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African Journal of Emergency Medicine

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ORIGINAL RESEARCH ARTICLES

The clinical practice of emergency medicine in Mahajanga, Madagascar



La pratique clinique de la médecine d'urgence à Mahajanga, Madagascar

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Received 6 August 2015; revised 20 November 2015; accepted 2 December 2015; available online 4 February 2016

Introduction: Little is documented concerning the clinical practice of emergency care in low- and middle-income countries. The lack of structural models presents serious obstacles to the development of effective emergency care services. This study provides such a model by describing the clinical practice at the emergency centre of the Centre Hospitalier Universitaire de Mahajanga in Madagascar.

Methods: This was a retrospective chart review of all adult patients presenting to the emergency centre from September to November 2012. Archived chart data were extracted into a computer database. Data included: age, sex, date, diagnostic investigations, procedures, medications, and diagnosis.

Results: 727 charts were reviewed, averaging eight patients per day. The three most frequent pathologies observed were trauma, gastrointestinal, and infectious disease. A total of 392 received diagnostic investigations. These were chiefly complete blood counts ($n = 218$), blood glucose ($n = 155$) and ECG ($n = 92$). Chest X-rays ($n = 83$), extremity X-rays ($n = 55$) and skull/face X-rays ($n = 44$) comprised the most common imaging. Ultrasounds were primarily abdominal ($n = 9$), renal/genitourinary ($n = 6$), and obstetric ($n = 2$). Therapeutic interventions were performed in 564 patients, most commonly intravenous access ($n = 452$) and wound/orthopaedic care ($n = 185$). Medications were administered to 568 patients, mostly anti-inflammatory/analgesics ($n = 463$) and antibiotics ($n = 287$).

Conclusion: This is the first descriptive study of the clinical practice of emergency medicine in Mahajanga, Madagascar. It provides both the Malagasy and international medical communities with an objective analysis of the practice of emergency care in Madagascar from both diagnostic and therapeutic standpoints. Emergency care here focuses on the management of traumatic injury and infectious disease. The diagnostic imaging, pharmacologic and procedural therapeutic interventions reflect the burdens placed upon this institution by these diseases. We hope this study will provide guidance for the further development of Malagasy-specific emergency care systems.

Introduction: La pratique clinique des soins d'urgence dans les pays à revenu faible et intermédiaire est peu documentée. L'absence de modèles structurels pose de sérieux obstacles au développement de services de soins d'urgence efficaces. Cette étude propose un tel modèle en décrivant la pratique clinique au centre d'urgence du Centre Hospitalier Universitaire de Mahajanga, à Madagascar.

Méthodes: Il s'agit ici d'un examen rétrospectif des dossiers de tous les patients adultes s'étant présentés au centre d'urgence de septembre à novembre 2012. Des données tirées de dossiers archivés ont été extraites et saisies dans une base de données informatique. Il s'agissait notamment de: l'âge, le sexe, la date, les enquêtes de diagnostic, les procédures, les médicaments et le diagnostic.

Résultats: 727 dossiers ont été examinés, soit en moyenne huit patients par jour. Les trois pathologies les plus fréquemment observées étaient les traumatismes ainsi que les maladies gastro-intestinales et infectieuses. Un total de 392 dossiers avaient fait l'objet d'enquêtes de diagnostic. Elles portaient principalement sur la numération et formule sanguine ($n = 218$), la glycémie ($n = 155$) et l'ECG ($n = 92$). Les types d'imageries les plus courantes étaient les radiographies du thorax ($n = 83$), les radiographies des extrémités ($n = 55$) et les radiographies du crâne et du massif facial ($n = 44$). Les échographies étaient principalement abdominales ($n = 9$), rénales/génitourinaires ($n = 6$) et obstétricales ($n = 2$). Des interventions thérapeutiques ont été effectuées chez 564 patients; il s'agissait le plus souvent d'une perfusion intraveineuse ($n = 452$) et du traitements de plaies/orthopédiques ($n = 185$). Des médicaments ont été administrés à 568 patients, pour la plupart des anti-inflammatoires/analgésiques ($n = 463$) et des antibiotiques ($n = 287$).

Conclusion: Il s'agit de la première étude descriptive de la pratique clinique en médecine d'urgence à Mahajanga, Madagascar. Elle fournit à la communauté malgache et à la communauté médicale internationale une analyse objective de la pratique des soins d'urgence à Madagascar du point de vue diagnostique comme du point de vue thérapeutique. Les soins d'urgence se concentrent ici sur la gestion des lésions traumatiques et des maladies infectieuses. L'imagerie diagnostique, les interventions thérapeutiques pharmacologiques et de procédure reflètent les charges que représentent ces maladies sur cette institution. Nous espérons que cette étude fournira des orientations pour la poursuite du développement de systèmes de soins d'urgence propres au contexte malgache.

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Peer review under responsibility of African Federation for Emergency Medicine.

<http://dx.doi.org/10.1016/j.afjem.2015.12.001>

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African relevance

- This is a description of a tertiary emergency care system in northern Madagascar.
- We describe diagnostic and therapeutic practice trends in this setting.
- This information may be used to guide and develop future emergency care systems there.

Introduction

Little is documented concerning the actual clinical practice of emergency care in low- and middle-income countries. Gaps in knowledge regarding emergency care in these regions should be filled so that future systems can be based on credible evidence.¹ The lack of structural models presents serious obstacles to the development of effective emergency care services.²

More than 20 million residents collectively known as the Malagasy people inhabit the Republic of Madagascar. Seventy per cent of the Malagasy live in rural areas. The life expectancy at birth is 63 years for males and 67 years for females, and the median age is 18 years. As of 2002, there were 5201 physicians in Madagascar, with a density of 0.291 physicians per 1000, compared to an average of 0.217 per 1000 for the AFRO region, and 5661 nurses for a density of 0.316 per 1000, compared to a regional average of 1.172 per 1000.³

The Centre Hôpitalier Universitaire de Mahajanga has a relatively low volume of patients (approximately eight per day) for a tertiary referral hospital with an estimated catchment population of over 500,000 (using the current population of the Boeny region). This likely reflects the substantial barriers to accessing healthcare facilities in this region.⁴ Potential contributing factors include transport barriers, financial burden, and social barriers. There is extremely poor access to pre-hospital transport in the region. Urban emergency medical systems (EMS) service areas with a radius of 100 km² on average and rural EMS a much smaller 25 km². Given that the catchment area of the Boeny region is over 31,000 km² and 70% of the population lives in rural settings, physically arriving at the Centre Hôpitalier Universitaire de Mahajanga is an ordeal.⁵ A second barrier to access is financing. The average yearly household income in Madagascar is \$440 USD, and as an example the cost of a single ambulance service to the Centre Hôpitalier Universitaire de Mahajanga is \$5.50 USD, or 1.3% of a household's yearly salary.⁶ Finally, religious taboos and beliefs regarding the use of western medicine lead many to instead seek access from traditional healers.⁵

This study describes the clinical practice at the emergency centre of the Centre Hôpitalier Universitaire de Mahajanga. It was reviewed and approved by the Institutional Review Committee of Research at the Centre Hôpitalier Universitaire de Mahajanga, and exempted from review by the Committee on Human Research at the University of California, San Francisco.

Methods

This study was performed in the Unité des Urgences et Soins Intensifs (literally, the Emergency and Intensive Care Unit) in

the Centre Hôpitalier de Mahajanga. This hospital is located in Mahajanga, the capital of Boeny region. It is a seaport town with a population of 135,660 according to a 2001 estimate by the Institut National de la Statistique (INSTAT). It is the only tertiary referral hospital in the region and has 400 beds. The emergency centre functions as both a primary and tertiary referral centre; patients may self-present, be referred from clinics, or be brought in by the fire department's ambulance—the only public emergency medical service (EMS) vehicle in the region.

An on-call attendee, a resident, a senior medical student, and a junior medical student staff this unit. Patients are triaged at the point of entry by the on-call resident to either the medical or surgical side of the emergency centre. Paediatric patients less than five years of age are predominantly directed to a separate paediatric emergency centre.

This was a retrospective study of patient charts from all patients presenting during September, October and November of 2012. All patients presenting to the emergency centre's medical and surgical wings were included. For unknown reasons, there was a small group of paediatric patients that presented to the adult medical and surgical wings of the emergency centre, and not to the paediatric emergency centre. These patients were included in this group in our demographics table for faithful site-specific characterisation, but excluded from further analysis.

Archived charts were systematically reviewed, and data extracted by the principal investigator and entered into a computer database. Data were anonymised and de-identified upon entry. Only one physician abstracted data in order to maintain consistency. Data collected included: age, sex, date and time of entry, diagnostic investigations, procedures performed, medications given, and diagnosis (classified physiologically). Clinical charts at the Centre Hôpitalier Universitaire de Mahajanga are hand-written onto a preformed template that has designated areas for entry, time of administration of medications, and results of laboratory investigations. With data being recorded in this fashion, there was no possibility of recording orders that were written on the chart but not executed. There was however no possibility to reconcile for orders that may have been executed without having been written on the chart.

The final diagnosis from each chart was entered into one of 16 physiologic categories. This included a free-text section for "Other" that allowed for recording unanticipated categories that appeared with high frequency. The categories were comparable to several similar studies from the region.^{7–9}

All charts were included in this study. Data were entered into an OpenOffice Base database and analysed using Microsoft Excel and OpenOffice Calc spreadsheets. Age, sex, and date and time of entry were entered directly into the database. Each diagnostic examination, procedure performed, medication given, and diagnosis was given a separate checkbox and logged in binary fashion, to reduce misclassification error.

Results

Data were collected for 727 patients. This represented every documented patient visit during the study period. The total number of charts was checked against the intake registry and found to be complete.

The median age of male patients was 33, females 30.5, and the overall median age was 32 (Table 1). The most represented

decile was 20–29 years, accounting for 22.7% of the sample. Paediatric (< 5 years) patients do not typically present to this unit and were therefore excluded from analysis beyond demographic characterisation, however 16% of the total population were under 18 but over 5 years. Accordingly, we have separated our analysis into patients age \geq 18 years and 5 years < age < 18 years where appropriate.

Trauma, gastrointestinal, and infectious diseases were the most frequently observed presentations (Table 2). The vast majority of non-infectious gastrointestinal disorders were haemorrhages, and likewise malaria dominated the infectious disease category.

A total of 392 (53.9%) patients had diagnostic investigations performed in the emergency centre, and 226 (31.1%) patients required multiple tests (Table 3). Complete blood counts ($n = 218$), finger stick blood glucose ($n = 155$), and electrocardiogram (ECG) ($n = 92$) were the most frequently ordered tests.

Of the imaging performed, X-rays were the most common with a total of 217. Ultrasound was performed on a total of 18 patients.

A total of 564 patients (77.6%) underwent a procedure and 413 (56.8%) underwent multiple (Table 4). Intravenous fluid

resuscitation was performed on 452 patients (62.2% of the total). Wound and orthopaedic care, which included wound cleaning and disinfection, casting, and suturing, was performed in 185 (25.4%) patients.

A total of 568 (78.1%) patients were administered medications in the emergency centre (Table 5). The most common in both those over- and under-18 years were anti-inflammatory and analgesic medications, given to a total of 463 patients (63.7%). Antibiotics were the second most frequently administered medication, given to 287 (39.5%) patients.

Discussion

The Centre Hôpitalier Universitaire de Mahajanga patient population is best characterised as a young, more commonly male group that frequently present with traumatic injury and infectious disease. Clinical practice patterns in Madagascar vary from facility to facility.¹⁰ Physicians in Mahajanga, working in an extremely limited resource setting, rely heavily on clinical presentation when evaluating patients as demonstrated by the fact that nearly half did not undergo any sort of diagnostic laboratory or imaging testing at all. When these

Table 1 Patient demographics.

	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89	90+	Unknown	Total
Male	21	60	100	89	68	38	37	17	6	0	4	440
Female	17	56	65	41	34	31	21	12	6	1	3	287
Total	38	116	165	130	102	69	58	29	12	1	7	727

Table 2 Burden of disease.

Disease category	Total patients $N = 727$	Number of patients requiring...			
		Labs $N = 292$	Imaging $N = 199$	Procedures $N = 566$	Medication $N = 570$
	n (%)	n			
Trauma	322 (44.3)	19	111	243	238
Gastrointestinal disorders	74 (10.2)	48	14	55	63
Infectious disease	49 (6.7)	44	9	46	46
Neurologic disorders	48 (6.6)	38	8	41	40
Cardiovascular disorders	46 (6.3)	43	14	43	45
Psychiatric disorders	31 (4.3)	10	1	23	29
Respiratory disorders	24 (3.3)	18	14	20	20
Genitourinary disorders	21 (2.9)	6	10	15	13
Endocrine disorders	17 (2.3)	17	3	16	13
Unknown	14 (1.9)	1	0	0	0
Gynaecologic disorders	12 (1.7)	8	3	9	8
Oncologic disorders	8 (1.1)	7	3	7	7
Renal disorders	8 (1.1)	5	5	6	7
Obstetric disorders	3 (0.4)	2	0	3	2
Haematologic disorders	2 (0.3)	2	0	2	2
Dermatologic disorders	1 (0.1)	1	0	1	1
<i>Other</i>					
Ingestion/intoxication	34 (4.7)	16	4	27	25
Anaphylaxis	6 (0.8)	3	0	6	6
Otolaryngologic disorders	3 (0.4)	1	0	2	2
Rheumatologic disorders	2 (0.3)	1	0	0	2
Syncope	2 (0.3)	2	0	1	1

Table 3 Diagnostic investigations.

Examination	Overall number performed	Performed on patients ≥ 18 years $N = 602$	Performed on patients 5 years < age < 18 years $N = 118$
	n	n (% of total ≥ 18)	n (% of total < 18)
Complete blood count	218	197 (32.7)	19 (16.1)
Blood glucose	155	150 (24.9)	5 (4.2)
ECG	92	88 (14.6)	4 (3.4)
Metabolic panel	82	80 (13.3)	2 (1.7)
Rapid malaria test	61	58 (9.6)	3 (2.5)
Widal & Felix	22	20 (3.3)	2 (1.7)
Urinalysis	22	20 (3.3)	2 (1.7)
Culture (blood, sputum, etc.)	15	13 (2.2)	1 (0.9)
Other serology	13	11 (1.8)	2 (1.7)
Haemoglobin	3	3 (0.5)	0
Tuberculosis	1	1 (0.2)	0
HIV	1	1 (0.2)	0
Urine HCG	1	1 (0.2)	0
<i>X-ray</i>			
Chest	83	75 (12.5)	6 (5.1)
Extremity	50	38 (6.3)	10 (8.5)
Skull	44	29 (4.8)	9 (7.6)
Abdomen	36	32 (5.3)	3 (2.5)
Spine	4	2 (0.3)	2 (1.7)
<i>Ultrasound</i>			
Abdomen	9	8 (1.3)	1 (0.9)
Renal/genitourinary	6	6 (1.0)	0
Obstetric	2	2 (0.3)	0
Cardiac	1	1 (0.2)	0

Table 4 Interventions and procedures performed.

Intervention or procedure	Overall number performed	Performed on patients ≥ 18 years $N = 602$	Performed on patients 5 years < age < 18 years $N = 118$
	n	n (% of total ≥ 18)	n (% of total < 18)
Intravenous fluid resuscitation	452	399 (66.3)	49 (41.5)
Wound & orthopaedic care	185	148 (24.6)	28 (23.7)
Oxygen	45	42 (7.0)	3 (2.5)
Nasogastric tubes	37	33 (5.5)	4 (3.4)
Transfusion	18	17 (2.8)	1 (0.9)
Gastric lavages	11	7 (1.2)	4 (3.4)
Pleural/ascites punctures	6	6 (1.0)	0

physicians do opt to perform a haematologic workup, the most highly utilised tests are complete blood counts, serum glucose, ECG, and thick and thin smears for malaria. X-ray is the most commonly used imaging modality. These findings likely reflect resource limitations as much as clinical need.

It has been posited that urbanisation in developing countries is leading to an epidemiologic shift in the acuity of the disease burden (e.g. traumatic injury is more common due to increasing number of motor vehicle collisions), necessitating the modernisation of emergency care systems in these settings.^{11,12} This shift is clearly observed at the Centre Hospitalier Universitaire de Mahajanga where we see trauma, gastrointestinal, and infectious diseases predominate. These findings,

in addition to the mode and median ages, are consistent with similar reports from Kenya and Tanzania.^{13,14} This is likely due to the fact that this age group is known to be at the highest risk for Mahajanga's most common emergency presentation, trauma.¹⁵ What this ultimately suggests is that Mahajanga, like many other sub-Saharan African regions before it, is in a country with a population in great need of emergency care modernisation.

By providing increased granularity regarding diagnostic testing at the Centre Hospitalier Universitaire de Mahajanga, we seek to highlight potentially high-yield targets for future development. Regarding haematologic testing, thick and thin smears for malaria were rarely ordered and negative results

Table 5 Medications given.

Medication	Total number of patients administered	Administered to patients ≥ 18 years <i>N</i> = 602	Administered to patients 5 years < age < 18 years <i>N</i> = 118
	<i>n</i> (% of total)	<i>n</i> (% of total ≥ 18)	<i>n</i> (% of total < 18)
Analgesia & anti-inflammatory	463 (63.7)	381 (63.23)	67 (56.8)
Antibiotics	287 (39.5)	236 (39.2)	39 (33.1)
Gastrointestinal agents ^a	75 (10.3)	58 (9.6)	7 (5.9)
Antispasmodic agents	71 (9.8)	61 (10.1)	10 (8.5)
Anticonvulsants	59 (8.1)	52 (8.6)	7 (5.9)
Diuretics	58 (8.0)	49 (8.4)	8 (6.8)
Antihypertensives	37 (5.1)	26 (4.3)	3 (2.5)
Endocrine agents	14 (1.9)	12 (2.0)	0
Anticoagulants	13 (1.8)	12 (2.0)	1 (0.9)
Steroids	12 (1.7)	11 (1.8)	1 (0.9)
Respiratory agents	10 (1.4)	9 (1.5)	0
Antihistamines	7 (1.0)	5 (0.8)	0
Antiarrhythmics	2 (0.3)	2 (0.3)	0
Antipsychotics	1 (0.1)	1 (0.2)	0
<i>Other</i>			
Vitamins ^b	90 (12.4)	80 (13.3)	9 (7.6)
Cardiovascular agents	35 (4.8)	25 (4.2)	2 (1.7)
Vaccines	18 (2.5)	14 (2.3)	3 (2.5)
Anxiolytics	7 (1.0)	5 (0.8)	1 (0.9)
Antihaemorrhagics	6 (0.8)	3 (0.5)	0
Neurologic Agents	6 (0.8)	3 (0.5)	1 (0.9)
Antidotes	4 (0.6)	3 (0.5)	0

^a Mostly antacids and anti-emetics.

^b Over 95% of vitamins were vitamin C.

often disregarded when forming treatment plans. Practitioners cited a lack of skill and therefore implied lack of confidence in the preparation and reading of such tests. Reports addressing this concern from several low- and middle-income countries do in fact show that the diagnostic test performance of blood smears for malaria is user-dependent.^{16,17} This combined with the high prevalence of malaria likely contributed to this phenomenon.

Our diagnostic imaging analysis shows that only 18 ultrasound scans were performed during the three-month time period. This suggests that it is underutilised in this facility. The utility of ultrasound in low-resource emergency care settings is well established, particularly in the case of traumatic disease.^{18,19} One study from Rwanda showed that its use changed management in 43% of patients scanned.²⁰ One possible reason for this underutilisation is the lack of a formal ultrasound curriculum in emergency physician training. Emergency medicine is not considered a distinct specialty in Madagascar, therefore it is not taught as a separate discipline in medical school curricula. Previous reports on the state of emergency medicine here identify the development of formalised emergency care training to be a priority.¹⁰ Integration of an ultrasound curriculum into this training may address the underutilisation noted in our findings, significantly boosting the diagnostic capacity of emergency physicians at Centre Hôpitalier Universitaire de Mahajanga.

The pharmacologic trends at Centre Hôpitalier Universitaire de Mahajanga reveal that interestingly, 13.3% of

adults were prescribed vitamins, and over 95% of these were given vitamin C. The liberal administration of vitamin C was observed during our study to be practitioner dependent, and can be attributed to one of two primary rationales. Anecdotally, it is a widely held belief amongst local practitioners that a large portion of Malagasy patients presenting to the service are burdened by vitamin deficiencies, therefore vitamin C is often an adjunctive act of primary care. Second, the administration of vitamin C is still included in the treatment protocols for tetanus as well as certain intoxications.

Limitations

This was a retrospective study and as such is subject to possible loss of clinical charts in the interim. However, the total number patients presenting in September 2012 was crosschecked with the patient registry that tracks all patients at the emergency centre intake, and the two figures were equal. Accordingly, we feel there was minimal to no loss of data.

Seasonal variations in disease presentation could affect the pathology seen during this interval. However, when compared to a 21-month retrospective study on the burden of acute disease in Mahajanga, the percentage of patients presenting with trauma and infectious disease during our study period was roughly equivalent to the yearly average, suggesting minimal seasonal effect on this study.²¹

As only a primary diagnosis was used during data entry in this study, the incidence of psychiatric disease is slightly under-reported. A number of the ingestions were suicide attempts coming in for treatment of acute illness secondary to poisoning. These were included in the Ingestion/Intoxication category, and not in the Psychiatric category.

Data regarding the medications administered to each patient were logged in an all-or-none fashion, e.g. a patient receiving both vancomycin and ceftriaxone was entered as having received antibiotics, without a numeric qualifier to specify that two different drugs of the same class were used. These data are therefore a reflection of the frequency of use of each category, and not a tally of how many different drugs were given.

Finally, as these data were recorded in the clinical chart and not directly observed by the principal investigator, some actions performed may not have been recorded. However, given the high documentation rate of simple procedures such as intravenous access this seems unlikely.

Conclusion

This is the first descriptive study of the clinical practice of emergency medicine in Mahajanga, Madagascar. It provides both the Malagasy and international medical communities with an objective analysis of the practice of emergency care in Madagascar from both diagnostic and therapeutic standpoints. Emergency care here is in large part focused on the management of traumatic injury and infectious disease. The diagnostic imaging, pharmacologic and procedural therapeutic interventions reflect the burdens placed upon this institution by these diseases. We hope this study will provide guidance for the further development of Malagasy-specific emergency care systems.

Conflicts of interest

The authors declare no conflicts of interest.

Dissemination of results

This work was presented in poster format at the 2014 African Conference on Emergency Medicine.

Author contributions

VK, GR, CA, and TR have all made substantial contributions to the article's conception and design, acquisition of data, and analysis and interpretation of data. Each of the aforementioned authors has played an integral role in drafting the article or revising it critically for important intellectual content, and each of the aforementioned authors has given final approval of the version to be published.

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