TWO EMERGENCY DEPARTMENTS, 6000 KILOMETERS APART: DIFFERENCES IN
PATIENT FLOW AND STAFF PERCEPTIONS ABOUT CROWDING

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ABSTRACT

Introduction: Emergency department (ED) crowding is a worldwide public health issue. In this study, patient flow and staff perceptions of crowding were assessed in Pakistan (Aga Khan University Hospital (AKUH) and in the Netherlands (Medical Centre Haaglanden Westeinde (HMCW)). Bottlenecks affecting ED patient flow were identified.

Methods: First, a one-year review of patient visits was performed. Second, staff perceptions about ED crowding were collected using face-to-face interviews. Non-participant observation and document review were used to interpret the findings.

Results: At AKUH 58,839 (160 visits/day) and at HMCW 50,802 visits (140 visits/day) were registered. Length of stay (LOS) at AKUH was significantly longer than at HMCW (279 minutes (IQR 357) vs. 100 minutes (IQR 152)). There were major differences in patient acuities, admission and mortality rates, indicating a sicker population at AKUH. Respondents from both departments experienced hampered patient flow on a daily basis, and perceived similar causes for crowding: increased patients’ complexity, long treatment times, and poor availability of inpatient beds.

Conclusion: Despite differences in environment, demographics, and ED patient flow, respondents perceived similar bottlenecks in patient flow. Interventions should be tailored to specific ED and hospital needs. For both EDs, improving the outflow of boarded patients is essential.
INTRODUCTION

Background

One of the most critical issues affecting emergency department (ED) delivery of care worldwide is crowding [1]. ED crowding is defined as a state where care demands exceed available resources, resulting in long waits for tests and treatments [2-4]. Crowding is a major barrier to receiving timely emergency care and it contributes to poor quality care, such as prolonged waiting times, increased suffering for those in pain, poor clinical outcomes, delays in treatment and increased risks of adverse outcomes [5-10]. Supply-demand mismatch is often caused by large hour-to-hour, and day-to-day variation in care demands where large swings in demands exceed ED resources – including staff, treatment spaces, and interdependent resources – which results in long waiting times. In addition, one of the major causes for ED crowding is by delays in accessing inpatient beds for admitted patients (i.e. boarding), which throughout the day consumes more ED resources, leaving less staff and space to care for newly arriving patients.

The causes, consequences, and solutions for ED crowding have been extensively described in hospitals in the USA, Canada, Australia [2,4,11-13] and Europe [14-16]. However, the problem is not limited to high-income countries: ED crowding is also an issue in lower middle-income countries such as Pakistan [17]. Although no comparison has been made between crowding issues in high-income versus lower middle-income countries, fewer resources may result in more severe crowding in lower middle-income countries.
The aim of our study was to compare patient flow and staff perceptions of the causes and solutions of ED crowding in two EDs: one in a lower middle-income country (Pakistan) and one in a high-income country (the Netherlands). By comparing patient flow and staff perceptions regarding crowding, we sought to identify bottlenecks affecting patient flow in the ED and provide insight into promising solutions.

**METHODS**

**Design**

We conducted an exploratory mixed method study incorporating a retrospective review of patient visits and semi-structured face-to-face interviews, non-participant observation, and document review. This combination of methods was chosen to provide a more complete understanding and interpretation of the quantitative data and details of the differences and similarities in patient flow and perceived crowded conditions between the two EDs. The study was performed in two EDs: the Aga Khan University Hospital (AKUH), an academic university centre in Karachi, Pakistan, and Haaglanden Medical Centre Westeinde (HMCW), a level 1 trauma centre in the Hague, the Netherlands.

**Setting**

The AKUH is a mixed adult and paediatric academic medical centre with 60,000 ED visits per year. Patient care in a broad range of secondary and tertiary care services is provided to all patients who present for care. Patients who are unable to pay for treatment, receive assistance through the hospital's patient welfare program. The 62-bed ED is staffed by emergency physicians (EPs), residents from the emergency medicine training program, and rotating senior residents from the departments of Medicine, Surgery, and Pediatrics. At arrival, patients are triaged by nursing staff, assisted by physicians. After triage, patients are registered and advised to wait in the waiting room in case of non-
availability of ED beds. Critical patients (acuity 1 and 2) are immediately led to the resuscitation area. Per shift, 20 nurses are available, most of them recently (<1 yr) graduated from nursing school.

The HMCW is a mixed adult and paediatric teaching hospital, with 52,000 ED visits annually. The 24-bed ED serves as a regional trauma centre. All incoming patients are registered before they undergo triage. A certified emergency nurse (CEN) performs the triage. This CEN decides whether patients need hospital emergency care or may be assessed by an emergency nurse practitioner (ENP) or general practitioner (GP), based on the triage outcome. The latter are redirected to the GP cooperative (GPC). Critical patients are brought to an ED room. When no beds are available, patients with acuity levels 3-5 wait in the waiting room. Per shift, 8 nurses (CENs, CENs in training, or ENPs) are available.

Hospital profiles are listed in Box 1.

Data collection

A retrospective review of all patient visits was conducted using data from August 1, 2014 to July 31, 2015. Data included arrival time and date, demographics, acuity level, length of stay (LOS) and disposition (discharged home, hospital admission, transferred to other facility, left without being seen, left against medical advice, dead). Acuity levels were registered according to 5-level triage scales in which acuity 1 (Immediate, Priority (P) 1) has the highest priority and 5 (Non-urgent, P5) has the lowest priority. Examples of P1 patients are patients in respiratory or cardiopulmonary arrest, major head trauma, unresponsiveness, or active seizures [18,19].

Additionally, we used three qualitative sources for evidence: face-to-face semi structured interviews, non-participant observation [20], and document review. Data were collected by two researchers through 14 site visits per ED between August and November 2015, varying in length between 1 to 3 hours. ED and hospital staff were instructed to help and support the researchers with the data collection by hospital management. The researchers acted together during all three parts of the qualitative data collection, individually taking notes. For the interviews, purposive sampling was used to recruit those informants that were, according to hospital leadership and ED management, most
likely to have relevant information regarding ED processes. Interviews were conducted using an interview guide which was developed by the researchers and included open-ended questions regarding the causes of crowding and interventions to decrease crowding. Eighteen one-hour interviews were conducted with hospital administrators (1 in each setting), ED nurse managers (1 in each setting), ED nurses (4 in AKUH, 2 in HMCW), nurses and nurse managers from inpatient units (3 in AKUH, 1 in HMCW), EPs (1 in each setting) and other physicians (2 in AKUH). All respondents were questioned individually at their workplace. After 18 interviews (12 in AKUH) and 6 in HMCW) no new relevant knowledge was obtained (data saturation). Observations were performed at EDs, inpatient units, Operation Rooms, and Admission Offices. Observations focused on patient flow through the ED, and as such, the processes from waiting room, triage, and placement in an ED bed, to the diagnostic procedures and physician assessment, admission procedures and outflow of the department were observed. Finally, 24 documents that might add knowledge about the patient flow processes were reviewed. These documents included medical and nursing notes of 16 patients (8 per hospital), admission policies (1 per hospital), transfer protocols (1 per hospital), triage protocols (1 per hospital), and procedures for internal transportation (1 per hospital).

Ethical considerations

As the current project originated from a consultancy assignment carried out at the request of AKUH management, use of the data for scientific research and publication was not foreseen originally. Therefore, ethical review committee approval was not obtained before the moment of first data collection. While ethical approval for re-use and publication of the data was sought later, the ethical review committee at AKUH was not authorized to evaluate the re-use of data collected at a previous point in time. Formal ethical approval of the study is therefore only available from the Dutch ethical review committee (METC Southwest Holland, nr.15-111), which granted review board exemption. The patient datasets from both countries did not contain individual identifiers. In both countries, informed consent was gained before the interview began; the respondents were fully informed of the nature and purpose of the project, and the voluntary nature of their participation was emphasized. In both countries, consent for non-participant observation and document review was provided by hospital
leadership and ED management. Close involvement of authors from both countries in the project and
the writing process ensured correct interpretation of location-specific findings.

Data analysis

Quantitative data were entered in SPSS v.22. Data were reported as mean and standard deviation (SD),
or, in case of skewed distribution, median and interquartile ranges (IQR). Data were analyzed using
two-tailed \( t \) tests, Mann Whitney U tests, and \( \chi^2 \) tests where appropriate. Statistical significance was
set at \( P < 0.05 \).

The transcription of the interviews was completed within 12 hours of the interview. Two researchers
read these transcripts several times to achieve a general feeling of the whole. Then the transcripts were
analyzed using inductive content analysis [20]. The unit of analysis was text relating to the
respondents’ perceptions of causes of crowding and interventions to reduce crowding. The text within
the unit of analysis was extracted to meaning units; the meaning units were then condensed, coded and
categorized [21] (Table 1). A pre-determined framework was used for the codes, based on the
conceptual model of ED crowding [22], which structures crowding causes and interventions into ED
input, ED throughput, and outflow of the ED / exit block. Where there was ambiguity, the final coding
was determined by mutual agreement. Categories were causes of ED crowding and interventions to
reduce crowding. Finally, we used member-checking with the respondents to verify the accuracy and
validity of the codes and categories.

Observation notes and document review notes were transcribed within 12 hours. First, two researchers
labeled the notes and coded and categorized the notes the same way as the interview data. Then the
notes were shared and reviewed by the same two researchers. Second, we used member-checking by
sharing initial drafts of the results with ED management to verify the accuracy and validity of the
observations and document review.

RESULTS
The results emerging from the analysis are described below.

**Patient and visit characteristics**

At AKUH 58,839 ED visits were registered during the 1-year study period (160 visits/day, min. 117 - max. 247 visits). At HMCW 50,802 ED visits were registered (140 visits/day, min. 94 - max. 186 visits). Both EDs have peak times in patient arrivals between noon and 8 pm, but at AKUH the peak lasts until midnight (Figure 1).

Basic characteristics are shown in Table 2. Median LOS at AKUH was 279 minutes (IQR 357). For 37.9% of the AKUH patients LOS exceeded 6 hours. Median ED LOS at HMCW was 100 minutes (IQR 152). Only 3.3% of the patients at HMCW had LOSs >6 hours. There were major differences between AKUH and HMCW in acuity. Almost 17% of AKUH patients were assigned a P1 acuity, while this was 1% of HMCW patients. The P4 and P5 acuities were assigned to 10% of AKUH patients, while in HMCW more than 42% of the patients were assigned a standard or not-urgent acuity (Figure 2). At AKUH, significantly more patients were admitted (35%) than at HMCW (20.9%, \(P<0.001\)). Also, mortality was significantly higher at AKUH (1.4% vs. 0.1%, \(P<0.001\)).

At AKUH, P1 patients have the longest LOS (387 minutes), followed by P2 patients (372 minutes). In HMCW, P2 patients have the longest LOS (168 minutes), followed by P3 patients (135 minutes) (Table 3 & Figure 2).

**Interviews**

Perceived causes for ED crowding

Respondents from both EDs indicated that crowding occurs on a daily basis. On an average day, the ED is crowded during 12 hours, from 12 AM until 12 PM (at AKUH) and during 4 hours, from 4 to 8 PM (at HMCW).

**ED Input:** Respondents from both EDs mentioned an increase in visits of patients with complex problems (Table 4).
Many of our patients first go to cheaper doctors, until they are very sick; AKUh is the hospital of last resort, so our patients are really in need for specialist care, they are almost all P1 or P2 (AKUh, physician).

HMCW respondents stated that the increase in severity is caused by the increase in geriatric patients with comorbidities, and the increase in number of referred patients since the implementation of the GPC.

Patients are getting more and more complex and also more and more elderly present to the ED (HMCW, ED nurse).

**ED Throughput:** Respondents at both EDs mentioned delays in triage and long waiting times for diagnostics. The actual waiting times for diagnostics differed from “up to 6 hours” at AKUh to “up to 2 hours” at HMCW. The delay in decision-making process, especially in patients needing admission was also mentioned by respondents at both EDs. At AKUh, a specialty consultation is required in order to process the decision for admission, and these specialties often order extra diagnostic tests. At HMCW, EPs are allowed to admit patients independently, but involvement of multiple medical specialists delay the process. The lack of experienced nursing staff was mentioned at AKUh. Also, financial issues were mentioned by AKUh respondents. Patients keep ED beds occupied until advance payment is arranged by their family.

Money issues delay the admission process “[…]”. During the day, a financial help is available for the ED. During the evening, there is only one financial help for the entire hospital (AKUh, admission coordinator).

**Outflow of the ED / Exit block:** Staff of both EDs mentioned high hospital occupancy rates and a shortage of available inpatient beds.

Sometimes, there is no bed available in our hospital and we’re waiting for an ambulance to bring the patient to another hospital, and sometimes we’re just waiting for a nurse from an inpatient unit. Meanwhile, new patients can’t get in (HMCW ED nurse).
AKUH respondents stated that research and education activities are organized in the morning, and inpatient patient care in the afternoon. Therefore, inpatient beds come available in the evening and patient transfer from the ED to the wards is delayed (up to 8 hours waiting time at the ED, for the majority of the admitted patients). HMCW respondents also mentioned delayed patient transfer to the wards, in particular when more than one medical specialty is involved (up to 4 hours, for less than half of the admitted patients).

Interventions that would be helpful in mitigating ED crowding according to the respondents

**ED Input:** Some AKUH nurses would like to be educated as ENP to handle patients with minor injuries and minor illnesses.

**ED Throughput:** Respondents wished for more mandate of EPs at AKUH, to cut back the delays in reaching a decision to admit or discharge a patient. AKUH respondents emphasized the need for more efficient processes for diagnostics, pharmacy, and financial issues, as well as a higher level of education for the nurses.

**Outflow of the ED / Exit block:** respondents at both EDs stated that an Acute Admission Unit (AAU) would be the solution to the crowding problems. The coordination of the discharged patients before noon was mentioned by the Admission Coordinator at AKUH.

The respondents at HMCW considered a more effective hospital bed coordination the most important intervention to decrease ED crowding.

At both EDs, respondents wanted additional nursing staff and EPs.

Observations and document review

Observations at both EDs supported the remarks mentioned by the respondents: delays in triage (both), in the decision-making process (both), in diagnostic imaging and laboratory results (AKUH), and inpatient boarding (both) were observed. Delays at AKUH were longer than delays at HMCW. There
was also a difference in activities and tasks of the nursing team; AKUH nurses wait for instructions of
the physicians. The CENs at HMCW are allowed to request a variety of diagnostic procedures and
administer analgesia without a physicians’ order. Guidelines regarding nurse-initiated medication
prescriptions and diagnostics are readily available for ED staff.

A real-time patient tracking system is available at HMCW, which warns ED staff when a patients’
LOS approaches 4 hours and when target times to treatment elapse. AKUH staff working in the
treatment bays cannot overview the waiting room, and have no visual on the patients waiting for triage
and patients with elapsed target times to treatment.

DISCUSSION

Although patient populations and acuities differ between the EDs, both experience regular crowding.
Contributing factors to crowding are similar: increased patients’ complexity, long treatment times, and
poor availability of inpatient beds. In both hospitals, ED crowding is caused by exit block from the ED
and the resulting boarding of admitted patients. In addition, at AKUH major throughput causes are
apparent: lengthy patient stays, waits for physicians’ decision-making, and other time-consuming
circumstances such as the pharmacy process and waits for financial clearance. At HMCW, patient
outflow is considered an essential intervention. At AKUH throughput as well as output should be
improved.

Both EDs have struggled against crowding for years. At HMCW, crowding is a problem since 2002.
To improve patient flow, standing orders are used: triage nurses are trained to request analgesia, x-rays
and blood tests. In response to an increasing demand for emergency care, an ENP service was
established to handle non-urgent patients. Furthermore, flexible bed management was implemented to
improve outflow of admitted patients [23]. Waiting times and LOSs were cut back with two hours per
patient and are nowadays short in comparison with international standards [24].
At AKUH, ED crowding was first described in 2004 [25]. To improve patient flow a dedicated triage bay with 24/7 cover and physician-assisted triage (PAT) was introduced. PAT has been shown to improve patient flow [26]. The number of treatment bays at the AKUH ED was expanded from 26 to 49 in 2008 and then to 62 in 2012. Personnel still experience a shortage of treatment bays, which is not surprising given the lengthy stays of patients.

Differences between the EDs were mainly found in the throughput phase, or more specifically, the time spent in the ED. Some problems at AKUH are not an issue at HMCW, such as the lack of experienced nursing staff (almost all nurses have a CEN-degree), financial issues (Dutch citizens have basic health insurance) and the time-consuming pharmacy process (a pharmacy-depot is readily available at the HMCW ED and nurses are allowed to arrange the needed medication themselves).

According to the respondents, the long LOSs at AKUH are caused by delays in reaching a decision to admit the patient. This is supported by the quantitative data: even the P1-patients have long LOSs at AKUH (>6 hours). One would expect that patients in the highest level of acuity wait for a shorter period of time than patients in the lower acuities since criteria for admission are usually clear-cut: the patient needs intubation and ventilation, or another life- or limb saving intervention. Since P2 and P3 patients in general need more assessment in order to decide whether they need admission, their LOSs are expected to be longer than for P1-patients [27]. While this is the case at HMCW, it is not at AKUH. At AKUH, LOS increases simultaneously with acuity. Prolonged LOS is one of the throughput-causes of ED crowding [3].

AKUH staff perceived that crowding could be reduced by more efficient ED processes and by increased capacity within the hospital. Involving senior doctors in the rapid assessment and treatment could improve the decision-making process [28,29]. Waiting times for radiology and laboratory might reduce when installing service level agreements [29]. Coordinating the discharge process of hospital patients before noon could be helpful in speeding up the admission process at AKUH [28].

In both hospitals, urgency for improving flow is felt mainly in the ED and less in the hospital. At HMCW, ED staff is continuously focused on expediting patient flow. Having an average of 140
patients per day at a 24-bedded ED puts the focus on throughput and output, to be able to care for new, incoming patients. During crowding, an extra triage room is set up, inpatient units are summoned to pick up the admitted patients immediately and consultants are called by the EPs to help with the decision-making process. At the 64-bedded AKUH ED, nurses and EPs working in the treatment areas are not aware of the patients waiting for treatment in the waiting room and in triage. A patient tracking system visible for ED staff at AKUH could allow the nurses and EPs to anticipate on the incoming patients.

Crowding is an important patient safety issue [30,31]: patients presenting to a crowded ED experience poorer health outcomes [32]. Successful solutions to crowding are necessary to protect our patients. Individual organizations face different problems, and each organization should determine the best solutions to its crowding problem [8]. For example, early ward rounds at AKUH to match bed availability with demand is likely to improve patient flow at AKUH.

There are also similarities in possible solutions. Both hospitals may benefit from agreed, achievable, escalation policies: clear thresholds to what level of crowding is acceptable and when to recruit support from resources outside the ED, e.g. from inpatient units, admission office, and medical specialists. To achieve that, culture and process changes are necessary in both hospitals. Acknowledgement from hospital management and medical specialists that crowding is a hospital-wide patient flow problem is key for both EDs [33,34].

Limitations

This study represents an initial effort to compare patient flow and perceived crowding issues between a hospital in a lower middle-income country and one in a high-income country. The EDs were grossly similar, both being level 1 trauma centers in large cities. Differences between both countries in healthcare systems, patient populations, financial regulations, and pre-hospital care directly influence ED patient flow, which became clear during the interviews and observations. Still, the generalizability of our findings is limited. The HMCW is not representative to all EDs in high-income countries, and
AKUH is not representative to all other EDs in Pakistan nor to other EDs in lower middle-income countries. Moreover, we were not able to include crowding measures such as time to physician or other measures that can be linked to ED crowding besides patients’ LOS. While at HMCW waiting room time and crowding scores (NEDOCS) are available per 15 minutes, these data were not available at AKUH. More studies are needed to substantiate the impact of crowding in lower middle-income countries.

The second part of this study, by nature of being a qualitative assessment, does not attempt to generalize findings. We assumed that hospital administrators, ED staff, nurse managers, nurses, and EPs correctly assess the operations in their department. During the data analysis procedure, data were reviewed and discussed by two researchers to ensure inter-reliability. Furthermore, we used member-checking and triangulation to increase data and conclusion credibility and transferability.

Finally, the cultural diversity of the EDs should be considered. There are major differences in attitudes and major differences in workflow and environment. Not all solutions to crowding that are used in HMCW are equally applicable to AKUH and the other way around. However, the model of input, throughput, and output which we used to study the causes of crowding is very useful in recognizing the most important causes as well as the promising solutions for both EDs.

CONCLUSIONS

At the two EDs with different patient populations and different working strategies in two different countries, nurses and EPs experience bottlenecks in patient flow on a daily basis. Despite differences between the hospitals in environment, demographics, and health care organization, the causes of this hampered patient flow appear to be similar.

Solutions to mitigate crowding should be tailored to the specific ED and surrounding hospital, although improving the outflow of patients will improve patient flow in both EDs.
REFERENCES


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[34] Rabin E, Kocher K, McClelland M, Pines J, Hwang U, Rathlev N, et al. Solutions to emergency department 'boarding' and crowding are underused and may need to be legislated. Health Aff (Millwood ) 2012;31:1757-1766.


### Box 1. Hospital profiles

<table>
<thead>
<tr>
<th></th>
<th>AKUH</th>
<th>HMCW</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of ED beds</td>
<td>64</td>
<td>24</td>
</tr>
<tr>
<td>No. of staffed beds in hospital</td>
<td>597</td>
<td>300</td>
</tr>
<tr>
<td>No. of ICU beds in hospital</td>
<td>55</td>
<td>16</td>
</tr>
<tr>
<td>Triage system</td>
<td>Emergency Severity Index</td>
<td>Manchester Triage System</td>
</tr>
<tr>
<td>Triage staffing</td>
<td>Physician Assisted Triage</td>
<td>Certified Emergency Nurse</td>
</tr>
<tr>
<td>Average no. of physicians per shift</td>
<td>16 (3 consultants, 13 residents)</td>
<td>8 (1 consultant, 7 residents)</td>
</tr>
<tr>
<td>No. of nurses per shift</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>No. of nurse-assistants per shift</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>No. of nurse practitioners per shift</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Abbreviations:** AKUH, Aga Khan University Hospital; ED, emergency department; ICU, intensive care unit; HMCW, Haaglanden Medical Centre Westeinde.
Table 1. Example of Content Analysis Categorization

<table>
<thead>
<tr>
<th>Meaning Unit</th>
<th>Condensed meaning unit</th>
<th>Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>“The main problem are the patients who are waiting for a bed, ready to be</td>
<td>Patients waiting to get picked up by the nurses of the inpatient unit</td>
<td>Outflow of the ED / exit block</td>
<td>Perceived cause of ED crowding</td>
</tr>
<tr>
<td>admitted to the hospital, waiting and waiting in an ED exam room just to get</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>picked up by the hospital nurses.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The hospital nurses have no clue that when they [hospital nurses] don’t show</td>
<td>Hospital nurses have no clue of ED problem</td>
<td>Outflow of the ED / exit block</td>
<td>Perceived cause of ED crowding</td>
</tr>
<tr>
<td>up timely, we [ED nurses] have a problem.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Often, they [hospital nurses] are reluctant in accepting a new patient – as</td>
<td>Reluctance of hospital nurses in accepting new patients</td>
<td>Outflow of the ED / exit block</td>
<td>Perceived cause of ED crowding</td>
</tr>
<tr>
<td>if patients are not their core business!”(HMCW, ED nurse)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: ED, emergency department; HMCW, Haaglanden Medical Centre Westeinde.
Table 2. Visit characteristics (N=109,641)

<table>
<thead>
<tr>
<th></th>
<th>AKUH (n=58,839)</th>
<th>HMCW (n=50,802)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median ED LOS, minutes (IQR)*</td>
<td>279 (357)</td>
<td>100 (152)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LOS &gt; 6 hours (%., n)*</td>
<td>37.9 (22,313)</td>
<td>3.3 (1,676)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Gender, male (%., n)</td>
<td>53.3 (31,360)</td>
<td>52.3 (26,571)</td>
<td>0.001</td>
</tr>
<tr>
<td>Mean age, y (SD)**</td>
<td>35.1 (25.4)</td>
<td>41.4 (23.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age categories (%., n)**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;17 y</td>
<td>29.5 (17,384)</td>
<td>14.9 (7,556)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>18-60 y</td>
<td>49.1 (28,866)</td>
<td>61.6 (31,299)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&gt;60</td>
<td>21.4 (12,588)</td>
<td>23.5 (11,944)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Acuity level (%., n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No triage</td>
<td>0</td>
<td>2.5 (1,283)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>P1, immediate</td>
<td>16.7 (9,834)</td>
<td>1.0 (500)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>P2, high urgent</td>
<td>19.9 (11,688)</td>
<td>16.6 (8,440)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>P3, urgent</td>
<td>53.4 (31,427)</td>
<td>37.5 (19,032)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>P4, standard</td>
<td>8.2 (4,810)</td>
<td>41.3 (21,003)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>P5, non-urgent</td>
<td>1.8 (1,080)</td>
<td>1.1 (544)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Disposition (%., n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admitted to the hospital</td>
<td>35.0 (20,584)</td>
<td>20.9 (10,625)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Discharged home</td>
<td>52.2 (30,874)</td>
<td>57.2 (29,077)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Transferred to other facility</td>
<td>0.7 (435)</td>
<td>0.6 (312)</td>
<td>0.012</td>
</tr>
<tr>
<td>Dead</td>
<td>1.4 (825)</td>
<td>0.1 (59)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Left against medical advice</td>
<td>7.2 (4,257)</td>
<td>0.9 (458)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Left without being seen</td>
<td>0</td>
<td>0.4 (205)</td>
<td></td>
</tr>
<tr>
<td>Assessed by ENP</td>
<td>0</td>
<td>19.5 (9,888)</td>
<td></td>
</tr>
</tbody>
</table>
Other  3.2 (1,864)  0.4 (178)  <0.001

Abbreviations: AKUH, Aga Khan University Hospital; ED, emergency department; ENP, emergency
nurse practitioner; HMCW, Haaglanden Medical Centre Westeinde; IQR, interquartile range; LOS,
length of stay; SD, standard deviation.

*Based on 109,632 cases, due to 9 with missing data on LOS
** Based on 10,963 cases, due to 4 with missing data on age
Table 3. Length of stay per acuity level (N=108,358)

<table>
<thead>
<tr>
<th>LOS Level</th>
<th>AKUH (n=58,839)</th>
<th>HMCW (n=50,802)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS No triage</td>
<td>-</td>
<td>3 (27)</td>
<td></td>
</tr>
<tr>
<td>LOS P1, life-threatening</td>
<td>387 (415)</td>
<td>116 (149)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LOS P2, high urgent</td>
<td>372 (335)</td>
<td>168 (111)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LOS P3, urgent</td>
<td>254 (323)</td>
<td>135 (138)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LOS P4, standard</td>
<td>71 (117)</td>
<td>44 (98)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LOS P5, non-urgent</td>
<td>34 (50)</td>
<td>10 (24)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Abbreviations: AKUH, Aga Khan University Hospital; HMCW, Haaglanden Medical Centre Westeinde; IQR = interquartile range; LOS, length of stay.

*Based on 108,358 cases, due to 1,283 observations with missing data on acuity level and 9 missing data on LOS.
Table 4. Perceptions of causes for ED crowding, similarities of AKUH and HMCW

<table>
<thead>
<tr>
<th>ED INPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Increase in ED visits of patients with complex problems.</td>
</tr>
<tr>
<td>- Increase in severity over the years.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ED THROUGHPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Delay in triage</td>
</tr>
<tr>
<td>- Long waiting time for diagnostic procedures</td>
</tr>
<tr>
<td>- Delay in decision-making process, especially in patients needing admission, leading to long LOS.</td>
</tr>
<tr>
<td>- Delay in admission-time when more than one specialty is involved.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OUTFLOW OF THE ED / EXIT BLOCK</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Boarding of patients</td>
</tr>
<tr>
<td>- High hospital occupancy rate / shortage of available inpatient beds.</td>
</tr>
<tr>
<td>- Delayed transfer of patients to wards.</td>
</tr>
</tbody>
</table>

Abbreviations: AKUH, Aga Khan University Hospital; ED, emergency department; HMCW, Haaglanden Medical Centre Westeinde; LOS, length of stay.
Figure 1. Arrival times of the patients

Abbreviations: AKUH, Aga Khan University Hospital; HMCW, Haaglanden Medical Centre Westeinde.

Figure 2. Length of stay and No. of patients per acuity level
Abbreviations: AKUH, Aga Khan University Hospital; LOS, length of stay; HMCW, Haaglanden Medical Centre Westeinde.