

Evaluating call prioritisation discrepancies and Emergency Medical Services resource allocation in the North West province of South Africa

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ARTICLE INFO

Keywords:

Emergency medical services
Call prioritisation
Triage system
Emergency communication centre
Emergency medical dispatch

ABSTRACT

The overwhelming flow of non-emergent cases burdens Emergency Medical Services (EMS), reducing their capacity to respond to life-threatening emergencies and compromising care for patients with emergent clinical needs. This study evaluated the appropriateness of the EMS deployment in a district of the North West Province in South Africa.

Methods: A retrospective quantitative descriptive analysis was conducted on cases completed by the district EMS service between 1 and 12 January 2022. Patient report forms and control room assessment forms, containing demographic and clinical data, were analysed to assess the EMS deployment accuracy. Descriptive statistics were used to analyse the continuous and categorical variables, while Pearson's chi-square test and ANOVA tests examined associations between call prioritisation decisions, on-scene resource allocation, and the qualifications of call takers and dispatchers.

Results: Of the 535 records meeting the inclusion criteria, 71.1% revealed mismatches between call prioritisation and on-scene triage. The over-prioritisation rate was 90.9%, while the under-prioritisation rate was 17.1%. Additionally, 35.0% of patients were transported to a medical facility without receiving any medical interventions.

Conclusion: Significant disparities exist between call prioritisation and actual patient clinical needs, exacerbating the strain on an already resource-constrained EMS system. Standardised call prioritisation protocols and improved training for call takers and dispatchers are necessary to enhance EMS efficiency.

African relevance

- The healthcare systems in low- and middle-income countries face a significant shortage of resources, and this study offers an opportunity for data-driven insights on the efficiency of emergency medical dispatch in resource-constrained settings.
- There is a pressing need for more literature in Africa regarding various dispatch systems and their efficacy in improving resource management and patient care to support evidence-based practices.
- The study establishes the groundwork for further investigation into solutions by highlighting the gaps in resource management and call prioritisation accuracy.

Introduction

The South African healthcare system is pluralistic, with a well-

resourced private sector serving a minority and a heavily burdened public sector serving the majority. Due to the high cost of private medical insurance, approximately 82% of the population depends on publicly funded healthcare [1]. This disparity in funding creates serious inequalities in service delivery. The tax-funded public sector is plagued by significantly high demand for emergency medical services (EMS), leading to ongoing resource shortages, such as a lack of equipment, staff and infrastructure [2,3]. Despite these constraints, EMS is expected to play a critical role in providing timely out-of-hospital care to ill or injured patients [4].

The EMS response cycle begins when the public requests for medical assistance at the Emergency Communications Centre (ECC), where call takers assess the nature of the emergency, prioritise the call based on the severity of the patient's condition, and dispatch an appropriate ambulance. While the ECC's primary goal is to coordinate responses and allocate EMS units based on call priority, resource constraints, such as

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<https://doi.org/10.1016/j.afjem.2025.100913>

Received 19 April 2025; Received in revised form 25 August 2025; Accepted 1 October 2025

Available online 29 October 2025

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the absence of computer-aided dispatch, limit the effectiveness of call prioritisation and dispatch decision making [5,6].

The appropriateness of EMS deployment depends on several factors. These factors include accurate call prioritisation that aligns with on-scene findings, the allocation of appropriate resources that meet the actual clinical needs of the patient and adherence to national response time targets, which mandate a 15-minute response for priority one cases in urban areas, 40 min in rural areas and an hour for other triage codes [7]. Effective call prioritisation at the ECC is essential for ensuring that patients with critical conditions receive prompt care while those with non-emergent conditions either wait for availability of resources or are redirected to alternative care pathways. Properly aligning allocated resources with patient needs minimises both overutilisation and underutilisation of EMS services.

Studies indicate that a considerable number of EMS calls are for non-emergent cases, with estimates ranging from 11 to 52% [2,8–10]. These cases often lack an emergent clinical need for emergency care yet consume available resources, reducing EMS efficiency [11]. When an ambulance is dispatched to a scene, emergency care providers are frequently required to transport these patients to medical facilities, even when emergency interventions are not indicated [3]. Increasingly, EMS serves as a gateway to healthcare for non-emergent cases. However, the over-prioritisation of these cases without concurrent expansion of capacity risks compromising critical responses [2,3,12]. These non-emergent conditions lengthen response times to cases, weakening the overall efficiency of the EMS system [2,12]. To mitigate this issue, most resource-constrained EMS agencies have adopted a priority-based dispatch system designed to improve resource utilisation by prioritising calls based on clinical necessity [3].

The priority-based dispatch approach requires call takers to assess patient conditions through structured questioning, appropriately prioritising the call and allocating EMS resources accordingly [2,3]. This approach is often backed by detailed dispatch protocols to guide decision-making and improve call prioritisation accuracy [13]. The North West EMS lacks standardised guidelines as ECC personnel rely heavily on their medical knowledge and experience to make call prioritisation decisions, which may contribute to inconsistencies in dispatch accuracy [3].

North West EMS, like many EMS systems in low-middle-income countries, operates under significant resource constraints that impact service delivery. The region's EMS dispatch system does not follow a standardised and evidence-based approach, leading to inefficiencies in the allocation of emergency medical resources. Addressing the gaps in call prioritisation accuracy and EMS resource management is critical for

optimising patient outcomes and strengthening emergency healthcare systems across the continent.

This study aimed to evaluate discrepancies between call prioritisation and on-scene triage, assess the adequacy of EMS resource allocation, and describe response time performance in the North West EMS. By identifying inefficiencies and areas for improvement, this research seeks to contribute to the development of evidence-based strategies to enhance EMS operations in South Africa and similar contexts.

Methods

Study design and setting

This study used a quantitative design to assess the appropriateness of EMS deployments in the Dr Kenneth Kaunda district, located in the southern part of the North West province. The district borders Gauteng and the Free State provinces and had an estimated population of approximately 809 000 in 2019 [14] (Fig. 1). The EMS in the district comprise an ECC and four EMS stations: Matlosana, Potchefstroom, Ventersdorp, and Wolmaransstad, which provide 24/7 services.

Sample size

The study focused on records of emergency calls received and managed by the Dr Kenneth Kaunda EMS, one of four districts in the province. Data collection spanned 12 consecutive days (1–12 January 2022), encompassing the festive season and weekend peak periods to ensure a representative mix of case types. The EMS operated continuously during this period, handling an average of 59 emergency calls a day.

All patient report forms and ECC records of primary calls managed by Dr Kenneth Kaunda district EMS between 1 – 12 January 2022 were included. The study excluded all incomplete patient records lacking the required information and ECC records without corresponding patient report forms and records of booked patients. The latter are typically transported by planned patient transport services and are not registered at the ECC.

Data collection procedures and analysis

Ethical approval for the study was granted by the Durban University of Technology Institutional Research Ethics Committee (IREC 248/22), and gatekeeper permission was obtained from the North West Department of Health. Following this, data collection arrangements were made

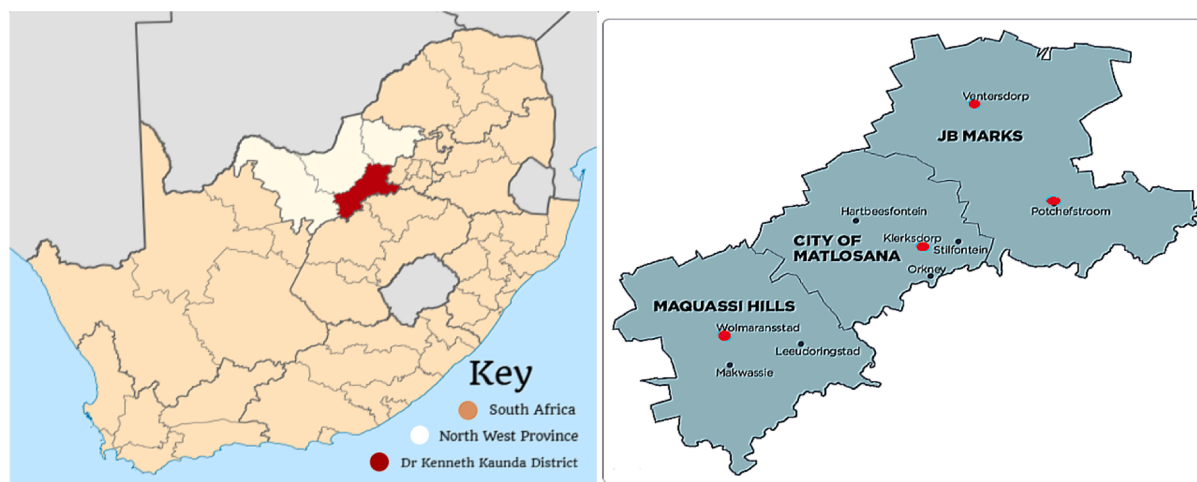


Fig. 1. A: Map of South Africa showing the location of North West province and the Dr Kenneth Kaunda District [15]. tB: Map of the Dr Kenneth Kaunda district showing the three municipalities, as well as the four towns (marked) where EMS stations are located [16].

with the EMS station and ECC managers. Patient report forms were retrieved from the EMS stations, and corresponding ECC records were collected from the ECC using matching call numbers. The first author captured the relevant data in an Excel spreadsheet, which was subsequently imported into the Statistical Package for the Social Sciences software version 29 for analysis.

Univariate analysis was conducted to describe single variables such as response time and age distribution using measures of central tendency (mean and median) and data dispersion (range). Standard deviation was used to measure frequency distributions. Pearson chi-square tests were utilised to analyse associations between two variables, specifically, call prioritisation and on-scene triage, and between dispatched resources and on-scene level of care. One-way analysis of variance (ANOVA) was conducted to examine the relationship between dispatcher qualifications and resource allocation, as well as between call-taker qualifications and decisions related to dispatch priority and on-scene triage. Statistical significance was set at $p < 0.05$.

EMS staff qualifications

The minimum qualification for ECC and operational staff includes Basic Life Support (BLS), a 4–5-week course covering the fundamental principles of basic emergency care. Intermediate Life Support (ILS), a 12-week qualification built on BLS skills, incorporating additional competencies such as establishing intravenous line access and administering several low-scheduled medicines. Advanced Life Support (ALS) represented the highest level of clinical expertise and included advanced airway management, advanced cardiovascular life support, and paediatric advanced life support [2]. ALS practitioners completed a 9–10 month course, a three-year qualification or a four-year professional degree in emergency care from accredited EMS training institutions. The South African EMS training has been restructured, with some of the short courses being phased out (Table 1).

Call prioritisation and triage systems

In the North West EMS, the ECC uses a subjective approach to call prioritisation. Call takers rely on their medical knowledge and experience to interrogate callers and assign perceived call urgency. However, on-scene triage is more objective, with emergency care providers using the South African Triage Scale and protocols to make triage decisions. In the province, a four-level triage system is primarily used to triage patients on-scene or conduct call prioritisation at ECC:

- Priority 1 (code red): life-threatening conditions requiring immediate intervention
- Priority 2 (code yellow): urgent but not immediately life-threatening conditions
- Priority 3 (code green): non-emergent and do not necessarily require urgent care
- Priority 4 (code blue): deceased patients

In this study, appropriate call prioritisation occurred when the dispatch priority level matched the on-scene findings, and inappropriate

call prioritisation referred to mismatches between dispatch and on-scene priority classification [4]. Inappropriate call prioritisation can manifest in two forms: over-prioritisation, where a patient is given a higher dispatch priority level than warranted, and under-prioritisation, where the patient requiring urgent care is assigned an inappropriately low dispatch priority level [2].

Ethical considerations

Ethical approval for conducting the study was obtained from the Durban University of Technology Institutional Research Ethics Committee (ethical clearance number: IREC 248/22), and the gatekeeper permission was obtained from the Northwest Department of Health. After obtaining gatekeeper approval, arrangements were made with the EMS station and ECC managers to facilitate data collection. All data were securely stored and anonymised to protect patient confidentiality and maintain ethical research standards.

Results

Of the 708 total calls received, 535 met the inclusion criteria (Fig. 2). The average response time across all priority levels was 1h26 min $\pm$ 2h30. The average response time was 1h22 $\pm$ 2h55 for priority 1 cases, 1h17 $\pm$ 2h44 for priority 2 cases, and priority 3 cases had the longest response times (2h02 $\pm$ 3h38).

The most frequent emergency calls received at the ECC were related to medical incidents ($n = 323$, 60%), followed by obstetrics ($n = 78$, 14%) and assault cases ($n = 65$, 12%). Most emergencies ($n = 300$, 56%) were dispatched as priority 1, with a higher proportion of maternity ($n = 5$, 100%), obstetrics ($n = 74$, 95%) and motor vehicle accidents (MVA) ($n = 27$, 96%) assigned this priority level at the ECC (Table 2).

On-scene triage differed significantly from call prioritisation ($p < 0.001$), with most cases classified as priority 2/yellow code (231 cases, 53%) and fewer as priority 1/red code (29 cases, 6.7%). Overall, 71.1% of cases were inappropriately prioritised. Specifically, 91% of priority 1 dispatch calls were over-prioritised, and the under-prioritisation rate for priority 2 and 3 dispatch calls was 17% ($n = 26$) (Table 3).

While there was no significant association between dispatched resources and on-scene triage ($p = 0.075$) or between dispatched resources and on-scene interventions ($p = 0.231$), some trends were observed. Only 7% ($n = 29$) of cases were triaged as priority one on-scene, with ILS teams responding to a higher proportion of these ($n = 17$, 4%) compared to ALS teams ($n = 4$, 1%). Most ALS responses ($n = 45$, 10%) were for patients assigned priority two on-scene (Table 4). The deployment of an ILS team matched the actual clinical needs of the patient in most cases ($n = 112$, 22%), followed by ALS team deployment ($n = 11$, 2%). Of the 514 dispatched cases, 16% (80) required no interventions, and 35% (180) only needed transport to a health facility (Table 5).

There was no statistically significant correlation between the dispatcher's qualifications and their ability to appropriately dispatch EMS resources ($p = 0.413$) or between the call taker's level of qualification and their ability to accurately conduct call prioritisation ($p = 0.740$).

Table 1
South African emergency care providers' qualifications [17].

Qualification	Duration	Date for last offering	Level of care
Basic Ambulance Assistant	4–5 weeks	January 2018	BLS
Ambulance Emergency Assistant	12–14 weeks	January 2020	ILS
Critical Care Assistant	9–10 months	January 2018	ALS
Emergency Care Technician	2 years	Last offering 2019	ALS
National Diploma Emergency Medical Care	3 years	January 2018	ALS
Bachelor of Technology Emergency Medical Care	1 or 2 years post NDip EMC	Last offering 2019	ALS
Bachelor of Emergency Medical Care	4 years	Nil	ALS

BLS: Basic Life Support; ILS: Intermediate Life Support; ALS: Advanced Life Support.

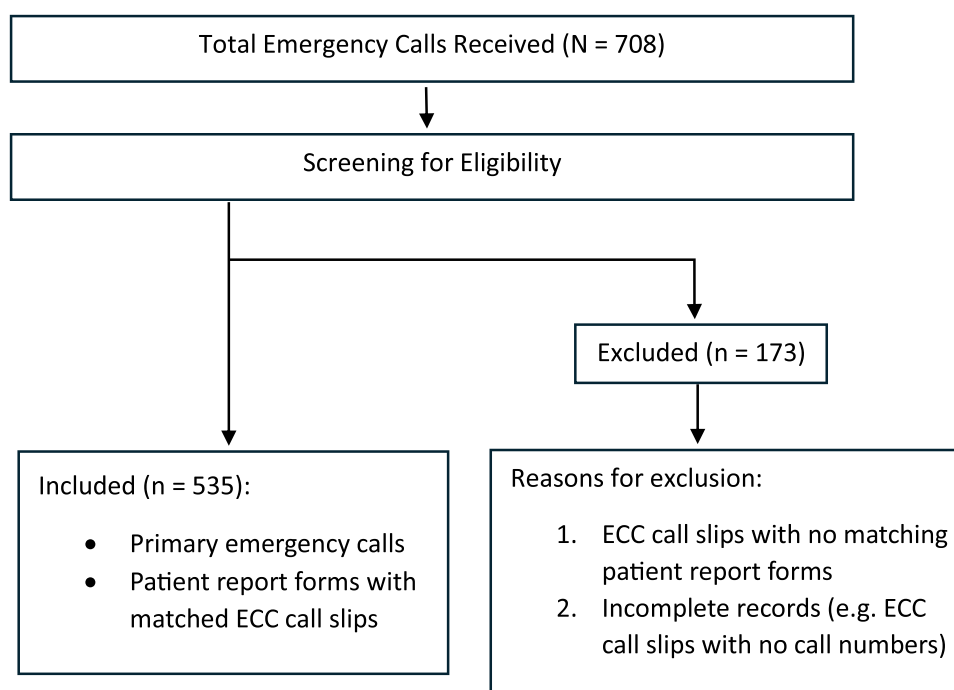


Fig. 2. Inclusion and exclusion criteria flowchart.

Table 2

Call prioritisation within incident categories.

		Call prioritisation, n (%)				Total, n (%)
		Priority 1/Red code	Priority 2/Yellow code	Priority 3/Green code	Priority 4/Blue code	
Incident category at ECC	Accident	16 (44)	16 (44)	4 (11)	0 (0)	36 (100)
	Assault	30 (46)	31 (48)	3 (5)	1 (2)	65 (100)
	Maternity	5 (100)	0 (0)	0 (0)	0 (0)	5 (100)
	Medical	148 (46)	94 (29)	50 (16)	31 (10)	323 (100)
	Motor vehicle accident	27 (96)	0 (0)	0 (0)	1 (4)	28 (100)
	Obstetric	74 (95)	4 (5)	0 (0)	0 (0)	78 (100)
Total		300 (56)	145 (27)	57 (11)	33 (6)	535 (100)

Table 3

Cross-tabulation of call prioritisation and on-scene triage codes.

		On-scene triage, n (%)				Total, n (%)
		Priority 1/Red code	Priority 2/Yellow code	Priority 3/Green code	Priority 4/Blue code	
Call prioritisation	Priority 1/Red code	23 (9)	156 (61)	62 (24)	13 (5)	254 (100)
	Priority 2/Yellow code	4 (4)	54 (49)	51 (46)	1 (1)	110 (100)
	Priority 3/Green code	2 (5)	20 (48)	20 (48)	0 (0)	42 (100)
	Priority 4/Blue code	0 (0)	1 (3)	0 (0)	29 (97)	30 (100)
Total		29 (7)	231 (53)	133 (31)	43 (10)	436 (100)

Discussion

The findings of this study provide valuable insight into the existing call prioritisation discrepancies and resource allocation inefficiencies within the EMS system in the North-West Province of South Africa. While previous literature has highlighted the importance of accurate call prioritisation and efficient prehospital resource use, few studies have evaluated actual discrepancies between ECC dispatch priorities and on-scene triage using primary data in a South African context. This study addresses this gap by directly comparing the ECC-assigned priorities with those assessed by the responding crew, alongside an evaluation of interventions provided and practitioner qualification levels.

The study revealed a substantial mismatch (71.1%) between call prioritisation and on-scene triage, where most cases were over-

prioritised. Specifically, 90.9% of calls dispatched as priority one were deemed clinically inappropriate upon on-scene assessment. Furthermore, one-third of all patients were transported without any interventions being performed, suggesting potential overutilisation of resources in cases that may not have required urgent transport.

There was no statistically significant association found between the clinical qualification level of the dispatcher and their ability to appropriately allocate resources. International studies show that in many cases, non-clinical dispatchers equipped with structured protocol systems (e.g., Medical Priority Dispatch System) tend to prioritise calls more appropriately than medically trained dispatchers. The advantage of structured protocols is that they are algorithmic and, therefore, much less reliant on subjective biases [28,29]. In North West EMS, where calls are prioritised based on perceived urgency rather than clinical criteria,

Table 4

Cross-tabulation of allocation of resources and on-scene triage.

		On-scene triage code, n (%)				Total, n (%)
		Priority 1/Red code	Priority 2/Yellow code	Priority 3/Green code	Priority 4/Blue code	
Dispatched resources	BLS	8 (2)	25 (6)	26 (6)	6 (1)	65 (15)
	ILS	17 (4)	161 (37)	90 (21)	32 (7)	300 (69)
	ALS	4 (1)	45 (10)	17 (4)	5 (1)	71 (16)
Total		29 (7)	231 (53)	133 (31)	43 (10)	436 (100)

BLS: Basic Life Support; ILS: Intermediate Life Support; ALS: Advanced Life Support.

the critical factor lies in implementing evidence-based dispatch protocols. The practical barriers to this implementation will warrant consideration of: [1] workforce variation which may lead to differing adherence to protocols based on level of qualifications BLS/ILS/ALS and experiences; [2] geographical variation in availability of resources, possibly undermining priority algorithms; and [3] resistance on the part of administrators who may not appreciate changing long-standing practices [2,18]. The implications of these issues suggest that protocol adjustments would need to be supported by community education, periodic and ongoing dispatcher training, and careful pilot testing to find an acceptable balance between efficiency and stability of the system.

The study suggests that call takers applied greater caution when triaging maternity, obstetrics and motor vehicle incidents, as these are associated with high morbidity and mortality rates, leading to a high over-prioritisation rate [19–23]. This finding was unsurprising given the government's commitment to reducing morbidity and mortality with maternity cases and MVAs [24–26]. Previous studies conducted in South Africa revealed a staggering over-prioritisation rate of 85% among obstetric cases and 96,6% among MVA cases [3,7]. While some maternity, obstetric and MVA cases may not require urgent care, this over-prioritisation may tie up the response teams and delay care for patients with emergent conditions [2].

Our findings mirror those in previous research, although our over-prioritisation (91%) rate was significantly higher than the 59% reported in a Cape Town study [7]. Current international studies highlight similar disparities. A Switzerland study found a 78% over-prioritisation rate of ambulance dispatches, which was attributed to cautious protocols for high-risk calls [27]. Similarly, a 2021 Australian study reported 85% over-prioritisation in trauma-related calls, with dispatchers preferring over-prioritisation due to liability concerns [28]. The extreme over-prioritisation in our study, particularly in priority 1 cases, underscores systemic inefficiencies. Over-prioritisation may have taken place due a number of interactive reasons, such as: [1] cognitive biases (e.g., dispatchers are afraid to miss an emergency and face litigations), [2] operational pressures (e.g., there exists some public or political expectation for EMS to immediately respond to all calls regardless of clinical priority), and [3] structural constraints (e.g., the dispatch process does not utilise decision support tools nor does it incorporate feedback loops to allow dispatchers to calibrate their judgement) [2,3,6]. This way, similar systems suggest protocol non-adherence is often due to systemic rather than individual-level constraints, such as the pressure to allocate a scarce ambulance before full assessment is possible [2,29]. These systematic limitations align with research, suggesting that resource-constrained EMS increasingly encourages large-scale or

defensive dispatching.

Several limitations must be acknowledged. The study's retrospective design depended on the completeness and accuracy of available ECC and patient care records. Cases with incomplete or missing records were excluded, which may have introduced selection bias. While the study was limited to a small sample size ($n = 535$), it aligns with similar EMS studies in low-middle-income countries [3] and provides sufficient power to detect call prioritisation discrepancies at $p < 0.05$. However, generalisability was limited to a shorter duration (12 consecutive days) and may not be representative of seasonal and long-term trends in call types and call prioritisation patterns. Furthermore, while the data reflects the resources used and the call prioritisation discrepancies, it does not capture the potential impact on patient outcomes, which would be a critical component of future evaluations.

These limitations notwithstanding, the results highlight several areas for future research. Further investigation is needed into the decision-making frameworks used by ECC staff, including potential cognitive biases or systemic pressures that lead to consistent over-prioritisation. There is also a need to explore the impact of standardised prioritisation protocols and structured training on dispatch accuracy. Qualitative studies examining EMS staff perspectives may reveal operational or policy-level barriers to effective resource utilisation. Importantly, studies correlating prioritisation accuracy and prehospital interventions with patient outcomes would offer a more comprehensive view of care effectiveness.

Conclusion

This study underscores significant gaps between call prioritisation and on-scene triage, with a mismatch rate of 71.1%, clearly demonstrating systemic inefficiencies. Our findings call for context-appropriate solutions: [1] pilot-testing a modified call prioritisation and dispatch algorithm that draws on validated low- and middle-income countries frameworks (e.g. South African call prioritisation scale and dispatch protocols), [2] rolling out decision-support tools for call-takers on a tiered model based on low bandwidth, and [3] running monthly ECC quality circles where dispatchers and their EMS teams review audio of mismatched priority patients. These actions meet the needs of resource limitations while promoting improved utilisation of the existing resources.

A long-term recommendation includes evaluating the effectiveness of the computer-aided dispatch system linked to dispatch protocols. This study makes three key contributions. First, it provides empirical evidence from low- and middle-income countries that dispatch accuracy is

Table 5

Cross-tabulation of resources dispatched and on-scene interventions.

		On-scene interventions provided/required, n (%)					Total, n (%)
		No interventions required	Transport only	BLS	ILS	ALS	
Dispatched resources	BLS	8 (2)	30 (6)	9 (2)	17 (3)	8 (2)	72 (14)
	ILS	58 (11)	127 (25)	29 (6)	112 (22)	30 (6)	356 (69)
	ALS	14 (3)	23 (5)	13 (3)	25 (5)	11 (2)	86 (17)
Total		80 (16)	180 (35)	51 (10)	154 (30)	49 (10)	514 (100)

BLS: Basic Life Support; ILS: Intermediate Life Support; ALS: Advanced Life Support.

more dependent on the dispatch system than on the prior training of the dispatcher. Second, the study illustrated that long response times persist despite high over-prioritisation, ultimately leading to findings of inefficiencies within a crisis-driven EMS system. Thirdly, it offered an insight on the existing ECC system of North West EMS, providing opportunities to improve quality even where there is little dedicated research capacity.

Dissemination of results

The results of this study were shared with relevant stakeholders in the North West EMS.

CReDiT Author contributions

BM: Conceptualisation, Methodology, Investigation, Formal analysis, Data curation, Writing – original draft, Writing – review & editing. **NC:** Writing – review & editing, Supervision. **SS:** Conceptualisation, Methodology, Writing – review & editing, Supervision. All the authors approved the final version of the manuscript for publication and take full responsibility for all aspects of the work.

Declaration of competing interest

The authors declared no further conflict of interests.

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