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## ORIGINAL RESEARCH ARTICLES

### Availability of resources for emergency care at a second-level hospital in Ghana: A mixed methods assessment



### *Disponibilité des ressources allouées aux soins d'urgence dans un hôpital de deuxième niveau au Ghana: évaluation de méthodes combinées*

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**Introduction:** Emergency care is an essential component of health systems, particularly in low- and middle-income countries. We sought to assess the availability of resources to provide emergency care at a second-level hospital in Ghana. By doing so, deficits that could guide development of targeted intervention strategies to improve emergency care could be identified.

**Methods:** A qualitative and quantitative assessment of capacity for care of emergency patients was performed at the Emergency Centre of the Police Hospital, a second-level hospital in Accra, Ghana. Direct inspection and job-specific survey of clinical, orderly, administrative and ambulance staff was performed. Responses to quantitative questions were described. Qualitative responses were examined by content analysis.

**Results:** Assessment revealed marked deficiencies in many essential items and services. However, several successes were identified, such as laboratory capacity. Among the unavailable essential items, some were of low-cost, such as basic airway supplies, chest tubes and several emergency medications. Themes from staff responses when asked how to improve emergency care included: provide periodic training, increase bed numbers in the emergency unit, ensure availability of essential items and make personal protective equipment available for all staff caring for patients.

**Conclusion:** This study identified opportunities to improve the care of patients with emergency conditions at the Police Hospital in Ghana. Low-cost improvements in training, organization and planning could improve item and service availability, such as: developing a continuing education curriculum for staff in all areas of the emergency centre; holding in-service training on existing protocols for triage and emergency care; adding checklists to guide appropriate triage and safe transfer of patients; and perform a root cause analysis of item non-availability to develop targeted interventions.

**Introduction:** Les soins d'urgence sont une composante essentielle des systèmes de santé, notamment dans les pays à faible et moyen revenus. Nous avons cherché à évaluer la disponibilité des ressources allouées aux soins d'urgence dans un hôpital de deuxième niveau au Ghana. Il serait ainsi possible d'identifier les lacunes et ainsi guider le développement de stratégies d'intervention ciblées afin d'améliorer les soins d'urgence.

**Méthodes:** Une évaluation qualitative et quantitative de la capacité de prise en charge des urgences a été réalisée au sein de l'Unité accidents et urgences de l'hôpital de la Police, un hôpital de second niveau situé à Accra, au Ghana. Un examen direct et propre à la profession a été réalisé à propos du personnel soignant, administratif et ambulancier. Les réponses aux questions quantitatives ont été décrites. Les réponses qualitatives ont été examinées par une analyse de leur contenu.

**Résultats:** L'évaluation a révélé des déficiences prononcées dans nombre d'articles et services essentiels. Cependant, plusieurs succès ont été enregistrés, tels que la capacité des laboratoires. Parmi le matériel essentiel faisant défaut, il s'agissait pour certains de matériel peu coûteux, comme les dispositifs d'alimentation des voies aériennes de base, les drains thoraciques et plusieurs traitements d'urgence. Les réponses fournies par le personnel à la question de savoir comment améliorer les soins d'urgence incluaient les thèmes suivants: l'accès à une formation périodique, l'augmentation du nombre de lits au sein des urgences, la garantie de la disponibilité du matériel essentiel, et la mise à disposition de tous les employés s'occupant des urgences d'un équipement de protection individuelle.

**Conclusion:** Cette étude a identifié des opportunités d'amélioration de la prise en charge des urgences au sein de l'hôpital de la Police au Ghana. Des améliorations peu coûteuses en termes de formation, d'organisation et de planification pourraient améliorer la disponibilité du matériel et du service, telles que l'élaboration d'un programme d'enseignement médical continu dans tous les domaines du centre des urgences, la tenue d'une formation interne sur les protocoles de triage et de soins d'urgence existants, l'ajout de listes de vérification afin de permettre un triage approprié et le bon transfert des patients, et la conduite d'une analyse des causes premières de la non-disponibilité de matériel afin d'élaborer des interventions ciblées.

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## African relevance

- Secondary-level hospitals play an integral role in hierarchical African healthcare systems.
- Staff responses highlighted need for in-service training.
- Personal protective equipment (PPE) should be available to anyone with patient or potentially-hazardous material contact.

## Introduction

Emergency care is an essential component to health systems and of growing importance given the increasing burden of medical, surgical and traumatic emergency conditions.<sup>1,2</sup> Inopportunely, this burden is highest in low- and middle-income countries (LMICs), which are least prepared to evaluate and treat emergency conditions due to deficiencies in organization and planning, trained personnel and physical resources.<sup>3–5</sup> In response, efforts have been made to develop capacity and quality improvement programs for emergency care in LMICs.<sup>6,7</sup>

Most emergency health system strengthening efforts have focused attention at the pre-hospital level and first- and tertiary-level hospitals.<sup>8–10</sup> In Ghana, this has been evidenced by the foundation of a National Ambulance Service, investment in district-level obstetric emergency care and creation of an emergency medicine residency training program at a teaching hospital.<sup>6,11,12</sup> Second-level hospitals are often overlooked during these important capacity building initiatives, yet are an important essential for emergency care in most LMIC healthcare systems.<sup>13</sup>

Second-level hospitals are in a challenging position in the healthcare hierarchy of LMICs. They receive patients referred from district-level hospitals, many of whom have had prolonged pre-hospital times, were under-resuscitated and arrive in urgent need of prompt diagnosis and treatment to avert preventable death and disability.<sup>13</sup> However, some advanced diagnostics and definitive care items are infrequently available at these facilities (e.g. computed tomography scan, neurosurgery), requiring safe transfer to higher levels of care.<sup>5</sup> Despite the integral role these hospitals occupy in LMIC emergency systems, emergency care capacity assessments at second-level facilities are underrepresented in the literature.<sup>14–18</sup>

To address this gap, we sought to assess the availability of resources to provide emergency care at a second-level hospital in Ghana. By doing so, the findings might identify deficits in the essential components of second-level hospitals that would allow development of targeted intervention strategies to improve emergency care.

## Methods

Ghana is a heavily indebted, lower-middle income country in West Africa with a population of 26 million people and an annual per capita income of US\$ 1760.<sup>19</sup> Ghana has 10 regions divided into 110 districts. Most districts have several primary health centres (PHC) and a government or mission hospital that serves as a district (first-level) hospital. PHCs provide only basic public health and primary care services. Subsequently, most emergency cases are referred to district-level hospitals. District-level hospitals are staffed by medical

officers and nurse anaesthetists, typically offer some surgical services and have between 50 and 100 beds. Emergencies requiring more complex care are referred to one of the regional or four teaching hospitals. In addition to medical officers and nurse anaesthetists, second-level (regional) hospitals are staffed by specialist providers (e.g. paediatricians, obstetricians, and general and orthopaedic surgeons) and contain between 100 and 400 beds. Emergency and surgical services offered at regional hospitals are broader in scope. However, sub-specialist care (e.g. cardiology, neurosurgery, critical care) is usually not present. Therefore, patients requiring advanced care are referred to a tertiary facility.

Among the second-level hospitals is the Police Hospital in Accra. Though initially developed to care for police service-members and their families, the crowded healthcare system has required the Police Hospital to care for any patient with medical, surgical and traumatic emergencies from the surrounding area. The hospital receives emergency cases from the eastern area of Accra, as the tertiary care centre is in western Accra and is difficult to reach when traffic is congested. The Police Hospital also receives referrals from district-level hospitals around the country.

To assess emergency care capacity, a survey instrument was developed to capture staff perceptions of and/or challenges with the availability of emergency care services and the resources (human and physical) needed to provide these services. Staff members working at the Emergency Centre of the Police Hospital were purposively sampled to represent all professions necessary for emergency care. Variations of the survey instrument were used for collecting job-specific data from different staff (e.g. ambulance drivers, orderlies, clinicians, and administrators) and some sections that were not applicable to a specific job were omitted.

The instruments assessed trauma care items considered essential by the Ghana Health Service (GHS) Emergency Supply Checklist or the World Health Organization's (WHO) *Guidelines for essential trauma care* or *Integrated management for emergency and essential surgical care (IMEESC) tool kit*.<sup>20–22</sup> Staff members based in the Emergency Centre were asked about the availability of each item. In addition, direct inspection was used to corroborate reported item availability. Item availability was rated as: 0 – Absent but should be present; 1 – Inadequate, available to less than half of those who need it; 2 – Partially adequate, available to more than half, but not to everyone who needs it; or 3 – Adequate, present and readily available to almost everyone in need and used when needed. Staff members were also asked about their opinions on ways to overcome deficiencies and to strengthen emergency care provided at the hospital.

Data were collected in 2014. Data were collected on paper forms and entered into Microsoft Excel (Redmond, WA, USA). Responses to quantitative questions were described using Stata v13 (College Station, TX, USA). The proportion of essential items available, as recommended by the GHS or WHO essential emergency equipment and supply list, were tabulated and plotted. Responses to qualitative questions on recommendations for strengthening care were examined using a content analysis framework.<sup>23</sup> First, qualitative responses were grouped into categories based on codes representing clustered responses. Next, categories were further refined into useful themes and described. Responses

were triangulated between staff of different professions and within the same profession to evaluate the extent of theme convergence.

The Kwame Nkrumah University of Science and Technology Committee for Human Research and Publication Ethics and the leadership of the Police Hospital approved this study. The study was considered exempt by the University of Washington Institutional Review Board. Survey procedures were explained to each participant, and participants provided informed consent prior to survey. All data were collected anonymously.

## Results

A total of 78 of the 80 (98%) approached emergency care personnel participated in the assessment. These included 44 clinical staff (56%; 24 nurses, 13 medical officers and 7 ambulance crew members) and 34 non-clinical staff (44%; 23 orderlies and 11 administrative staff).

Regarding physical resources for resuscitation, several items were consistently available with ratings of 3 (e.g. Magill forceps, stethoscope, blood pressure cuff, IV catheter and infusion set, urinary catheter). Some items were less available (i.e. rating 1 or 2), including basic airway adjuncts, oxygen supply, pulse oximetry and cervical collars. Most other items were not available, particularly medical technology (e.g. cardiac monitors, ventilators, defibrillator). Despite being a referral hospital for trauma and obstetric emergencies, blood transfusion capabilities were not present (Table 1).

No diagnostic imaging service was reliably available (i.e. ratings were less than 3). There was no portable X-ray, ultrasound machine or image intensification. Several essential laboratory items were intermittently available (i.e. rating 1 or 2), such as glucometry, haemoglobin determination, gram stain and urinalysis (Table 2).

Though equipment for several emergency care procedures was available intermittently (e.g. wound closure, surgical airway, lumbar puncture), none had ratings greater than 1. Other procedure trays were not available, including diagnostic peritoneal lavage. Notably, other than gloves, all essential personal protective equipment (PPE) items were not reliably available, including safe sharps and biological waste disposal, goggles or post-exposure prophylaxis for HIV (ratings 1 or 2) (Table 3).

Nearly 60% of essential medications were in stock with some availability; however, no medication was reliably available (i.e. no rating of 3). Several WHO groups of medications were not present; there were no anticonvulsants (other than diazepam), tocolytics, blood products, muscle relaxants or tetanus immunoglobulin. In addition, several drugs essential in managing adverse events related to iatrogenic overdose, namely naloxone and glucagon, were not available (Table 4). Fig. 1 demonstrates the relative deficiencies of each category of emergency care equipment and supplies. Notably, no component of the capacity assessment demonstrated adequate availability of essential items. Critical deficits included diagnostic imaging, airway and breathing items for resuscitation and emergency medications. Laboratory equipment and supplies were the most available; however, they did not reach 70% of expected availability based on WHO and GHS recommendations.

**Table 1** Essential items recommended by the World Health Organization or Ghana Health Service at the Emergency Centre in Ghana Police Hospital.

|                                     | WHO/GHS recommendation | Police Hospital |
|-------------------------------------|------------------------|-----------------|
| <b>Airway</b>                       |                        |                 |
| Nasal or oral airway                | E                      | 1               |
| Suction pump, tubing and tip        | E                      | 1               |
| LMA or Combitube                    | G                      | 0               |
| Laryngoscope                        | E                      | 0               |
| Endotracheal tube                   | E                      | 0               |
| Elastic gum bougie                  | G                      | 0               |
| Bag-valve-mask                      | E                      | 1               |
| Magill forceps                      | E                      | 3               |
| Nasogastric tube                    | E                      | 3               |
| Capnography                         | D                      | 0               |
| <b>Breathing</b>                    |                        |                 |
| Stethoscope                         | E                      | 3               |
| Oxygen supply                       | E                      | 1               |
| Nasal prongs, face mask             | E                      | 0               |
| Chest tube and underwater seal      | E                      | 0               |
| Nebulizer                           | G                      | 1               |
| Pulse oximetry                      | D                      | 1               |
| Peak flow meter                     | G                      | 0               |
| Transport ventilator                | G                      | 0               |
| Mechanical ventilator               | D                      | 0               |
| <b>Circulation</b>                  |                        |                 |
| Blood pressure cuff                 | E                      | 3               |
| Bandages                            | E                      | 3               |
| Arterial tourniquet                 | E                      | 3               |
| IV catheter and fluid set           | E                      | 3               |
| Blood transfusion capabilities      | E                      | 0               |
| Intraosseous needles                | E                      | 0               |
| Central venous catheter             | E                      | 0               |
| Urinary catheter                    | E                      | 3               |
| Electronic cardiac monitoring       | D                      | 0               |
| Defibrillator                       | G                      | 0               |
| Fluid warmer                        | D                      | 0               |
| <b>Disability</b>                   |                        |                 |
| Cervical collar                     | E                      | 2               |
| Spine board                         | E                      | 0               |
| Long-bone splints                   | E                      | 2               |
| Closed reduction                    | E                      | 1               |
| Plaster of Paris                    | E                      | 2               |
| Measurement of compartment pressure | E                      | 2               |

WHO/GHS – World Health Organization/Ghana Health Service; E – item considered essential for emergency care at second-level hospitals by the WHO; D – item considered desirable for second-level hospitals by the WHO; G – item considered essential for emergency care by GHS; rating scheme: 0 – absent; 1 – inadequate, available to less than half of those who need it; 2 – partially adequate, available to more than half, but not to most who need it; 3 – adequate, present and readily available to almost everyone in need and used when needed. LMA – laryngeal mask airway; IV – intravenous.

Across areas in the emergency unit, the majority of staff recommended training of new and current staff in triage and emergency care procedures (range 82–89%). Along these lines, only 7% of all respondents indicated that they had undergone regular job-specific training. Improvements or expansion in

**Table 2** Emergency diagnostic capacity at the Emergency Centre in Ghana Police Hospital.

|                                 | WHO/GHS recommendation | Police Hospital |
|---------------------------------|------------------------|-----------------|
| Diagnostic imaging              |                        |                 |
| X-ray                           | E                      | 1               |
| Portable X-ray                  | D                      | 0               |
| Ultrasound machine              | E                      | 0               |
| Image intensification           | E                      | 0               |
| Contrast radiography            | E                      | 0               |
| CT scan                         | D                      | 0               |
| Laboratory                      |                        |                 |
| Glucometer                      | G                      | 2               |
| Haemoglobin determination       | E                      | 2               |
| Blood electrolyte determination | D                      | 0               |
| Gram stain                      | E                      | 2               |
| Bacterial cultures              | D                      | 2               |
| Serum lactate                   | D                      | 2               |
| Urinalysis                      | G                      | 2               |

WHO/GHS – World Health Organization/Ghana Health Service; E – item considered essential for emergency care at second-level hospitals by the WHO; D – item considered desirable for second-level hospitals by the WHO; G – item considered essential for emergency care by GHS; rating scheme: 0 – absent; 1 – inadequate, available to less than half of those who need it; 2 – partially adequate, available to more than half, but not to most who need it; 3 – adequate, present and readily available to almost everyone in need and used when needed. CT – computed tomography.

**Table 3** Emergency procedure capacity and personal protective equipment availability at the Emergency Centre in Ghana Police Hospital.

|                                   | WHO/GHS recommendation | Police Hospital |
|-----------------------------------|------------------------|-----------------|
| Procedural equipment trays        |                        |                 |
| Wound closure                     | E                      | 1               |
| Surgical airway                   | E                      | 1               |
| Venous cutdown                    | G                      | 0               |
| Diagnostic peritoneal lavage      | E                      | 0               |
| Burr hole                         | D                      | 0               |
| Skin or skeletal traction         | E                      | 1               |
| Lumbar puncture                   | G                      | 1               |
| Suprapubic catheterization        | G                      | 1               |
| Personal protective equipment     |                        |                 |
| Disposable gloves                 | E                      | 3               |
| Goggles                           | E                      | 2               |
| Safe sharps disposal              | E                      | 1               |
| Biological waste disposal         | E                      | 1               |
| Gowns                             | E                      | 2               |
| Post-exposure prophylaxis for HIV | D                      | 2               |

WHO/GHS – World Health Organization/Ghana Health Service; E – item considered essential for emergency care at second-level hospitals by the WHO; D – item considered desirable for second-level hospitals by the WHO; G – item considered essential for emergency care by GHS; rating scheme: 0 – absent; 1 – inadequate, available to less than half of those who need it; 2 – partially adequate, available to more than half, but not to most who need it; 3 – adequate, present and readily available to almost everyone in need and used when needed.

infrastructure and bed space was suggested by clinical and non-clinical staff (36% and 24%, respectively). Both clinical (34; 77%) and non-clinical staff (27; 79%) reported the need to ensure the availability of essential emergency equipment and supplies to improve care (Table 5). Several non-clinical staff recommended making PPE available for all staff that care for patients or handle potentially contaminated materials, suggesting that these items were not easily accessible by this subgroup.

## Discussion

This study sought to measure emergency care capacity at a second-level hospital in Ghana and identify deficits that would benefit from targeted intervention at this level. The results demonstrate a critical lack of job-specific continuing education and training among all staff members and shortages or an absence of many essential emergency care items and medications, including several low-cost items (e.g. airway supplies, chest tubes, PPE). Despite these deficiencies, several successes were identified, such as availability of essential laboratory services.

The most common recommendation for improvement in emergency capacity was increase in job-specific training. Even faced with critical resource deficits, significant improvements to emergency care have been achieved with staff training and process improvement. For example, pre-hospital care training designed for community members in Iraq and Cambodia reduced trauma-related mortality from 40% to 15% over four years.<sup>24</sup> Similarly, hospital-based care training for triage, trauma and emergency obstetric and paediatric care have resulted in reductions in mortality, recognition of patients in need of transfer and identification of patients in need of prompt intervention.<sup>7,8,25–27</sup> In Ghana, there have been several efforts to improve emergency care training that could be used at the Police Hospital and in other LMIC second-level hospitals. Of these, one was an annual university-led, government-funded continuing education program for injury care targeting district-level hospital providers that ran from 1996 to 2011. An assessment of the courses was reported in 2004.<sup>28</sup> Pre- and post-test scores documented good retention of the program's content and follow-up assessments between 6 months and 2 years after the training demonstrated that program participants were significantly more comfortable with trauma management principles and procedures covered by the program. The Ministry of Health and the hospitals of participants shouldered the entire expense of the courses (individual participant cost was US\$ 135). Given the affordability and success of these training interventions and the lack of training and knowledge deficiencies reported by the respondents, re-invigorating the emergency care training course and including second-level hospitals would be a meaningful intervention. Often in training, pre-hospital, orderly and nursing staff are left out. Though separate coursework would be required, ensuring adequate training in all members of the emergency care team is important for success in emergency care quality improvement.<sup>12,29</sup>

In terms of physical resources, other assessments of emergency capacity at second-level hospitals have been reported. In Sierra Leone, stable electricity, blood transfusion capabilities, cardiac monitoring and low-cost non-drug consumables, such as chest tubes and cervical collars were regularly not

**Table 4** Essential medication availability at the Emergency Centre in Ghana Police Hospital.

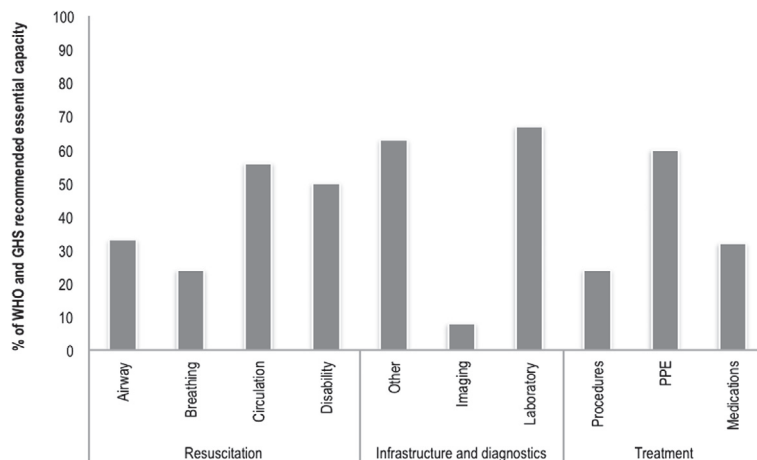
|  | WHO/GHS recommendation | Police Hospital |
|--|------------------------|-----------------|
| <b>Anaphylaxis</b>                             |                        |                 |
| Epinephrine                                    | E                      | 2               |
| Hydrocortisone                                 | E                      | 2               |
| <b>Anaesthesia</b>                             |                        |                 |
| Diazepam                                       | E                      | 2               |
| Etomidate                                      | G                      | 0               |
| Ketamine                                       | E                      | 2               |
| Local anaesthetic                              | E                      | 2               |
| Midazolam                                      | E                      | 0               |
| Neostigmine                                    | G                      | 0               |
| Propofol                                       | G                      | 0               |
| Suxamethonium                                  | E                      | 0               |
| Vecuronium                                     | E                      | 0               |
| <b>Anticonvulsants</b>                         |                        |                 |
| Magnesium sulphate                             | E                      | 0               |
| Phenobarbital                                  | E                      | 0               |
| Phenytoin                                      | E                      | 0               |
| <b>Antiseptics and disinfectants</b>           |                        |                 |
| Antiseptics (e.g. polyvidone, ethanol)         | E                      | 2               |
| Disinfectants (e.g. chlorine base solutions)   | E                      | 2               |
| <b>Pulmonary disorders</b>                     |                        |                 |
| Salbutamol                                     | G                      | 2               |
| <b>Burn care</b>                               |                        |                 |
| Silver sulfadiazine                            | E                      | 2               |
| <b>Cardiovascular disorders</b>                |                        |                 |
| Dopamine                                       | D                      | 0               |
| Atropine                                       | D                      | 0               |
| Dobutamine                                     | G                      | 0               |
| Hydralazine                                    | E                      | 2               |
| Labetalol                                      | G                      | 0               |
| Nitroglycerine                                 | G                      | 0               |
| Norepinephrine                                 | G                      | 1               |
| Phenylephrine                                  | G                      | 0               |
| <b>Diuretics</b>                               |                        |                 |
| Furosemide                                     | E                      | 1               |
| Mannitol                                       | D                      | 0               |
| <b>Fluid, blood products, plasma expanders</b> |                        |                 |
| 5% & 50% glucose solution                      | E                      | 2               |
| Fresh frozen plasma                            | G                      | 0               |
| Isotonic saline                                | E                      | 1               |
| O-negative whole blood                         | E                      | 0               |
| Plasma expanders                               | D                      | 0               |
| Ringer's lactate                               | E                      | 2               |
| Sodium bicarbonate                             | G                      | 0               |
| <b>Gastrointestinal disorders</b>              |                        |                 |
| Antacid  | E                      | 0               |
| Oral rehydration salts                         | E                      | 2               |
| <b>Hormone disorders</b>                       |                        |                 |
| Glucagon                                       | E                      | 0               |
| Insulin  | E                      | 2               |
| <b>Infections</b>                              |                        |                 |
| Spectrum of antibiotics                        | E                      | 2               |
| <b>Medications affecting blood</b>             |                        |                 |
| Aspirin  | E                      | 2               |
| Heparin  | E                      | 1               |
| Vitamin K                                      | G                      | 1               |

*(continued on next page)*

**Table 4** (continued)

|  | WHO/GHS recommendation | Police Hospital |
|--|------------------------|-----------------|
| <b>Minerals</b>                        |                        |                 |
| Calcium chloride or gluconate          | D                      | 1               |
| Potassium solution                     | E                      | 1               |
| <b>Pain, fever, inflammation</b>       |                        |                 |
| Acetaminophen                          | E                      | 2               |
| Ibuprofen                              | E                      | 2               |
| Narcotic analgesia                     | E                      | 1               |
| <b>Poisoning, envenomation, wounds</b> |                        |                 |
| Appropriate snake species antivenom    | G                      | 0               |
| Naloxone                               | E                      | 0               |
| Tetanus immunoglobulin                 | E                      | 0               |
| Tetanus toxoid                         | E                      | 1               |

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WHO/GHS – World Health Organization/Ghana Health Service; PPE – personal protective equipment

**Figure 1** Availability of essential resuscitation, infrastructure, diagnostics and definitive emergency care at the Emergency Centre in Ghana Police Hospital. WHO/GHS – World Health Organization/Ghana Health Service; PPE – personal protective equipment.

**Table 5** Recommendations by staff at the Emergency Centre in Ghana Police Hospital for improvements in emergency services.

|   | Clinical |      | Non-clinical |      |
|---|----------|------|--------------|------|
|   | n = 44   |      | n = 34       |      |
|   | n        | (%)  | n            | (%)  |
| Regular training for new and current staff          | 39       | (89) | 28           | (82) |
| Improve infrastructure, bed space                   | 16       | (36) | 8            | (24) |
| Ensure availability of essential items/medications  | 34       | (77) | 27           | (79) |
| Make PPE available to all staff caring for patients | 0        | (0)  | 4            | (12) |

PPE – personal protective equipment; staff include 24 nurses, 13 medical officers and 7 ambulance crew members; non-clinical staff include 23 orderlies and 11 administrative staff.

present.<sup>30</sup> Similar patterns of equipment, supply and medication deficiencies from second-level hospitals in Kenya, Uganda, Malawi and Nicaragua suggest that the capacity gap found at the Police Hospital is not unique. Therefore, committed attention to improve essential item availability to this keystone of LMIC referral systems is urgently needed.<sup>31–34</sup>

Though this study demonstrated a number of deficiencies in equipment, supplies and medications necessary for basic emergency care, the root causes of the deficiencies were not assessed. In Gujarat State, India, a systematic assessment of the causes of essential trauma care item deficiencies was undertaken. The authors described a lack of numerous specific items due to stock-outs and equipment breakdowns. By doing so, they were able to identify several potential interventions for improving item availability, including: better procurement and stock-management; optimizing training for use of existing resources; and strengthening service contracts and local repair capabilities.<sup>5</sup> Similar assessments performed at the hospital-level may be able to distinguish between deficiencies due to externalities and those resulting from lack of organization and planning; the latter can often be improved low-cost interventions. Performing capacity assessments can be made richer by including evaluation of the causes of essential item deficiencies (e.g. lack of trained personnel, inefficient procurement process, lack of technicians to service broken technology, poor stock management of essential medications). Once this information is obtained, health systems can target interventions to improve the availability of essential emergency items and services.

The main limitation of this study was that objective data on practices of triage, emergency treatment and patient transfers were not collected. However, questions were triangulated between and within staff at different areas of the emergency unit to ensure responses most accurately reflect the real situation and available resources. For example, a specific concern not identified by other staff was the lack of PPE available to staff who transport patients, despite PPE being one of the items most available during direct observation. Lastly, in-depth focus group discussions that may have added richness to qualitative responses were not done. However, responses were clustered around the themes presented and no response was omitted from being presented in the results. Despite these limitations, this mixed-methods study gives a hypothesis-generating understanding of actual and perceived challenges faced by emergency care personnel at a resource-limited second-level hospital. Thus, specific areas requiring further examination (e.g. causes of deficiencies, transfer process) and targeted interventions (e.g. in-service training) can be developed.

## Conclusion

This study identified a number of challenges in care of patients with emergency conditions at the Police Hospital in Ghana. In addition, several successes were identified, for instance laboratory capacity. Low-cost improvements in training, organization and planning could affordably improve item and service availability, such as: developing a continuing education curriculum for staff in all areas of the emergency unit; holding in-service training on existing protocols for triage and emergency care; adding checklists to guide appropriate triage and safe transfer of patients; and performing an analysis of the root

causes of item non-availability to develop targeted interventions. Regarding specific essential items, ensuring that low-cost consumables are reliably in-stock, such as airway supplies, chest tubes, glucagon and tocolytics, is an important first step in improving emergency care capacity.

## Author's contributions

KBJ, GA, EOD, BTS, BEE and CNM designed the study. KBJ and GA collected data. KBJ, BTS, and PD analysed and interpreted the data. KBJ and BTS prepared the first manuscript draft. All authors contributed significantly and critically to the final manuscript.

## Conflict of interest

The authors declare no conflict of interest. This study was funded in part by grants from the Fogarty International Center, US National Institutes of Health (R25-TW009345; D43-TW007267).

## Dissemination of results

Results from this study were shared with staff members at the Police Hospital Emergency Centre and with the hospital administration prior to publication.

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