protection of Personal Information Act (POPIA) of South Africa. No identifiable patient or practitioner information was accessible to the researcher. Date confidentiality was maintained throughout the study. Access to the dataset was limited to the researcher.

Consent for publication

Consent was not required as this study reviewed cases retrospectively. However, the relevant gatekeepers were approached, and permission was granted before continuing.

Competing Interests

The authors declare that they have no competing interests.

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Author Contribution

All the authors contributed to the conception and design of the study and to the drafting of the manuscript. All the authors read and approved the final manuscript.

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Data Availability

Following approval from the University of Johannesburg and the private emergency medical service, a formal request for data extraction was submitted. A designated data officer within the private emergency medical service identified eligible cases in accordance with the predefined inclusion criteria. Only de-identified data was extracted. No patient names, identification numbers, or practitioners' identifiers were included in the dataset. The following variables were extracted: date of incident, time of dispatch, time of arrival on scene, type of airway intervention performed, time of airway intervention, and the practitioner's qualification. The dataset was compiled into Microsoft Excel and securely transferred via encrypted

electronic methods. Access to the dataset was restricted to the researcher. Data was analysed descriptively.

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Figures

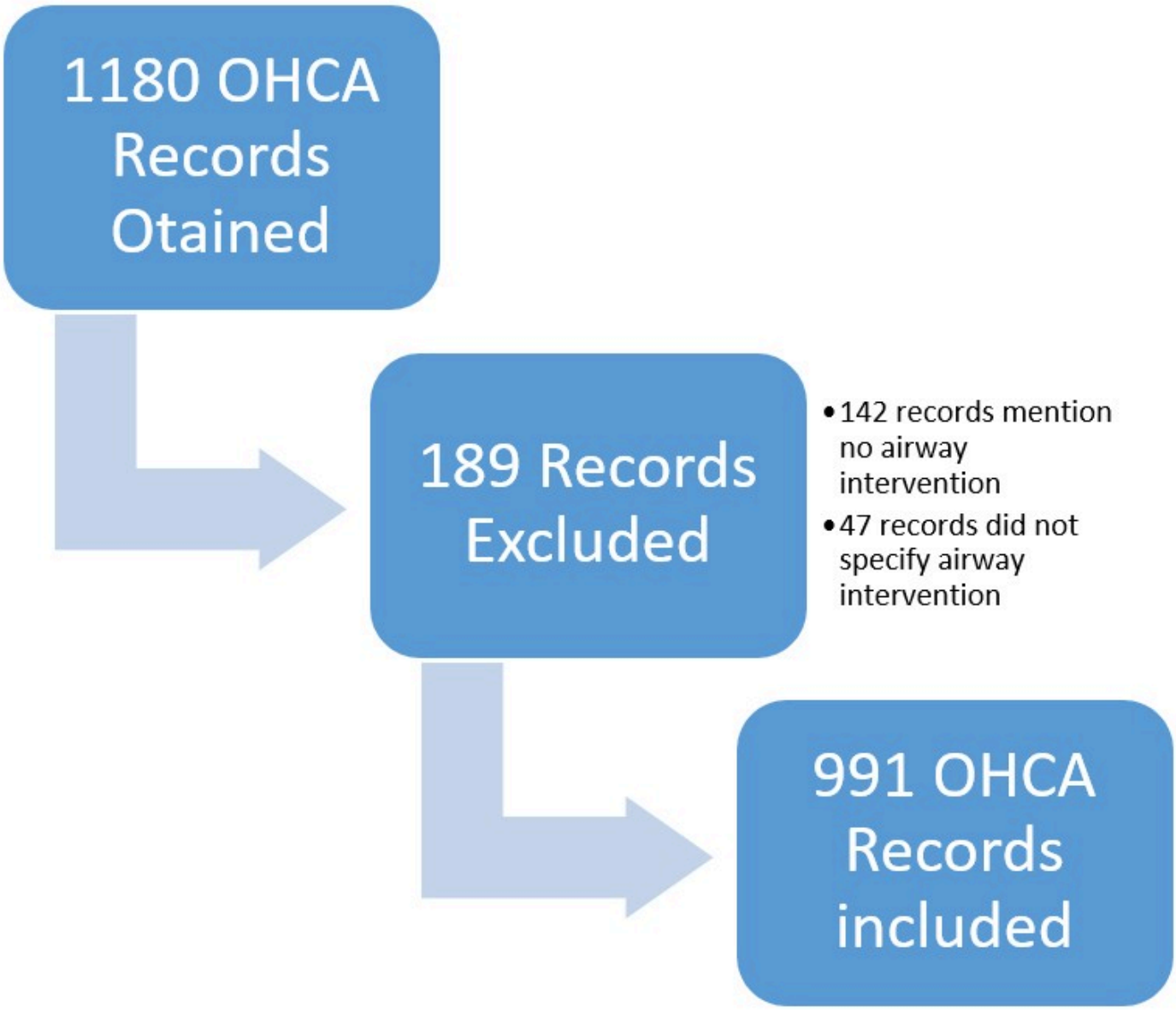


Figure 1

OHCA records obtained