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Description of the effect of patient flow, junior doctor supervision and pandemic preparation on the ability of emergency physicians to provide direct patient care

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Abstract.

Objective. A pilot study to: (1) describe the ability of emergency physicians to provide primary consults at an Australian, major metropolitan, adult emergency department (ED) during the COVID-19 pandemic when compared with historical performance; and (2) to identify the effect of system and process factors on productivity.

Methods. A retrospective cross-sectional description of shifts worked between 1 and 29 February 2020, while physicians were carrying out their usual supervision, flow and problem-solving duties, as well as undertaking additional COVID-19 preparation, was documented. Effect of supervisory load, years of Australian registration and departmental flow factors were evaluated. Descriptive statistical methods were used and regression analyses were performed.

Results. A total of 188 shifts were analysed. Productivity was 4.07 patients per 9.5-h shift (95% CI 3.56–4.58) or 0.43 patients per h, representing a 48.5% reduction from previously published data ($P < 0.0001$). Working in a shift outside of the resuscitation area or working a day shift was associated with a reduction in individual patient load. There was a 2.2% (95% CI: 1.1–3.4, $P < 0.001$) decrease in productivity with each year after obtaining Australian medical registration. There was a 10.6% (95% CI: 5.4–15.6, $P < 0.001$) decrease in productivity for each junior physician supervised. Bed access had no statistically significant effect on productivity.

Conclusions. Emergency physicians undertake multiple duties. Their ability to manage their own patients varies depending on multiple ED operational factors, particularly their supervisory load. COVID-19 preparations reduced their ability to see their own patients by half.

What is known about the topic? An understanding of emergency physician productivity is essential in planning clinical operations. Medical productivity, however, is challenging to define, and is controversial to measure. Although baseline data exist, few studies examine the effect of patient flow and supervision requirements on the emergency physician's ability to perform primary consults. No studies describe these metrics during COVID-19.

What does this paper add? This pilot study provides a novel cross-sectional description of the effect of COVID-19 preparations on the ability of emergency physicians to provide direct patient care. It also examines the effect of selected system and process factors in a physician's ability to complete primary consults.

What are the implications for practitioners? When managing an emergency medical workforce, the contribution of emergency physicians to the number of patients requiring consults should take into account the high volume of alternative duties required. Increasing alternative duties can decrease primary provider tasks that can be completed. COVID-19 pandemic preparation has significantly reduced the ability of emergency physicians to manage their own patients.

Additional keywords: clinical services, health services management, performance and evaluation, workforce.

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Introduction

An understanding of emergency physician (EP) productivity is essential to planning clinical operations.[1] Medical productivity, however, is challenging to define, and is controversial to measure.[2] EPs in Australian public hospitals supervise junior doctors, manage patient flow, perform administrative duties and teach healthcare students while undertaking clinical shifts.[3] Kee *et al.* has quantified these tasks in the Australian setting,[4] and these results are reproduced with permission in Table 1. High workloads are thought to contribute to the very high burnout rates seen in EPs.[3] In addition, there is tremendous pressure felt by EPs in most emergency departments (EDs) to also have their own individual patient load, especially if this is considered a primary measure of performance.

Baseline data exist regarding EP productivity in Australia[5–7] and internationally;[1,8–11] for example, baseline productivity in an Australian private hospital setting has been measured at 1.04 primary consults per h in 2014 (1.32 patients per h total)[6] and in a mixed public and private setting at 0.81 primary consults per h in 2015–18 (1.13 patients per h in total).[5] A primary consult was when the physician was assigned as the main physician for the patient.[5] A secondary consult was a medical triage consultation in advance of another physician who then provides a full consult, or a patient handover.[5] The baseline productivity rate for patients has been measured as anywhere from 1.89[9] to 2.5[8] patients per h in systems outside of Australia.[8–11] It is interesting to note, however, that this figure includes supervised 'secondary consult' patients in the patient count. These figures give the administrator a measure of the primary consult output of an EP, but fails to capture all other aspects of productivity.[4]

Despite these studies, there are no explorations of the relative effects of various system and process factors that may impede EPs' ability to provide direct patient care. This is even more important given that EPs found that work tasks during February to June 2019 changed dramatically, and were additional to their ongoing usual load.[12] Box 1 describes some of these increased duties. To our knowledge, there are no studies that report on the effect of preparing for the COVID-19 pandemic on physician productivity.

In light of these additional challenges, the present study aims to: (1) describe the ability of EPs to provide primary consults at a metropolitan adult ED during the COVID-19 pandemic when compared with historical performance; and (2) to identify the effect of system and process factors on productivity.

Methods

Study design

This study was a retrospective, cross-sectional, observation of shifts worked by EPs between 1 February and 29 February 2020 at an adult tertiary referral centre in Melbourne. The primary outcome was a description of the mean number of patients seen per hour. The secondary outcome was the identification of significant predictors of productivity when productivity is defined as primary consults per hour. This study was approved by the Monash Human Research Ethics Committee (RES-20–0000–238 L).

Setting

Monash Medical Centre is a 640-bed tertiary teaching hospital that provides a range of surgical, medical, allied health and mental health services. The ED sees ~90 000 presentations annually. The hospital has a large emergency medicine training program and hosts interns, residents, medical students and international medical graduate observers. The adult patients and paediatric patients are seen in separate areas. This study examined the adult ED. Shifts worked are AM (0800 – 1730 hours), PM (1430 – 2400 hours) and midday (1030 – 2000 hours). Areas worked are classified into Acute (resuscitation bays and emergency mental health), Fast Track (ambulant injuries and illnesses), Short Stay Unit (a ward of rapid turnover, uncomplicated admissions) and Main (stretcher-based, complex patients). In-charge shifts involve maintaining overall responsibility for the ED including supervision, teaching and troubleshooting. There were always patients awaiting doctor assessment, so availability of patients to see was not a limiting factor for physician productivity.

Participants

Physicians were included if they were employed as a consultant EP and worked at least one shift in the study period at the study site. Usual work tasks are listed in Table 1. Only primary consults were recorded, so this was chosen as the primary outcome.

Measurements or variables

Productivity was defined as the number of primary consults per hour, measured only if the EP is recorded in the Electronic Medical Record (EMR) as the 'Treating Physician'. Shift variable data (shift type, shift timing, number of junior doctors supervised and in-charge role) were collected using hospital administrative databases.

Table 1. Consultant emergency physician time spent on specific task categories in the emergency department (ED)
Results of a 130-h time motion study.[4] © John Wiley & Sons, reproduced with permission

Categories	Subcategories	Time on tasks (min)		Task number
		Total	Per hour	Per hour
Communication		3247.0	25.0	37.4
	Other doctors	1348.1	10.4	13.0
	Phone call	675.2	5.2	4.2
	Nurses	637.9	4.9	12.5
	Patients' family	181.1	1.4	1.2
	Clerical staff	85.3	0.7	2.3
	Other staff	105.6	0.8	1.6
	Students	125.8	1.0	1.3
	Paging out	37.0	0.3	0.7
	Ambulance	37.5	0.3	0.5
	Police	7.6	0.1	0.1
	Other	5.9	0.0	0.1
Transiting	Walking between sites	686.7	5.3	19.3
Clinical care		2748.4	21.1	14.9
	In cubicle with patient	1970.5	15.2	5.6
	Reviewing patient file	663.3	5.1	6.4
	Thoughtful contemplation	53.4	0.4	2.1
	Outside cubicle	49.3	0.4	0.5
	Reading textbook	0.3	0.0	0.0
	Other	11.6	0.1	0.1
Computer use		1868.7	14.4	14.8
	ED Information System	1335.8	10.3	9.9
	Radiology	260.2	2.0	1.9
	Pathology results	207.3	1.6	1.9
	Medication reference	14.1	0.1	0.5
	Google	8.1	0.1	0.1
	Medical e-texts	6.8	0.1	0.1
	Other e-knowledge	2.6	0.0	0.1
	Other	33.8	0.3	0.0
Documentation		772.9	5.9	8.3
	Medical record	580.8	4.5	5.8
	Discharge letter	46.0	0.4	0.2
	Sick certificate	1.5	0.0	0.0
	Other	144.6	1.1	2.2
Non-clinical task		708.5	5.5	6.4
	Meals and breaks (off the floor)	400.2	3.1	0.1
	Left ED (unspecified)	87.4	0.7	0.1
	Snacks (on the floor)	21.3	0.2	0.3
	Drinks (on the floor)	20.5	0.2	1.0
	Bathroom	18.7	0.1	0.1
	Other	160.4	1.2	4.9
Pharmacy	Prescribing	29.8	0.2	0.2
Total		10 061.6	77.3[A]	101.4[A]

[A]Because of parallel multitasking, figures add up to more than 60 min in each hour and 100%.

Data sources and cleaning

Shifts were recorded on an intention-to-treat principle, so if the physician decided to swap to a different role on the day, this was not captured. Shifts taken as sick leave and personal leave were excluded. Number of years of Australian medical registration was extracted from the publicly available Australia Health Practitioner Regulation Agency database for each EP. Departmental factors (total patient presentations, percentage ED length of stay <4 h, non-admitted length of stay <4 h, admitted length of stay <4 h, admitted non-short stay length of stay <4 h) were generated from the Business Intelligence database for each day studied.

Sample size calculation

Using a population mean of 0.83 patients per h[5] $\times$ 9.5 h $=$ 7.89 patients per shift and a standard deviaton $\sigma = 1.70$ calculated using internal data, the sample size to detect a 10% productivity reduction from this previously published value for $\alpha = 0.05$ and power $= 0.80$ was 37 shifts.

Statistical analysis

Descriptive data were reported as percentages or means with interquartile ranges. Change in productivity was compared against the baseline of 0.83 patients per h,[5] using a two-tailed,

Box 1. Increased duties of emergency physicians during the COVID-19 pandemic[12]

COVID-19 preparations:

- Personal protective equipment (PPE) and scenario simulation training
- Undertaking hand hygiene training and certification
- Donning, doffing, and spotting PPE
- Infection control precautions for almost all patients
- Training junior and non-Emergency Department (ED) healthcare workers
- Notifying Department of Health of all suspected or confirmed COVID-19 patients (this was required during the early pandemic phase)

Communication

- Disseminating daily Department of Health protocol changes to ED staff (testing eligibility, contact definitions, PPE guidelines)
- Advice on COVID-19 recommendations and screening processes
  - In-hospital staff and hospital administrators
  - Community healthcare workers (GPs, paramedics, aged-care facility enquiries)
  - Patients, families and community members (e.g. for testing, isolation, test results)
  - Managing community enquiries about hospital safety and visiting rules

Clinical care

- Supervision of redeployed junior doctors with minimal emergency medicine experience
- Managing and assisting with ambulance safe entry into the ED for suspected COVID-19 patients
- Assisting with ED flow decisions to improve social distancing in EDs
- Supervision of nursing, orderly and cleaning staff regarding infection control requirements (including supervising room cleaning)

single-sample *t*-test. Univariate negative binomial regression was used to investigate individual determinants of the model. Statistically significant components ($P < 0.05$) were included in a multivariate regression model to calculate the direction and magnitude of effects. Effect was reported as exponentiated coefficients with 95% confidence intervals and *P* values. No missing data were noted for the period studied. Statistical analysis was performed in RStudio v1.2.5033 with base R v3.6.0 (RStudio, Boston, MA, USA). The code written for the study is available on Github (San Francisco, CA, USA).[13]

Results

Participants

Figure 1 shows the flow of eligibility. A total of 32 EPs were included in the study; 14 (43.8%) were female and 18 (56.3%) were male. Median experience in the Australian system (i.e. years of Australian registration) was 19 years (IQR 12.25–25).

Shift and day characteristics

The 32 EPs worked a total of 188 eligible shifts during the study period. The characteristics of these shifts are described in Table 2 and Figure 2. The majority of shifts were worked on weekdays (79.3%), in the Main area (45.7%) and in an in-charge role (83.0%). The AM (50.5%) and PM (47.3%) shift division was roughly equal. The average number of juniors requiring supervision was 2.4. These 188 shifts were worked over a total of 29 days. The characteristics of these days are described in Table 3. Level of bed access during the study period (percentage of non-short stay patients who were admitted to the ward in <4 h) was lower than usual for this site (11%, IQR 7.7–13.8%).

Key outcomes

The average number of primary patients seen by EPs per shift was 4.07 (95% CI 3.56–4.58), or 0.43 patients per h. This represented a 48.5% reduction in primary consults (3.8 patients per 9.5-h shift or 0.4 patients per h; $P < 0.0001$). Univariate negative binomial regression was used because the primary outcome measure mean was 4.07 and the variance was 12.7, demonstrating overdispersion. Day of shift, years of registration, shift type, shift time and the number of juniors supervised were included in the final model as these had a statistically significant effect on the primary outcome. Results of these analyses are described in Table 4. Working in a non-resuscitation setting (Fast Track, Main or Short Stay Unit) reduced the number of patients seen. Working a PM or swing shift significantly increased the number of patients seen. There was a 2.2% (95% CI: 1.1–3.4, $P < 0.001$) decrease in primary patient load with each year of Australian medical registration. This relationship is non-linear, with a steep drop in the first two decades followed by a gradual increase in gradient thereafter. This is described in Figure 3. There was a 10.6% (95% CI: 5.4–15.6, $P < 0.001$) decrease in primary patient load for each junior that needed to be supervised. This too was non-linear, with peak productivity occurring with one junior supervised. This is described in Figure 4. The volume of patient arrivals and the markers of departmental flow had no statistically significant effect on the productivity of each EP studied.

Discussion

This retrospective study provides a description of EP productivity in the context of multiple health service challenges. The key findings were: (1) productivity for primary consults dropped by 48.5% to 0.43 patients per h during COVID-19 preparation; (2) ability to provide primary patient care was decreased by working in an area outside of the resuscitation bay, working a day shift, increasing year of Australian medical registration and increasing number of juniors supervised; and (3) departmental flow had no significant effect on number of primary consults.

The productivity rate of 0.43 primary consults per h for this study was below previously reported results.[5–8] Australian EP productivity data exists in the literature;[5–7] these papers defined ED physician productivity as a count of primary and secondary consults per hour. The hospital studied underwent digital transformation of the entire network's electronic medical record the year prior, was undergoing renovations at the time and was experiencing the early stage of the COVID-19 pandemic. These factors may have been associated with reduced productivity. Actual non-primary consult productivity is very hard to measure, and this information is not collected routinely in Australia.

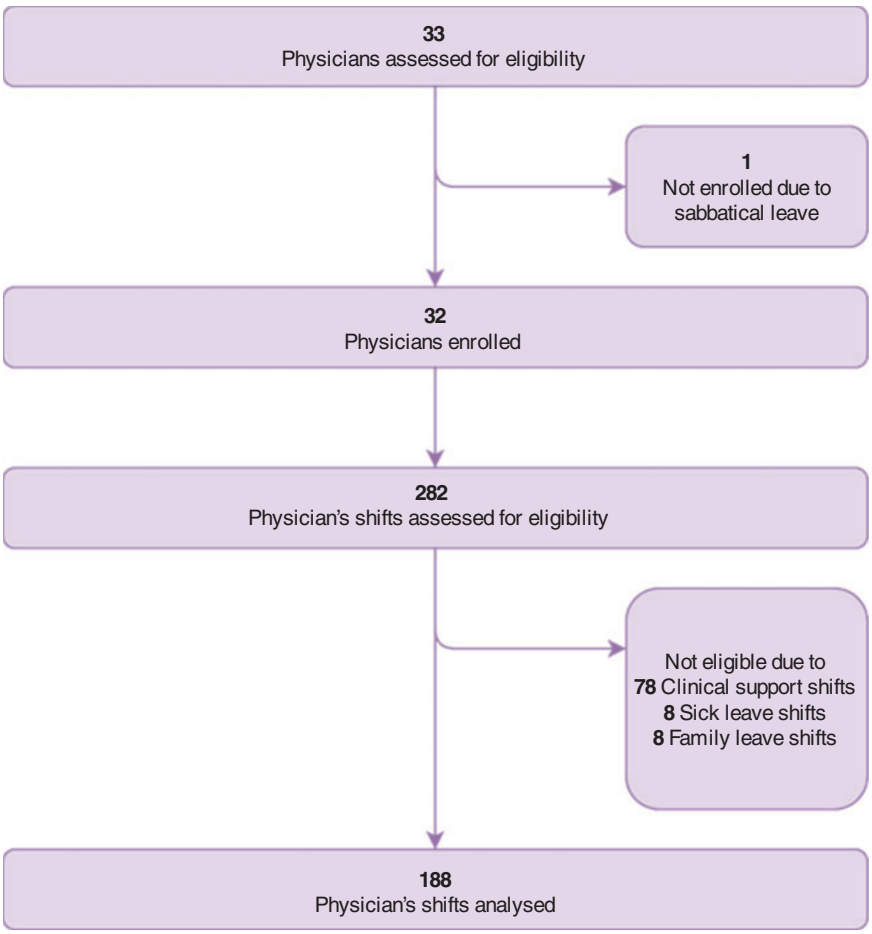

Fig. 1. Flow chart of the present study.

Table 2. Characteristics of the 188 shifts studied
IQR, interquartile range; SSU, Short Stay Unit; AM, ante meridiem; PM, post meridiem; EDLOS, emergency department length of stay

Variable	*n* (%)
Shifts	188 (100)
Day	
Weekday	149 (79.3)
Weekend	39 (20.7)
Shift type	
Main	86 (45.7)
Acute	47 (25.0)
SSU	30 (16.0)
Fast Track	25 (13.3)
Time	
AM	95 (50.5)
PM	89 (47.3)
Swing	4 (2.1)
In charge of the shift?	
Yes	156 (83.0)
No	32 (17.0)
	Mean (IQR)
Total patients seen	4.07 (2–6)
Juniors supervised	2.4 (1–4)

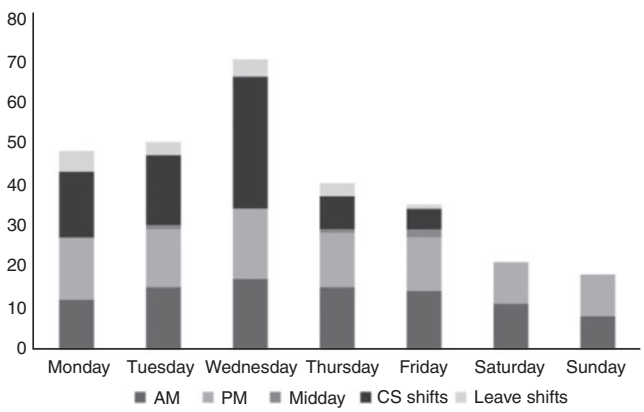

Fig. 2. Characteristics of the 282 shifts assessed by day of the week. AM, ante meridiem; PM, post meridiem; CS, clinical support.

EPs have very high hourly task rates (up to 101 per h), dominated by communication and clinical activities.[4] An increase in non-primary consult activity could explain the 0.43 patient per h result.

Table 3. Characteristics of the 29 days studied
IQR, interquartile range; EDLOS, emergency department length of stay; SSU, Short Stay Unit

System factor	Mean (IQR)
Total patient presentations	155 (145–165)
% EDLOS <4 h	41.6 (37.9–47.1)
% Non-admitted <4 h	53.1 (46.0–56.9)
% Admitted <4 h	30.6 (25.3–34.3)
% Admitted non-SSU <4 h	11.0 (7.7–13.8)

Table 4. Results of univariate and multivariate negative binomial regression
CI, confidence interval; FT, Fast Track; SSU, Short Stay Unit; PM, post meridiem; EDLOS, emergency department length of stay

Variable	Exponentiated coefficient	95% CI	*P*
Univariate Model			
Day (Weekend)	0.71	0.52–0.99	<0.05
Shift type			
FT	0.76	0.52–1.09	0.13
Main	0.54	0.41–0.71	<0.0001
SSU	0.30	0.20–0.45	<0.0001
Time			
PM	1.80	1.41–2.30	<0.0001
Swing	2.25	1.06–5.21	<0.05
In charge of the shift?	0.79	0.56–1.09	0.16
Years of Australian registration	0.98	0.97–0.99	<0.01
Juniors supervised	0.87	0.82–0.92	<0.0001
Total patient presentations	1.01	1.00–1.02	0.13
% EDLOS <4 h	0.75	0.12–4.81	0.76
% Non-admitted <4 h	1.32	0.26–6.69	0.74
% Admitted <4 h	0.58	0.12–2.92	0.50
% Admitted non-SSU <4 h	0.14	0.01–3.31	0.21
Multivariate Model			
Day (Weekend)	0.93	0.71–1.22	0.59
Shift type			
FT	0.68	0.49–0.96	<0.05
Main	0.67	0.51–0.88	<0.01
SSU	0.45	0.30–0.65	<0.0001
Time			
PM	1.64	1.30–2.07	<0.0001
Swing	1.99	1.04–3.88	<0.05
Years of Australian registration	0.98	0.97–0.99	<0.001
Juniors supervised	0.89	0.84–0.95	<0.001

Other studies have attempted to build a model to describe emergency doctor productivity changes by the hour.[1,14] Joseph *et al.* characterised the timing of new patient consults across shifts and found that there are predictable attenuations in this rate as the shift progresses for both EPs[1] and residents.[14] This was regardless of whether there were new patients waiting to be seen.[1,14] Our study differed in that it examined the shift as a whole and its macroenvironment rather than providing an hourly description.

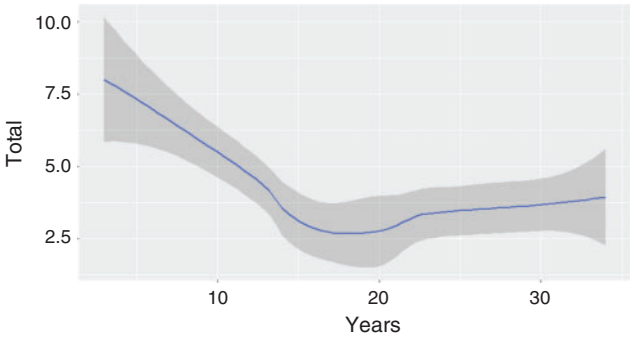

Fig. 3. Relationship between years of Australian registration and the number of primary consults per 9.5-h shift.

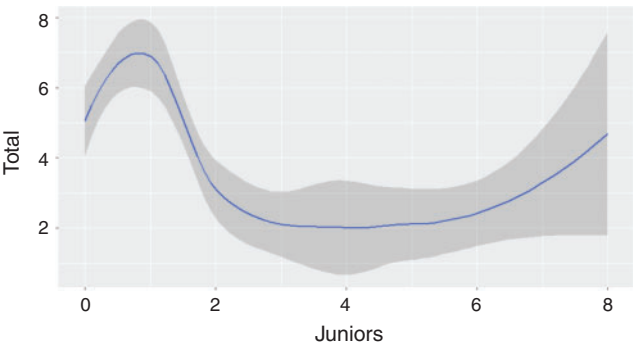

Fig. 4. Relationship between number of junior doctors supervised and the number of primary consults per 9.5-h shift.

Working in the acute setting increased the number of patients seen. These shifts are often worked with only one additional senior doctor to supervise, so this may allow the physician to see more primary consults. Working a swing or PM shift increased the number of patients seen, and this could be due to the known increase in presentation rate in the later stages of the day[15] or less alternative duties such as rostering and taking calls from physician's offices.

Increasing Australian experience reduced patients seen, and this may be the result of taking on a more supervisory role with increasing career time. As this study only measured the number of 'Treating Clinician' instances, it did not capture the times that a supervising EP rapidly reviewed a patient at triage, managed a deteriorating patient or provided a second opinion. Experience has been shown to increase hourly work productivity in the ED when measured by Relative Value Units[16] or patients per hour,[17] but this was United States data from emergency medicine residents (the equivalent to an Australian registrar).[16,17] The different doctor seniority and the different primary outcome measure makes this study less comparable with our results.

Increased supervisory loads were associated with decreased primary patient productivity, as this usually means spending more time reviewing patients as secondary consults. This contrasts with the American study that demonstrated that the requirement to supervise one resident (registrar) actually increased the rate of patients seen by the supervising physician (patients per h = 1.99 vs 1.87, $P < 0.005$).[18] This did not change with the level of resident (registrar) experience.[18] In contrast,

having a medical student to supervise resulted in the same rate of patients per hour as working alone.[18] Our study did not measure student supervisory loads.

Finally, although measuring primary productivity is one of a range of management strategies to monitor the health of a service, it is important to understand that the role of leadership in this situation is much broader. The pandemic poses a new situational challenge – technical (which personal protective equipment to use, what process to use to follow up potential exposures, etc.) and adaptive (building a new culture of staff safety, addressing staff concerns and anxieties regarding uncertainty, etc.). Such a problem calls for strong role modelling and for adaptive leadership, a process that mobilises people to address these complexities and thrive.[19] EPs are providing value to the health services and system by undertaking this work; this should be understood when interpreting individual patient productivity, which is a unidimensional measure of their performance.

Limitations

The study examined a single centre over an unusual 4 weeks. The shift data were prospectively collected for another purpose, so lacks rigorous verification. The primary outcome (patients per h) is only one aspect of productivity and does not take into account actions that are not recorded in the EMR. EPs have been recorded to perform up to 101 discrete tasks per hour,[4] and this aspect of productivity was not captured. Alternative measures such as Relative Value Units or Medicare Benefits Schedule billings generated do not apply in public Australian EDs.

Conclusions

The ability of EPs to provide primary consults at a metropolitan emergency department during COVID-19 preparations was significantly reduced when compared with historical performance. As years of Australian registration progresses, supervisors may take less of a primary provider role and concentrate instead on supervising. Bolstering numbers with junior staff may slightly increase the efficacy of the team, but it comes at an opportunity cost to the supervising EP. These findings are valuable for any healthcare practitioner who influences ED resources.

Competing interests

The authors declare no competing interests.

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