# Medical expertise as a critical influencing factor on the length of stay in the ED
## A retrospective cohort study

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**Abstract**

Overcrowding in the emergency departments (ED) is a significant issue associated with increased morbidity and mortality rates as well as decreased patient satisfaction. Length of stay (LOS) is both a cause and a result of overcrowding. In Israel, as there are few emergency medicine (EM) physicians, the ED team is supplemented with doctors from specialties including internal medicine, general surgery, orthopedics etc. Here we compare ED length of stay (ED-LOS), treatment time and decision time between EM physicians, internists and general surgeons.

A retrospective cohort study was conducted examining the Emergency Department length of stay (ED-LOS) for all adult patients attending Sheba Medical Center ED, Israel, between January 1st, and December 31st, 2014. Using electronic medical records, data was gathered on patient age, sex, primary ED physician, diagnosis, eventual disposition, treatment time and disposition decision time. The primary outcome variable was ED-LOS relative to case physician specialty and level (ED, internal medicine or surgery; specialist or resident). Secondary analysis was conducted on time to treatment/ decision as well as ED-LOS relative to patient classification variables (internal medicine vs surgical diagnosis). Specialists were compared to specialists and residents to residents for all outcomes.

Residents and specialists in either EM, internal medicine or general surgery attended 57,486 (51.50%) of 111,630 visits to Sheba Hospital's general ED. Mean ED-LOS was $4.12 \pm 3.18$ hours. Mean treatment time and decision time were $1.79 \pm 1.82$ hours, $2.84 \pm 2.17$ hours respectively. Amongst specialists, ED-LOS was shorter for EM physicians than for internal medicine physicians (mean difference 0.28 hours, 95% CI 0.14–0.43) and general surgeons (mean difference 0.63 hours, 95% CI 0.43–0.83). There was no statistical significance between residents when comparing outcomes.

Increasing the number of EM specialists in the ED may support efforts to decrease ED-LOS, overcrowding and medical errors whilst increasing patient satisfaction and outcomes.

**Abbreviations:** ED = emergency department, LOS = length of stay, ED-LOS = emergency department length of stay, EM = emergency medicine.

**Keywords:** crowding, emergency medicine, emergency service, hospital, length of stay, specialization

## 1. Introduction

As the emergency department (ED) is open to the public, attendance can be unpredictable and there often exists a mismatch between available resources and patient demand.[1] Overcrowding occurs when there is insufficient space, resources and time to effectively provide care for patients during emergency conditions which may result in the delay of urgent assessment or treatment (e.g., recognizing a septic patient or initiating invasive ventilation).[1–9] Care provided by emergency medicine (EM) physicians involves the rapid assessment and treatment of various urgent, emergent and non-emergent medical conditions including initial stabilization and life-support measures.[1,2] Moreover, the ED establishes an essential link between hospitals and the community, capable of initiating care pathways between inpatient and outpatient settings. This is particularly important for individuals who lack access to other avenues of care.[1]

ED overcrowding correlates with many negative outcomes including the occurrence of medical errors,[3] higher morbidity and mortality rates[4] and increased patient dissatisfaction.[5] Increased length of stay (LOS) is both a cause and a result of overcrowding.[6,7] Thus, efforts to understand and reduce overcrowding often attempt to improve emergency department length of stay (ED-LOS).[8,9] Examples include: introducing triage protocols,[10] point-of-care laboratory testing,[11] optimizing patient throughput,[12–14] LOS targets[15,16] and increasing staffing levels.[17]

Few studies, however, have investigated caregiver factors and none that we are aware of have investigated the association between ED-LOS and physician specialty.[18,19] In Israel and many other countries where EM is still a relatively new specialty, there are insufficient residents and attending physicians to independently staff the ED 24 hours a day.[20] Thus, many EDs internationally are staffed by multidisciplinary teams consisting of EM physicians, internists and general surgeons along with a number of others staff roles.[20] Identifying an association between specialty (i.e., resident specific training) and ED-LOS may lead to better understanding of how to minimize ED-LOS through effective staffing of the ED, as well as justifying recruitment drives, public health policies and funding to relevant academic faculties.

In this retrospective cohort study, conducted at The Department of Emergency Medicine of Tel HaShomer/Sheba Medical Center, Israel, we compared ED-LOS, treatment time and decision time between EM physicians, internists and general surgeons.

## 2. Methods

### 2.1. Study design

This retrospective cohort study analyzed all presentations to our ED between January 1st, 2014 and December 31st, 2014 whose primary case physicians were ED, internal or general surgical specialists or residents. Data was collected using electronic patient records. The institutional review board of Sheba Medical Center approved the study and waived the requirement for written informed consent (Ref no: 2938-16-SMC). This manuscript was prepared in accordance with the STROBE statement for improved reporting of outcomes from observational studies.

### 2.2. Setting

The Sheba Medical Center is a university-affiliated tertiary referral hospital. It is the largest medical center in Israel with over 1500 beds and the third largest in terms of ED visits. It is a Level 1 trauma center with multiple tertiary facilities including specialist cardiac and neurological departments. The center has a single, large general ED where unscheduled, undifferentiated adult patients arrive in addition to separate obstetric, pediatric and ophthalmological EDs. In total, there are about 110,000 presentations to the general ED each year, with an additional 80,000 presentations to the specialist EDs.

### 2.3. Emergency medicine in Israel

Emergency medicine was officially recognized as a specialty in Israel in 1999[21] initially providing sub-specialty qualifications to doctors from various related fields.[22] In 2012, Emergency Medicine was accredited as a primary residency by the Israeli Medical Association Scientific Council. The number of emergency physicians continues to grow but is still inadequate to staff all EDs in Israel round-the-clock.[23]

Thus, specialists and residents in other fields (mostly internal medicine, general surgery and orthopedics) as well as non-specialist physicians supplement the ED workforce. Specialists are employed mostly in the morning and evening. Night shifts are generally filled by residents, interns and non-specialists (for example physicians assistants and paramedics) as part of their on-call duties.[23]

### 2.4. Participants

We extracted all visits to the center's general ED between January 1st, and December 31st, 2014 regardless of age. Cases were excluded in which the primary case physician was not a resident or specialist of either EM, internal medicine or general surgery (for example, patients referred to, orthopedics, obstetrics or pediatrics after triage, or initially attended by interns). Visits were followed from registration to discharge (including self-discharge), admission or death.

### 2.5. Data collection

Two electronic databases were accessed in order to collect the relevant data required for the study; "Chameleon" and "Rekord". "Chameleon" (Elad Health, Tel-Aviv, Israel) is a comprehensive electronic medical record software used in the center's ED and admission departments. Data extracted for each patient visit included age, gender, triage assessment, medical assessment, test results, treatments, diagnosis and primary case physician name.

"Rekord" (Kopel Reem, Herzliya, Israel) is a human resources management software and was used to cross reference physician name with data concerning specialty and level of seniority. As doctors' levels may change throughout the year, data regarding rank changes was collected from the human resources department in order to ensure that the correct level at time of presentation was used for each case.

### 2.6. Primary data analysis

The primary outcome of the study was ED-LOS relative to primary case physician specialty and level. ED-LOS was measured from arrival to discharge, admission, death or patient absconsion before discharge. The physician's specialty and level were independent variables. Levels were categorized into intern,

## Table 1

**Characteristics of emergency department visits according to physician specialty (n = 111,630).**

| Characteristic | Physician specialty | | | |
|---|---|---|---|---|
| **Residents** | **Emergency medicine** | **Internal medicine** | **General surgery** | **Interns** |
| Visits | 12,637 (11.32%) | 14,235 (12.75%) | 8182 (7.33%) | 21,022 (18.83%) |
| Sex, male | 6457 (51.10%) | 7401 (52.00%) | 4319 (52.80%) | 10,684 (50.80%) |
| Age (yr) | 60.73 ± 21.17 | 61.39 ± 20.59 | 40.02 ± 23.29 | 63.33 ± 20.09 |
| Visit outcome | | | | |
|   Discharge | 5745 (46.10%) | 6131 (43.80%) | 4832 (63.30%) | 9401 (45.30%) |
|   Admission | 6646 (53.30%) | 7745 (55.40%) | 2751 (36.00%) | 11,253 (54.20%) |
|   Death in the ED[*] | 20 (0.20%) | 41 (0.30%) | 4 (0.00%) | 17 (0.10%) |
|   Leaving against medical advice | 80 (0.60%) | 107 (0.80%) | 56 (0.70%) | 109 (0.50%) |
| **Specialists** | **Emergency medicine** | **Internal medicine** | **General surgery** | **Total** |
| Visits | 13,880 (12.43%) | 6048 (5.42%) | 2504 (2.24%) | 111,630 (100%) |
| Sex, male | 6843 (49.30%) | 2587 (42.80%) | 1293 (51.60%) | 58,189 (52.13%) |
| Age (yr) | 54.63 ± 22.2 | 46.56 ± 19.92 | 46.16 ± 22.19 | 49.03 ± 23.66 |
| Visit outcome | | | | |
|   Discharge | 7795 (57.30%) | 4166 (71.40%) | 1872 (77.30%) | 66,048 (59.17%) |
|   Admission | 5761 (42.30%) | 1609 (27.60%) | 538 (22.20%) | 41,630 (37.29%) |
|   Death in the ED | 32 (0.20%) | 1 (0.00%) | (0.00%) | 118 (0.11%) |
|   Leaving against medical advice | 58 (0.40%) | 56 (1.00%) | 11 (0.50%) | 635 (0.57%) |

[*] ED denotes emergency department.

resident, and specialist. Specialty categories of interest were emergency medicine, internal medicine and general surgery. To address possible bias due to different employment patterns and differences in performance between levels of seniority, we compared residents to residents and specialists to specialists.

Several secondary outcomes were also analyzed with respect to specialty and level including: time to treatment, measured from arrival to the first prescription administered in the event that a prescription was recorded; time to decision, measured from arrival to decision to admit or discharge. Treatment-time and decision-time were equal to ED-LOS if the patient died or left before the physician's action. Patient's age, gender, diagnosis and visit outcome were also extracted.

To address possible bias resulting from presentation specific factors between specialties, secondary analysis was also conducted on cases relative to their subdivision into internal medicine and general surgery based on diagnosis. Common ED diagnoses categorized as relating to internal medicine were: Chest pain, chronic obstructive pulmonary disease, pneumonia, headache, and renal colic. Common ED diagnoses categorized as relating to general surgery were: Abdominal pain, motor vehicle accident, and traumatic head injury.

To address possible bias due to variations in visiting patients' age between specialties, we also investigated the independent association of age with regard to ED-LOS.

### 2.7. Statistical methods

Analyses were performed using SPSS Statistics (IBM, New York, USA). Categorical variables were compared using $\chi^2$. Pearson correlation was used to evaluate the association between the age of visiting patients and ED-LOS. For analysis of presentation subgroups, quantitative variables were compared using the Student $t$ test. For all other parameters, quantitative variables were compared using analysis of variance with Bonferroni correction. $P$ values <.05 were interpreted as statistically significant.

## 3. Results

Table 1 displays patient characteristics for all cases analyzed in this study, including disposition outcomes and the level of their primary case physician. For all presentations to the ED during the period of this study, sex was approximately equal (52% male, 48% female) and average age was 49.03 years ± 23.66. Residents and specialists in either emergency medicine, internal medicine or general surgery attended 57,486 (51.50%) of 111,630 cases after excluding cases initially attended by interns (Table 1). Before correction for doctor specialty and level, mean ED-LOS was 4.12 ± 3.18 h/Mean treatment time and decision time were 1.79 ± 1.82 hours and 2.84 ± 2.17 hours respectively. Respective medians were 3.75 (2.45–5.60), 1.20 (0.50–2.32) and 2.47 (1.50–3.93) hours.

### 3.1. ED LOS relative to physician specialty and level

ED-LOS was shorter for cases led by an emergency medicine specialist when compared to internal medicine (mean difference 0.28 hours, 95% CI 0.14–0.43) and general surgery specialists (mean difference 0.63 hours, 95% CI 0.43–0.83). The difference in ED-LOS was not statistically significant between emergency medicine, internal medicine and general surgery residents (Table 2). LOS was on average shortest for patients seen by emergency medicine specialists, and was statistically significant when compared to all other physician groups.

Treatment time was shorter for emergency medicine when compared to internal medicine but not to general surgery. Decision time was shorter for emergency medicine than for internal medicine and general surgery. Treatment time and decision time were similar between emergency medicine and internal medicine but shorter than general surgery (Table 2).

### 3.2. Analysis of LOS relative to diagnosis classification and the impact of patient age

In a subgroup analysis of diagnoses related to internal medicine, ED-LOS, treatment time and decision time were shorter for

**Table 2**

**Comparison of measures according to physician specialty (n=57,486).**

| Measure | Physician specialty | | | Internal medicine - emergency medicine | General surgery - emergency medicine |
|---|---|---|---|---|---|
| **Residents** | Emergency medicine | Internal medicine | General surgery | Mean difference (95% CI) | Mean difference (95% CI) |
| ED-LOS* (hours) | 4.54±2.81 | 4.43±2.77 | 4.61±3.98 | −0.1 (−0.22 to 0.01) | 0.67 (−0.06 to 0.20) |
| Treatment-time (h) | 1.54±1.69 | 1.53±1.66 | 2.15±2.03 | 0 (-0.09 to 0.08) | 0.61[†] (0.50 to 0.72) |
| Decision-time (h) | 2.91±2.19 | 2.85±2.17 | 3.45±2.55 | −0.05 (−0.13 to 0.03) | 0.55[†] (0.45 to 0.64) |
| **Specialists** | Emergency medicine | Internal medicine | General surgery | Mean difference (95%CI) | Mean difference (95%CI) |
| ED-LOS (hours) | 4.11±3.02 | 4.39±3.26 | 4.73±3.98 | 0.28[†] (0.14 to 0.43) | 0.63[†] (0.43 to 0.83) |
| Treatment-time (h) | 1.64±1.88 | 2.39±2.27 | 1.58±1.51 | 0.76[†] (0.63 to 0.89) | −0.05 (−0.22 to 0.11) |
| Decision-time (hours) | 2.76±2.21 | 3.42±2.27 | 3.49±2.66 | 0.66[†] (0.56 to 0.77) | 0.73[†] (0.58 to 0.88) |

* ED-LOS denotes emergency department length of stay.
[†] P value <.001.

emergency medicine specialists compared to internal medicine specialists (Table 3). When comparing residents of the 2 specialties, ED-LOS and treatment time were similar whereas decision time was shorter for emergency medicine residents compared to those of internal medicine residents (Table 3).

Subgroup analysis of diagnoses related to general surgery revealed a similar ED-LOS and decision time between specialists. Treatment time was however reduced for emergency medicine specialists compared to general surgery specialists (Table 4). Residents of emergency medicine had a longer ED-LOS and decision time whereas treatment time was shorter in comparison to general surgery residents (Table 4).

Age was significantly associated with ED-LOS ($r=0.144$, $P<.001$). Age of patients treated by specialists was significantly higher for emergency medicine than for internal medicine ($54.63 \pm 22.20$ vs $46.56 \pm 19.92$ years, $P<.001$) and general surgery ($54.63 \pm 22.20$ vs $46.16 \pm 22.19$ years, $P<.001$). Age of patients treated by residents was significantly higher for emergency medicine than for general surgery ($60.73 \pm 21.17$ vs $40.02 \pm 23.29$ years, $P<.001$) but not for internal medicine ($60.73 \pm 21.17$ vs $61.39 \pm 20.59$ years, $P=.179$).

## 4. Discussion

This study of over 50,000 visits compared ED-LOS, treatment time and decision time between emergency medicine physicians,

internal medicine physicians and general surgeons. In this study ED-LOS and decision time were shorter for emergency medicine specialists when compared to internal medicine and general surgery specialists. Treatment time was shorter for emergency medicine specialists compared to internal medicine specialists. These differences amounted to 16.8 (6.4%) and 37.8 (13.3%) minutes less per visit when a patient was treated by an emergency medicine specialist compared to internal medicine and general surgery specialists, respectively.

For residents, we found no difference in ED-LOS, treatment time and decision time between emergency medicine and internal medicine but found shorter treatment time and decision time when compared to general surgery.

In a subgroup analysis of patients with diagnoses related to internal medicine (Table 3), we found that ED-LOS was shorter in emergency medicine specialists but not in residents compared to their internal medicine counterparts. In a subgroup analysis of patients with diagnoses related to general surgery (Table 4), we found that ED-LOS was shorter in emergency medicine specialists compared with general surgery specialists but longer in residents. These comparisons suggest that emergency medicine specialists perform faster than internal medicine and general surgery specialists even in internal and surgical visits, respectively.

When attempting to interpret the underlying factors affecting these results one must appreciate the specific approach and aims of individual specialties. Emergency medicine's emphasis on

**Table 3**

**Comparison of measures according to physician specialty in a sub-analysis of diagnoses related to internal medicine* (n=8129).**

| Measure | Physician specialty | | Internal medicine - emergency medicine |
|---|---|---|---|
| **Residents** | Emergency medicine | Internal medicine | Mean difference (95%CI) |
| ED-LOS[†] (h) | 4.24±2.29 | 4.24±2.37 | 0.01 (−0.13 to 0.14) |
| Treatment-time (hours) | 1.35±1.46 | 1.35±1.49 | 0.00 (−0.11 to 0.11) |
| Decision-time (h) | 2.51±1.87 | 2.64±1.98 | 0.13[‡] (0.02 to 0.24) |
| **Specialists** | Emergency medicine | Internal medicine | Mean difference (95%CI) |
| ED-LOS (h) | 4.08±2.58 | 4.41±2.55 | 0.33[§] (0.14 to 0.53) |
| Treatment-time (h) | 1.5±1.52 | 2.39±2.10 | 0.89[§] (0.67 to 1.11) |
| Decision-time (h) | 2.77±2.1 | 3.66±2.23 | 0.89[§] (0.73 to 1.06) |

* Diagnoses include: chest pain, chronic obstructive pulmonary disease, pneumonia, headache and renal colic.
[†] ED-LOS denotes emergency department length of stay.
[‡] P value <.05.
[§] P value <.001.

**Table 4**

Comparison of measures according to physician specialty in a sub-analysis of diagnoses related to general surgery[*] (n=5497).

| Measure | Physician specialty | | General surgery - emergency medicine |
|---|---|---|---|
| Residents | Emergency medicine | General surgery | Mean difference (95%CI) |
| ED-LOS[†] (h) | 5.21±3.14 | 4.8±3.49 | −0.41[‡] (−0.70 to −0.12) |
| Treatment-time (h) | 1.43±1.76 | 2.61±2.33 | 1.18[§] (0.92 to 1.44) |
| Decision-time (h) | 4.23±2.74 | 3.94±2.98 | −0.30[**] (−0.54 to −0.05) |
| **Specialists** | **Emergency medicine** | **General surgery** | **Mean difference (95%CI)** |
| ED-LOS (h) | 4.78±3.57 | 5.48±4.24 | 0.70[§] (0.35 to 1.05) |
| Treatment-time (h) | 1.76±1.82 | 1.93±1.78 | 0.17 (−0.06 to 0.39) |
| Decision-time (h) | 3.87±2.77 | 4.17±3.03 | 0.30[**] (0.04 to 0.56) |

[*] Diagnoses include: abdominal pain, motor vehicle accident, and traumatic head injury.
[†] ED-LOS denotes emergency department length of stay.
[‡] P value <.01.
[§] P value <.001.
[**] P value <.05.

protocols and decision trees that explicitly address the importance of minimizing ED-LOS and treatment/decision times on patient outcome act to facilitate rapid assessment and treatment. Dowd et al demonstrated that specialists of emergency medicine were faster at evaluating and treating patients in the pediatric ED when compared to pediatricians or family medicine doctors.[23] This aligns with our results that emergency medicine specialists also treat and decide faster when compared to their specialist colleagues working in the ED.

Both Thibodeau et al and Brennan et al noted a positive correlation between the cumulative level of experience, measured in terms of years of residence, and resident productivity.[24,25] A similar relationship is seen in our study when comparing EM specialists with residents. This effect may be more significant than at first appreciated when analyzing the data. Although emergency medicine emphasizes speed, residents start their training in the ED, whereas internal medicine and general surgery residents staff the ED only after gaining enough experience on the wards—usually from the second year onwards. This relationship between experience and speed may explain why no overall difference in LOS was seen between residents but was seen in the specialist cohort group, as well as the longer ED-LOS and decision-time associated with emergency medicine residents for surgical visits seen in our study.

Patient age is associated with greater case complexity as well as worse outcomes and prolonged stays, as described by Ackroyd-Stolarz et al.[26] Emergency medicine physicians saw significantly older patients, particularly when compared to general surgeons. It is likely therefore that emergency medicine physicians saw a higher proportion of complex patients that would have taken longer to admit or discharge. It is therefore possible that these data underestimate the ED-LOS difference between specialties.

## 5. Limitations

Variations in presenting complaints between specialties introduce inherent bias to the results. We attempted to address this issue by conducting subgroup analyses of patients with similar diagnoses. Moreover, we found that increased patient age correlated with an increased ED-LOS. Since emergency medicine specialists attended patients on average 8 years older than internal medicine and general surgery specialists and emergency medicine residents attended patients on average 20 years older than general surgery residents, it

is likely that age disproportionately affected the primary and secondary outcomes of emergency medicine physicians.

We did not record the number of completed residency or specialist years as part of our data collection. As the literature suggests there is a significant difference between the productivity of new and established residents, our results likely underestimate the effect of EM training on LOS for the resident cohort.[24,25]

Given the outcomes assessed in this study, we were not able to directly assess the possibility that shorter ED-LOS might come at the expense of quality of care. Despite this being an important consideration, the literature suggests that longer ED-LOS is associated with an increased risk of adverse events.[26]

Additionally, as this was a single-center study, is that our findings may not be representative of other institutes. Yet, as training is similar both within Israel and internationally, we would anticipate similar results. Finally, we had an underlying assumption that the first physician treating the patient was the case manager. This assumption is invariably false in cases where the first physician was an intern as the supervising physician would determine tests, treatment and disposition. These cases were therefore excluded from analysis. This may also have been false in cases where the patient's physician changed due to high levels of complexity or the initial physician's shift ended before case resolution.

## 6. Conclusion

In conclusion, this study found shorter ED-LOS and decision-time for emergency medicine specialists compared to internal medicine and general surgery specialists, as well as shorter treatment-time for emergency medicine specialists compared with internal medicine specialists. Increasing the number of emergency medicine specialists in the ED may benefit efforts to shorten ED-LOS, decrease crowding and medical errors, increase satisfaction and improve patient outcomes. Further research looking at LOS relative to patient age, complexity and exact physician level should be conducted to further validate our results. Other promising areas to investigate would be the effects of physician specialty on resource utilization, quality of care and patients' outcome.

## Author contributions

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