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ORIGINAL ARTICLE

Describing the categories of people that contribute to an Emergency Centre crowd at Khayelitsha hospital, Western Cape, South Africa

Description des catégories de personnes contribuant à l'affluence dans un service des urgences public urbain de la ville du Cap, en Afrique du Sud

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ABSTRACT

Introduction: Emergency Centre (EC) crowding has globally been recognised to adversely affect patients, staff and visitors. Anecdotally, local ECs are perceived to be fairly crowded, however, not much is known about the size of this crowd and what constitutes it. Although more reliable, resource restrictions render more detailed flow studies less achievable. This study describes the EC crowd at Khayelitsha hospital in Cape Town, South Africa as the number and different categories of people, at predefined times during the day over a four-week period.
Methods: A prospective, cross-sectional design was used. Headcounts were made by predefined groups at 09h00, 14h00, and 21h00 every day for four weeks. Predefined groups included doctors, nurses, visitors, patients, and other allied health staff. Summary statistics were used to describe the data. Precision was described using the 95% confidence interval.
Results: A total of 16,353 people were counted during the study period. On average, 6370 (39%) of the groups were staff, 5231 (32%) were patients and 4752 (29%) were visitors. Of the staff, 586 (3.6%) were EC doctors, 733 (4.4%) were non-EC doctors, 1488 (9%) were EC nurses, and 445 (3%) were non-EC nurses. Although patient numbers in the EC remained constant, visitors and non-EC staff varied significantly with visitors peaking in the afternoon and non-EC staff drastically reducing in the evening. The EC was consistently crowded – average occupancy: 130%.
Conclusion: Staff levels fluctuated predictably, reducing at night and over weekends, while patient levels remained constant. Non-EC doctors more than doubled during the day on week shifts, in significantly more numbers than EC doctors, suggesting that many of the patients in the EC were likely to be admissions boarding in the EC. Visitor numbers were substantial during visiting hours and further aggravated crowding. Resource-light studies involving flow are important to explore crowding in low- and middle income settings.

ABSTRACT

Introduction: La foule présente dans les Services des urgences (SU) a été globalement reconnue comme affectant négativement les patients, les employés et les visiteurs. Nous savons que les SU locaux sont perçus comme relativement bondés, cependant, peu d'informations sont disponibles sur l'ampleur de cette affluence et les personnes qui la composent. Les études de flux plus détaillées, bien que plus fiables, sont rendues plus difficiles par les restrictions de ressources. Cette étude décrit l'affluence au SU de l'hôpital de Khayelitsha selon le nombre et les différentes catégories de personnes qui s'y trouvent à des horaires prédéfinis d'une journée, sur une période de quatre semaines.
Méthodes: Une étude transversale et prospective a été utilisée. Le dénombrement a été réalisé selon des groupes prédéfinis à 09h00, 14h00 et 21h00 tous les jours pendant quatre semaines. Les groupes

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prédéfinis étaient constitués des médecins, infirmières, visiteurs, patients et autre personnel médical affilié. Des statistiques sommaires ont été utilisées pour décrire les données. La précision a été décrite en utilisant un intervalle de confiance de 95%.
Résultats: au total, 16,353 personnes ont été comptabilisées au cours de la période couverte par l'étude. En moyenne, 6370 (39%) personnes étaient des employés, 5231 (32%) étaient des patients et 4752 (29%) étaient des visiteurs. Parmi les employés, 586 (3,6%) étaient des médecins du SU, 733 (4,4%) étaient des médecins n'appartenant pas au SU, 1488 (9%) étaient des infirmières du SU et 445 (3%) étaient des infirmières n'appartenant pas au SU. Bien que le nombre de patients au SU reste constant, les visiteurs et employés hors SU variaient dans une large mesure, le nombre de visiteurs connaissant un pic dans l'après-midi et le nombre d'employés n'appartenant pas au SU diminuant considérablement le soir. Le SU était bondé en permanence, avec un taux d'occupation moyen de 130%.
Discussion: Les niveaux d'employés fluctuaient de manière prévisible, se réduisant la nuit et les week-ends, alors que les niveaux de patients restaient constants. Le nombre de médecins n'appartenant pas au SU faisait plus que doubler pendant la journée sur les quarts de la semaine, de manière beaucoup plus significative que le nombre de médecins du SU, suggérant que nombre des patients se présentant au SU étaient susceptibles d'être admis. Le nombre de visiteurs était substantiel pendant les heures de visite et venait encore agraver l'affluence. Des études n'impliquant que peu de ressources sont importantes pour étudier l'affluence dans des pays à faibles et moyens revenus.

African relevance

- Crowding in emergency centres is not a unique problem.
- African emergency centres suffer from high loads and few staff.
- The impact on care is lapse of safety and quality.

Introduction

The Emergency Centre (EC) is a complex clinical environment with unpredictable workflow and, at times, a propensity for becoming crowded [1]. It is a vibrant and challenging setting from both an operational and a clinical perspective. The number of people in an EC (including patients, visitors and staff) not only affects service delivery locally in the EC, but also delivery in other areas of the hospital [2]. Globally, EC crowding has been recognised to adversely affect both patients and care providers [3,4]. The Australasian College for Emergency Medicine describes EC crowding as the resource discrepancy between supply and demand—or, in simpler terms, when the number of patients in the EC outstrips basic service capacity [5]. Unsurprisingly, crowding has a deleterious effect on patient care and has been the topic of many studies globally [6–12]. However, there is a paucity of research from Africa with regards to EC crowding locally. Anecdotally, the perception is that most African ECs are either running at or over capacity. However, this perceived crowd has never been proven or described, likely due to lack of systems and resources. Despite this setback, it is fair to assume that patient numbers likely do overwhelm the health care workforce; according to 2015 World Health Organization (WHO) statistics, the density of the healthcare workforce per 10,000 population in the Africa region was a mere three physicians compared to 32 in the Europe region. For nurses, the density was twelve compared to 80 in the Europe region [13]. Although various ways exist to describe patient flow through ECs, not many are achievable within a setting that lacks the finances, systems and resources to do so.

In a study undertaken by Gilligan et al., increases of patients in the EC correlated with increases of other people groups such as visitors and staff [14]. This particular study cast an interesting light on crowding, which had in the past been thought to mainly be a patient-related problem and is usually described in terms of flow and access block. When the EC is crowded with patients, medical staff is likely to increase as well, as inpatient teams converge in the EC to treat their patients there. However, an increase in staff members is bound to affect productivity, since staff will compete for the same EC resources (for instance computers and desk space) to manage higher volumes of patients in a smaller area [15]. In a way, describing the crowd provides an indirect litmus test to reveal the extent of crowding, and thus whether further investigation of flow (at the expense of greater resources) are justified. We were interested to know whether, given lower physician density locally, there is also an association between the volume of patients and other people groups contributing to the EC crowd. This study aimed to describe the EC crowd at a district public hospital on the outskirts of Cape Town, South Africa, by establishing the number and correlation of the different categories of people (patients, visitors and EC staff) at 09h00, 14h00 and 21h00 over a four-week period.

Methods

A prospective, cross-sectional design was used for this study. The study was undertaken at Khayelitsha hospital in Cape Town, a 47-bed and ambulatory space EC which forms part of a 230-bed public, district referral hospital. It provides a 24-h EC, as well as inpatient paediatrics, obstetrics, gynaecology, surgery, and medicine of which all but the EC, medicine and paediatrics are family medicine run. The EC sees around 3000 new patients per month with a reported inpatient bed occupancy level at around 131% [16]. The EC sees about 700 children, rising to 1200 per month between December and April during the gastroenteritis and pneumonia surge season [16]. The EC has a five-bed resuscitation area; an eight-reclining chair, non-ambulatory area; and 14-bed trolley area. The paediatric EC has eight beds and the EC run, paediatric overnight ward has six beds. The minor illness and injury area has three consultation rooms, each with one examination bed, and the procedure and two isolation rooms have a bed each. The EC's poverty-related burden of disease ranges from penetrating traumatic injuries (e.g. chest injuries, community assaults and road traffic accidents) through drug related psychosis, to infective illnesses such as HIV and tuberculosis [16].

For the study, all persons that were in the EC over the space of two hours from 09h00, 14h00 and 21h00 during a four-week study period during June 2016 were included. Categories of people were predefined and included doctors (EC, non-EC), nurses (EC, non-EC), visitors, patients, security staff, porters, catering, administration, paramedics and various staff from other departments. Doctors were sorted according to specialities and a space was provided to include undefined categories. The three time-slots were selected because these were perceived to be the peak crowding times (ward-rounds, visiting hours), using the same reasoning as described by Gilligan et al. [14]. Duplication was minimised by using a predetermined route through the EC for each data collection.

Data were analysed using Excel (Microsoft Office, Redmond, USA). Different people groups were expressed as proportions with the mean used to describe central tendency, standard deviation to describe spread and the 95% confidence interval to describe precision. Various patient-to-group ratios (for visitors and staff groups) were calculated to see how these changed over time. These ratios were compared between time-slots using the Chi-Square test (significance was described as a $p < 0.05$). Occupancy was defined as the number of patients per available EC spaces. This was graphically expressed to show change over time. The study received ethical approval from the University of Cape Town, Human Research Ethics Committee.

Results

A total of 16,353 people were counted during a study period lasting 29 days (this is a mean of 564 people per day and 188 per data collection time-slot). The breakdown of individuals at each stage of the study is depicted in Fig. 1.

Of the 733 (4.4%) non-EC doctors, 368 (50%) were from medicine, 147 (20%) were from surgery, 93 (13%) were from obstetrics and gynaecology, 62 (8%) were from paediatrics, 27 (4%) were from psychiatry, 26 (4%) were research clinicians, 7 (1%) were from anaesthetics and 3 (0.4%) were from family medicine. Of the 2117 (13%) ancillary staff, 682 (32%) were catering and housekeeping, 532 (25%) were security, 331 (16%) were porters, 249 (12%) were administrative staff, 55 (3%) were laboratory staff, 52 (2%) were radiographers, 39 (2%) were non-clinician research assistants, 32 (2%) were pharmacy staff, 30 (1%) were transport staff, 28 (1%) were maintenance staff, 23 (1%) were dieticians, 22 (1%) were physiotherapists, 17 (1%) were central sterile services staff, 12 (1%) were stores staff, 7 (0.3%) were forensic pathology service staff, 4 (0.2%) were undertakers, 1 (0.04%) was an occupational therapist and 1 (0.04%) was a psychologist.

Table 1 shows the number of different categories of people in the EC during the 09h00, 14h00 and 21h00 time-slots over the 29-day study period. Confidence intervals revealed significant differences between time-slots within groups and between groups. Overall, afternoons were significantly more crowded and evenings significantly less. Visitor numbers were significantly higher in the afternoon compared to mornings and evenings. The numbers of EC clinical staff and EC doctors were significantly less in the evenings and weekend shifts compared to week shifts. EC nurses were significantly fewer on weekend shifts than on week shifts. The findings were similar for non-EC clinical staff, doctors and nurses. In contrast, patients remained constant, with no significant difference in confidence intervals seen between shifts. Compared to non-EC doctors, there were significantly fewer EC doctors during week shifts, specifically at 09h00 and 14h00.

Fig. 2 graphically displays the differences between patients, visitors, EC clinical staff, non-EC clinical staff, EC doctors and non-EC doctors for the average shift at the three different time-slots, a week shift, weekend shift and an average shift. The only significant

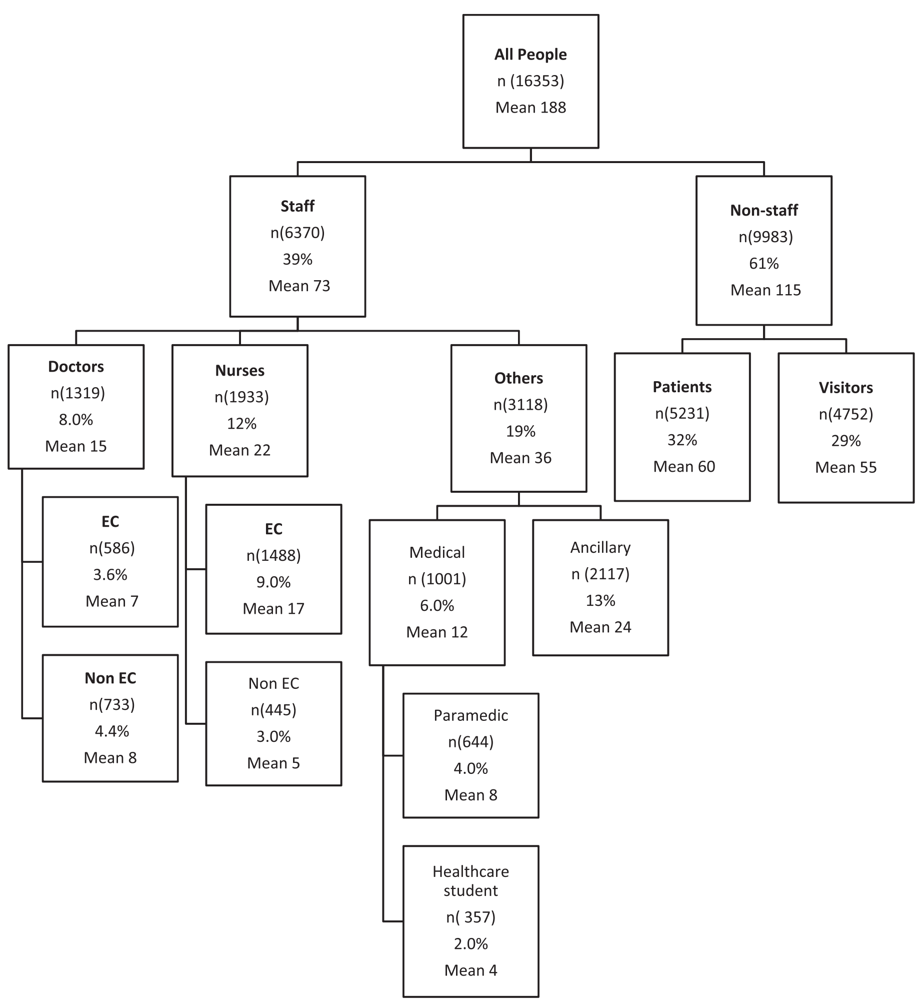

Fig. 1. Flow chart of all people in the Emergency Centre and mean number per data collection time-slot over the 29-day study period.

Table 1
The number of different categories of people in the Emergency Centre during the 09h00, 14h00 or 21h00 time-slots over the entire study period.

Groups	09h00 time-slot			14h00 time-slot			21h00 time-slot			Weekday (total for day)			Weekends (total for day)			Total for day		
	n (%)	Mean ± SD	95%CI	n (%)	Mean ± SD	95%CI	n (%)	Mean ± SD	95%CI	n (%)	Mean ± SD	95%CI	n (%)	Mean ± SD	95%CI	n (%)	Mean ± SD	95%CI
All	4854	168 ± 35	154.7–181.3	7587	262 ± 44.3	245.2–278.8	3912	135 ± 24	125.9–144.1	12130	578 ± 84	540.0–616.0	4223	528 ± 42	493.0–563.0	16353	564 ± 77	535.0–593.0
Patients	1751 (36%)	61 ± 13	55.0–66.0	1717 (23%)	60 ± 12	55.0–65.0	1763 (45%)	61 ± 11	57.0–65.0	3849 (23.5%)	183 ± 33.3	167.8–198.2	1382 (8.5%)	173 ± 19.3	157.0–189.0	5231 (32%)	180 ± 30	169.0–191.0
Visitors	773 (16%)	27 ± 11	23.0–31.0	3461 (46%)	119 ± 32	107.0–131.0	518 (13%)	18 ± 8	15.0–21.0	3366 (20.6%)	160 ± 38.1	142.7–177.3	1386 (8.5%)	173 ± 27.6	150.0–196.0	4752 (29%)	164 ± 36	150.0–178.0
EC clinical staff	721 (14.9%)	25 ± 2	24.2–25.8	732 (9.6%)	25 ± 3	24.0–26.0	621 (15.9%)	21 ± 1.8	20.3–21.7	1541 (9.4%)	74 ± 3.6	72.4–75.6	533 (3.3%)	67 ± 3.3	64.2–69.8	2074 (12.7%)	72 ± 4.6	70.2–73.8
EC doctors	214 (4.4%)	8 ± 1.3	7.5–8.5	230 (3%)	8 ± 2.4	7.1–8.9	142 (4%)	5 ± 1	4.6–5.4	454 (2.8%)	22 ± 2.9	20.7–23.3	132 (0.8%)	17 ± 1.9	15.5–18.5	586 (3.5%)	20 ± 4	19.0–21.0
EC Nurses	507 (10%)	17 ± 2	16.0–18.0	502 (7%)	17 ± 2	16.0–18.0	479 (12%)	17 ± 1	16.0–18.0	1087 (6.6%)	52 ± 3	50.6–53.4	401 (2.5%)	19 ± 2.9	16.5–21.5	1488 (9%)	51 ± 3	50.0–52.0
Non-EC clinical staff	476 (10%)	17 ± 5	15.0–19.0	480 (6%)	17 ± 6	15.0–19.0	227 (6%)	8 ± 2	7.0–9.0	947 (5.8%)	45 ± 5.9	42.3–47.7	231 (1.4%)	29 ± 4.8	25.0–33.0	1178 (7.2%)	41 ± 9.2	37.5–44.5
Non-EC doctors	308 (6%)	11 ± 4	9.0–13.0	332 (4%)	12 ± 6	10.0–14.0	98 (2%)	4 ± 1	3.0–5.0	612 (3.7%)	29 ± 5.5	26.5–31.5	121 (0.7%)	15 ± 2.6	12.7–17.3	733 (4.4%)	26 ± 8	23.0–29.0
Non-EC nurses	168 (3.4%)	6 ± 2	5.0–7.0	148 (2%)	5 ± 1	4.0–6.0	129 (3.2%)	5 ± 1	4.0–6.0	335 (2.0%)	16 ± 2	15.1–16.9	110 (0.7%)	14 ± 3	11.4–16.6	445 (2.7%)	16 ± 3	15.0–17.0

EC clinical: EC doctors, EC nurses; non-EC clinical: Surgery, Medicine, Paediatrics, Obstetrics and gynaecology, Psychiatry, Family medicine, Clinical research, Anaesthesia, non-EC nurses.

patient ratio was patient to visitors; the 14h00 time-slot ratio was significantly different from the ratios at 09h00 and 21h00 ($p < 0.001$).

The mean bed occupancy rate was 130%, 128% and 132% for the 09h00, 14h00 and 21h00 time-slots, respectively. Overall, bed occupancy was highest on Mondays and lowest on Sundays. Occupancy never dipped below 100% at any point during the study. Fig. 3 shows the trend for the mean bed occupancy rates for each data collection time-slot for a particular day of the week.

Discussion

Staff levels fluctuated predictably with fewer staff at night and on the weekend, though patient numbers remained constant throughout. Non-EC doctors more than doubled on week days compared to week evenings, and did so in significantly greater numbers than EC doctors at the same times. Taking into account in-patient crowding and that non-EC doctors likely attended the EC to attend to referrals and admitted patients not yet on the ward, this finding would suggest that a substantial number of patients in the EC were likewise not EC patients, but admitted patients boarding in the EC, likely due to access block. Paradoxically, the increase in clinical staff could have had a negative effect on efficiency as it would also have increased competition for limited EC resources and workspace. EC nurse numbers remained fairly constant throughout the week, but dipped significantly over weekends. Taking into account the fairly constant number of patients in the EC, nurses were likely to be stretched thin at times between new emergency arrivals and boarding patients. Gilligan et al. made similar observations in their study (although with smaller numbers), showing that there was an association between the volume of patients in the EC and other people groups (especially visitors) that contributed to the EC crowd [14]. Essentially this meant that more visitors and staff converged on the EC when there were more patients—in the case of Khayelitsha EC, this convergence was shown to be rather substantial, but mainly on week days—not evenings or weekends. What is also different in our study is the significant reduction in clinical staff after hours and weekends despite unchanged patient numbers. Taking all of this into account, the effect of a crowd of this magnitude on safety and quality of care would be worrisome.

Surprisingly, visitors made up nearly a third of persons overall in the EC with a significant peak in the afternoons. One explanation for this might be related to the suspected large number of EC boarders. Although clinical staff numbers did not reduce during the busiest visitor times, the huge amount of crowding at this time is likely to have reduced privacy, restricted access to patients and impacted on care. This observation was also commented on by Gilligan, et al., as well as Richards, et al. in his survey on overcrowding of directors of emergency centres in California [14,17]. Restricting access to visitors in order to maintain EC flow might be a solution to reduce this number, however, it does open an ethical question regarding patients' right to be visited in hospital. One more concerning finding to note was that there were nearly as many security staff on duty as there were EC doctors. The mere presence of security in that number would suggest a risky work environment, something likely to be exacerbated during significant periods of crowding.

The average occupancy level remained fairly constant, always greater than 100%, which matched reported occupancy rates on ward. Although not directly measured, this finding points to access block as a key culprit. The Australasian College for Emergency Medicine defines access block as a "situation where patients are unable to gain access to appropriate hospital beds within a reasonable amount of time" [5]. Occupancy is a simple metric used for measuring crowding in the EC as it allows assessment of crowding

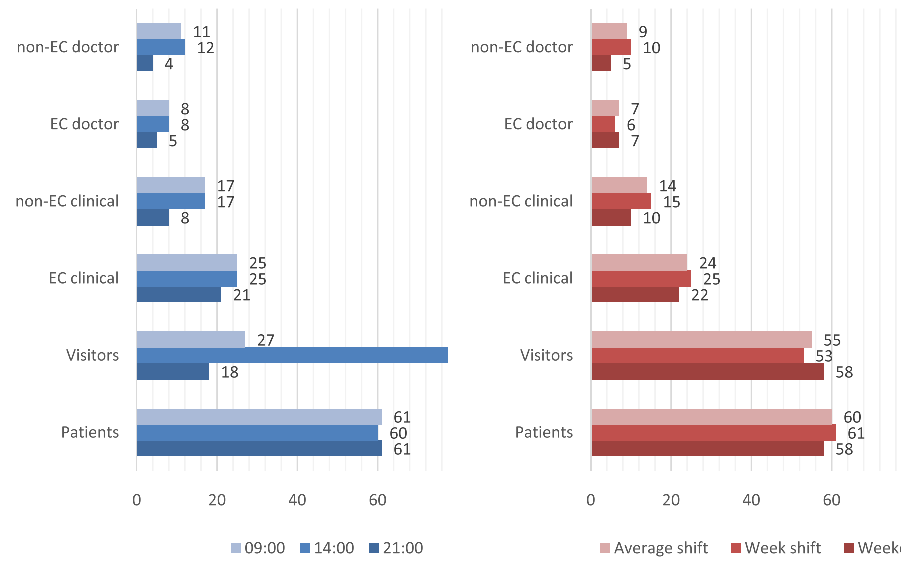

Fig. 2. A representation of the differences between the persons occupying the Emergency Centre for the three daily time-slots and week vs. weekend shifts.

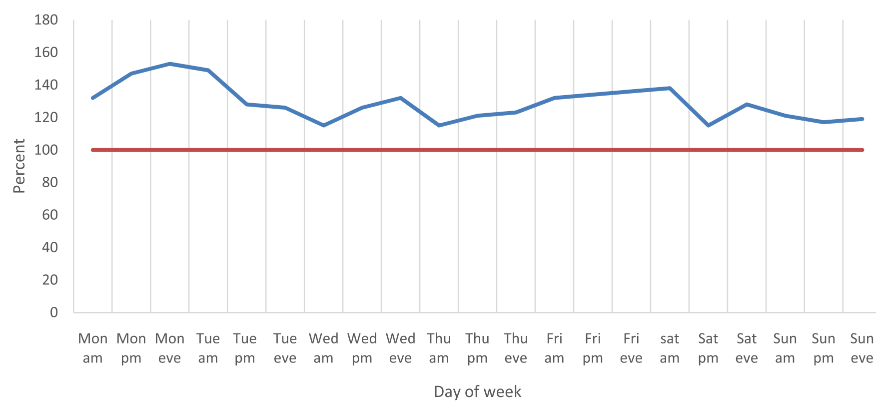

Fig. 3. Trend of bed occupancy rate (blue line) in the Emergency Centre averaged out over the study period. *Note:* Grey line, 100% capacity; am, 09:00 time-slot; pm, 14:00 time-slot; eve, 21:00 time-slot.

in real time [11,12]. Forster, et al. suggested that there is an association between the level of hospital occupancy and length of stay for patients who require an inpatient bed [18]. Our study did not consider length of stay, which would have been helpful. It would therefore be disingenuous to suggest that the cause for access block is not multi-factorial. One basic factor of a successful hospital is a smooth patient flow, that is, movement of patients through the service transitions [19]. Poor and weak patient flow through the network of queue creates poor patient care situations, patient discontent and unsatisfied staff [19]. Most research concurs that the magnitude of EC crowding is a reflection of a whole system flow pathology [20–23]. In other words, crowding in an EC exists not because of an EC problem but because of a hospital problem. Although not directly measured, it is evident that there is likely to be a systemic patient flow problem that requires further attention; non-EC doctors more than doubled during the day on week shifts, in significantly more numbers than EC doctors, suggesting that many of the patients in the EC were likely to be boarded. With a finite number of spaces available in the EC and the larger number of patients negotiating these, it is likely that many did not end up in a space conducive to their state of health.

There were a number of limitations to this study. Patient arrivals, acuity, length of stay, and downstream system barriers that affects boarding and EC-related crowding were not directly explored. It was not the intended purpose of the study; however, including these would have made the study stronger. Given that nearly all systems and data available to describe flow locally are fairly rudimentary, paper-based and lacking an electronic record, significant resources would be required to evaluate these in any detail. This would likely be exacerbated in even less-resourced ECs such as those north of the South African border. More work is required to define simple, cost-effective ways to track crowding within settings that lack adequate resources to collect and maintain the data to do so. Identifying details of the crowd allowed a simple overview of the problem, along with the discussed inferences, at an achievable budget. The lack of randomisation in selecting the four-week data collection period was an additional limitation, but was simply not practical given timelines and resource restrictions. The study team acknowledges the effect this might have had on generalisability and bias as it pertains to seasonal differences and normal variation. As a preliminary study in a single, high-patient turnover setting, the findings may therefore not reliably reflect the situations in other, local public hospital ECs. Anecdotally, however, most local public hospitals struggle with similar large patient numbers. Ours is one of the first studies to document crowding locally and is likely to present findings that many local public ECs would be able to relate to. Patients were not specifically identified as EC or non-EC. This would have required a different level of consent to allow access to patients' medical records. Unfortunately the study team did not have the resources for such a design. Although non-EC nurse numbers are provided as part of the sample, it is unlikely that they contributed to anything but crowding because non-EC nurses were mainly found to be loitering in the EC during data collection. Their presence in the sample may give an inaccurate perspective of the number of clinically engaged nurses. Occupancy was calculated as bed and clinical chair spaces inside the EC. Chairs in the minor ailments area waiting room were not included, but the three examination stretchers in this area were. These three beds, as well as the bed in the procedure room, are technically high turn-over spaces which patients do not occupy for extended periods of time (for instance, boarding). Not including these four beds would have resulted in an even higher occupancy rate.

Conclusion

Describing the people that contribute to the EC crowd in a low- to middle-income country may provide a uniform template for defining the contribution to the EC crowd where resources to perform a more detailed analysis are lacking. For our setting this can be summarised around three focal points: staff levels fluctuate predictably with less staff at night and over the weekend but with patient numbers remaining constant; visitors make up a substantial number of persons overall in the EC; and EC occupancy rates tend to be high, matching reported occupancy rates on the wards. We concur with Gilligan et al. that there is an association between the volume of patients and other people groups that contribute to the EC crowd. Replication of this study in other low resourced centres may provide a valuable insight into the make-up of the African EC crowd. As a descriptive study, findings should be carefully interpreted. Further research is recommended on EC crowding, specifically more research of flow and access block metrics that can be tracked at a relatively low cost, qualitative research of the perceptions of staff, patients and visitors regarding safety and quality, and the effect of crowding on quality of care and patient safety.

Conflicts of interest

Stevan Bruijns is an editor for the African Journal of Emergency Medicine. All peer reviews are performed blinded and the author was not involved with the editing of this paper. The authors declare no further conflict of interest.

Dissemination of results

The findings were shared at the African Conference on Emergency Medicine in Cairo (2016) as well as with the hospital management.

Author contribution

EA, SL and SB contributed to the conception and design. EA collected the data and did the initial analysis. EA and SB interpreted the data and wrote the first draft. SL contributed to the draft. All authors approved the final version of the paper. SB is the guarantor of the work.

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