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Duration of consultant experience and patient outcome following acute medical unit admission. An observational cohort study.

Abstract

Background: The effect of duration of consultant experience on clinical outcomes in the acute medical unit (AMU) model remains unknown.

Methods: Unscheduled acute medical admissions (n=66929) admitted by 56 consultant physicians between 2017 and 2020 to two large teaching hospital AMUs in Lothian, Scotland were examined. The association of consultant experience on AMU discharge, mortality, readmission and post discharge death were calculated adjusting for clinical acuity, pathology and comorbidity.

Results: Increasing consultant experience was associated with a continuous increase in likelihood of early AMU discharge (OR 1.08; 1.07 to 1.10 $p < 0.001$ per 5 years experience) which persisted after adjustment for confounders (1.06; 1.01 to 1.11 $p = 0.01$). There was no association with early readmission, death after discharge or 30-day inpatient mortality. The marginal effect estimate translates into 31 (95% CI 25-36), 41 (95% CI 30-53) and 52 (95% CI 35-71) additional safe discharges per 1000 admissions for clinicians of 15, 20 and 25 years respectively in comparison to those recently completing training.

Conclusions

Increasing consultant physician experience associates with early safe discharge after acute medical unit admission. These data suggest that the support and retention of experienced clinicians is of key importance if escalating pressures on unscheduled medical care are to be addressed.

Introduction

The impact of duration of physician experience on patient outcome remains disputed (1,2). Increasing duration of practice may be expected to result in greater cumulative clinical skill however also presents the challenge of maintaining current best practice. Evidence suggests that increasing clinical experience is associated with improved outcomes in some surgical and obstetric studies (3–6) but not others (7–9). Data on the effect of duration of experience on unscheduled medical hospital admissions are similarly conflicting. Single centre retrospective analyses from Dublin Ireland report a significant reduction in 30 day mortality and reduce length of stay in ‘high risk’ patients (10,11) (9). Conversely, single and multicentre studies in the US healthcare system report an increased length of stay and mortality with longer duration of practice (12,13) whilst a similar studies from the UK and Canadian healthcare systems report no significant effect (14,15)

Only two reported study cohorts have been within the acute medical unit (AMU) model (10,11,14). AMUs present an essential relief point for emergency medicine departments which have been under increasing strain in the UK. As such an essential role for AMU consultant physicians is to safely discharge patients who do not require inpatient care in order to promote patient flow and relieve departmental congestion (16).

The association between consultant experience on patient outcome following AMU admission remains uncertain. In light of current concerns regarding the loss of experienced physicians due to early retirement or ‘burnout’ (17,18) understanding the value of experience is of paramount importance if increasing pressures on unscheduled care are to be addressed. To investigate this further, we examined the relationship between duration of consultant experience and rates of immediate AMU discharge, 30 day inpatient mortality, and 7-day hospital readmission and post discharge death in patients admitted to two large teaching hospital AMUs in Lothian, Scotland.

Methods

Study design and setting

A retrospective observational study was performed across two secondary care hospital AMUs (Royal Infirmary of Edinburgh and Western General Hospital, Edinburgh) in NHS Lothian, a health board providing care for around 800,000 residents in southeast Scotland. AMU admissions in Lothian are referred from emergency medicine departments, general practices and out of hours general practitioner services. All AMU consultant admissions were included during a three year period (01/04/2017 to 31/03/2020). This period was select as the point at which data were reliably available (1st April 2017) until the point at which COVID-19 social restrictions were implemented, significantly altering admission case mix (19). Only NHS Lothian residents were included in the study to maximize completeness of readmission and demographic data.

Variables

Outcome variables: The primary outcome was discharge by the admitting acute medical consultant from the acute medical unit prior to 8pm on the last day of the on call period. Admission and discharge data were obtained from the TRAKcare inpatient clinical management system (Intersystems, US). The acute medicine rota in both hospitals runs on three on call periods (8am Mon - 8am Wed, 8am Wed – 8am Fri, 8am Fri – 8am Mon). Patients admitted under the consultant on call remain under that consultant until the end of the on-call period unless they are discharged, deceased or care taken over by another specialty. 'AMU discharge' was defined as a discharge (excluding discharge by another specialty service, self-discharge or death) prior to 8pm on the final day of the AMU on call period. We used AMU discharge rather than length of stay as previous studies report (11,12,15). This was chosen as discharge decisions beyond 48-72hours will be delivered by the incoming service rather than the admitting clinician. AMU

discharge is therefore the preferred outcome variable as the discharge decision can be reliably attributed to the admitting clinician allowing consultant level analysis.

Inpatient 30 day mortality was defined as death from any cause during admission within 30 days of admission date. Readmission was defined as unplanned admission within 7 days following an 'AMU discharge'. 30 day discharge mortality was defined as death registered (www.nrscotland.gov.uk) within 30 days following 'AMU discharge'. 'In community care' is defined as a patient who has undergone 'AMU discharge' but was not registered to have been readmitted within 7 days or died within 30 days following AMU discharge.

Exposure variable: Consultant experience was calculated as the time in years from admission to the UK General Medical Council Specialist Register to the date of patient admission and included as a continuous variable. Consultant gender and acute internal medicine (AIM) accreditation were included as binary variables.

Other covariates:

- Patient age – continuous
- Patient sex - binary
- Scottish Index of Multiple Deprivation quintile (www.isdscotland.org) quintile - ordinal.
- Charlson comorbidity index calculated using inpatient discharge diagnosis codes the 5 years preceding admission, analysed with 'comorbidity package' in R (20) - ordinal variable (0, 1-2, >2)
- Acute Kidney injury (AKIN score) calculated as previously described (19) - binary variable (No AKI = 0, AKI present 1-3).

Pathology case mix adjustment was performed using discharge diagnosis codes from the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) at the chapter level.

Model assumptions of predictor values were checked visually including multicollinearity and deemed acceptable.

Statistical analysis

Mixed model binary logistic regression was performed using 'finalfit' package in R with 'AMU discharge', 'inpatient 30 day mortality' and 'in community care' as separate dependent variables (21) with hospital site and individual consultant included as separate random effects. The model was then repeated on the AMU discharged patient population with 7-day readmission and 30 day death following discharge as dependent variables. A p value of <0.05 was deemed significant. Marginal effects of predicted outcome were generated as previously described (22) and used to estimate outcomes for a 1000 patient AMU admission sample. Analysis and graphic outputs were generated using R version 4.0.3 (23). The study utilised only anonymised retrospective routinely collected healthcare data. The NHS Research Authority decision tool confirmed this study did not require research ethics committee review and the study therefore proceeded to regional Caldicott Guardian approval (ref 2284).

Results

There were 66929 admissions relating to 40819 individual patients admitted under 56 individual consultants in the study period. The mean number of patients seen by each consultant was 1178 (SD+/- 679).

Markers of increasing frailty, comorbidity and acuity were negatively associated with AMU discharge such as age (OR 0.98; 0.98 to 0.98, $p < 0.001$ per year), increasing Charlson comorbidity index (0.91; 0.84 to 0.98, $p = 0.014$ for ≥ 2 vs 0) the presence of acute kidney injury (0.67; 0.63 to 0.72, $p < 0.001$, AKIN score 1 vs 0) and increasing deprivation (1.10; 1.04 to 1.17, $p = 0.001$ most affluent versus most deprived SIMD quintile) (table 1, figure 1). There was also a negative association with increasing number of previous admissions (OR 0.98; 0.97 to 0.98 $P < 0.001$, per previous admission over 5 years). There was no significant association between the likelihood of AMU discharge and other consultant level variables or physician male gender (1.14; 1.00 to 1.30, $p = 0.057$) and AIM accreditation 0.95 (0.82 to 1.11, $p = 0.524$).

Expected associations with 30 day inpatient mortality were identified with increasing age, male sex, increasing AKIN score, Charlson index (Supplementary figure 1, supplementary table 1). However, consultant experience, consultant gender and AIM accreditation had no significant association with mortality (OR 1.01; 0.97 to 1.04 P = 0.697, OR 1.00; 0.91 to 1.1 p = 0.981 and OR 1.05; 0.95 to 1.16 p = 0.3 respectively). Patients admitted at the weekend (Saturday 00:00 to Sunday 23:59) displayed a 18% increased likelihood of inpatient 30 day mortality in comparison to admissions on other days of the week (OR 1.18; 1.08 to 1.29 p < 0.001).

Factors increasing the likelihood of readmission within 7 days of discharge were limited to increasing age, the presence of a Charlson index of 2 or greater and an increased number of admissions over the previous 5 years (Supplementary Fig 2, supplementary table 2).

Interestingly, the presence and severity of acute kidney injury at presentation was strongly associated with an increase in likelihood of death within 30 days of AMU discharge (OR 1.56; 1.12 to 2.16 P < 0.001, OR 4.07; 1.59 to 10.40, p=0.003 and OR 15.16 : 7.71 to 29.82, p<0.001 for scores of 1, 2 and 3 respectively vs 0) as was increasing Charlson index (1.54; 1.09 to 2.16, p=0.013 and 3.13; 2.12 to 4.64, p<0.001 for Charlson index a and >=2 vs 0 respectively) (Supplementary Fig 3, supplementary table 3).

Consultant experience effect

Univariate analysis identified an increased likelihood of AMU discharge with increasing consultant experience (1.08; 1.07 to 1.10, p<0.001) which persisted after adjustment for confounders (OR 1.06; 1.01 to 1.11 p = 0.01 per 5 years' experience) (figure 1, figure 2A, table 1). Increasing consultant experience was not associated with change in the rate of in-hospital mortality, 7-day readmission or 30 day mortality following discharge (OR 1.01; CI 0.97 to 1.04: OR 1.03; CI 0.96 to 1.09: OR 1.07; CI 0.95 to 1.21. All p value > 0.1) (Fig 2 B-D, Supplementary figure 1-3, Supplementary tables 1-3). Application of the marginal effects estimates to patients numbers discharged who did not die and were not readmitted translates into 31

(95% 25-36), 41 (95%CI 30-53) and 52 (95%CI 35-71) additional safe discharges per 1000 admissions for clinicians of 15, 20 and 25 years respectively in comparison to those recently completing training. (table 2). In the study cohort across two hospital sites, this equates to 692, 915 and 1161 additional discharges annually.

Discussion.

This study for the first time demonstrates a significant association between consultant physician experience and early safe discharge within the AMU model, a framework predominating unscheduled care admissions within the UK. There was no demonstrable association with readmission or death following discharge, suggesting that this more proactive discharge behaviour results in safe transfer to community care and reduces inpatient stay. These findings are consistent across sites and are adjusted for markers of comorbidity, previous healthcare utilisation and clinical acuity. These data build on previous work suggesting reduced length of stay and in hospital mortality in more clinically unwell general medical inpatients cared for by consultants with greater than 20 years experience (11,14,24) but conflicts with others suggesting either no effect (14,25) or an association with negative outcome (12,13).

There were expected negative associations between discharge rate and markers of increased frailty and acuity such as age, Charlson index, recurrent hospital admissions and the presence of an acute kidney injury. The stepwise increase in likelihood of discharge with increasing deprivation is marked and warrants further research.

This is an important observation for healthcare staffing policy. It is perhaps expected that with increasing experience, diagnostic acumen will increase as will the ability to negotiate the complexities of admission and safe discharge. Greater confidence in the diagnosis with a reduced requirement for further investigation or observation periods may also play a role. Experiential knowledge and use of outpatient and community based facilities such as ambulatory care and hospital at home pathways may also be

important. These data suggest that maintaining experience within the acute medical service is an important factor in meeting the continually increased demands on unscheduled care services. The loss of consultants due to physician 'burnout' is widely reported (17) as are more recent concerns regarding early retirement (18,26,27). These data suggest that loss of accrued experience will negatively impact patient flow in the AMU setting, emergency care services and subsequently patient experience. The creation of sustainable job plans and appropriate support services for physicians participating in acute care is therefore essential if the escalating demands on unscheduled care are to be met. The financial implications are also significant. Assuming a conservative estimate of one additional bed day per patient and estimated cost of £1190.00 per bed day (Scottish health services report 2018 – Information Services Division for Scotland (28)) additional discharges for consultants of 20 and 25 years' experience equates to £1.08 million and £1.38 million per year respectively across the two subject hospital sites. This estimate does not account for any additional primary care costs incurred following discharge.

There may also be important implications for rota management and shared learning. Lothian as with other regions frequently operates with two or more consultants during each on call period. Pairing experienced consultants with more recent appointments may result in more consistent discharge rates and allow for more reliable site discharge planning.

Strengths and limitations

Strengths of this study are its size, duration and adjustment for patient level factors of prehospital comorbidity and health care access as well as admission acuity; factors which are likely to account for the contrast in findings to the only similar published study in the UK (14). A key weakness in this study is the simplified outcome measure. Discharge rate and readmission rate are important but not paramount indices of patient care and risk simplifying what is a complex and emotive issue. Limitations in available data do not capture patient and carer experience, quality of communication, subsequent primary care

contact or diagnostic accuracy. Inpatient admission is associated and adverse events including falls with injury, drug error, hospital acquired infection, isolation and distress in patients with cognitive impairment and delirium (29–33). In this context a higher safe discharge rate is an attractive goal and is aligned with the current national health strategy of predominantly community based care (34,35). However, evidence is lacking that expediting discharge at the AMU interface ultimately results in better patient care, patient experience or cost saving and as such over interpretation of this study to drive an increase in discharge rates and an increase in risk tolerance by individual consultants is not warranted. A further weakness is that there are no data on inpatient subspecialty referral, use of radiological investigation or junior doctor numbers and grade supporting each medical take. It was felt however that given the high numbers of patients analysed per consultant (mean n = 1178) and the study duration of over 3 years, there is no reason why staffing levels should bias one consultant over another of differing clinical experience. Finally, we do not account for consultant attrition from acute medical services. Historically, consultants can and do opt out of acute medical unit cover with career progression and therefore there may be a selection bias in the more experienced consultants remaining in acute medicine within our cohort.

We did not identify an association between consultant experience level and inpatient mortality as previously reported (11). While the importance of early therapy on outcome in time sensitive pathologies is well established, the infrastructure of the acute medical care system in this analysis means the window for these treatments occurs predominantly in emergency medicine areas prior to admission without the input of the receiving consultant. Similarly, beyond the 48-72 hour acute medical on call shift in acute medicine the care of each patient will typically be delivered by downstream internal medicine teams and as such mortality beyond the first few days of admission will be greatly influenced by other care givers. We did however identify a significant 'weekend effect', supporting published works describing an increased adjusted 30 day mortality in patients admitted over the weekend period (36). We further identified a striking incremental increase in 30 day discharge mortality in patients presenting with an acute

kidney injury and subsequently discharged from the AMU. We speculate that this reflects a likely ongoing pathological process and the normalisation of biochemistry by resuscitation or perhaps dilution may be falsely reassuring in the early stages of admission. While the association of renal dysfunction and mortality in hospitalised patients is well documented, the persistent risk after discharge warrants further study (37).

Conclusion:

Physician consultant experience in the acute medical unit associates with an increase in rate of early discharge to community care without influencing readmission or post discharge mortality. These findings support the need for sustainable careers to maintain experience within acute care services.

Summary Box.

1 – **What is known?** Acute medical units (AMU)s are the dominant route of unscheduled care admission in the UK. The effect of consultant duration of experience on patient outcome within the AMU model remains unclear. Given concerns around early consultant retirement and attrition from acute medical services, understanding the effect of experience on patient care is of great importance.

2 – **The question?** Does duration of consultant experience effect the rate of early discharge, inpatient death, early readmission or death following discharge within the AMU model.

3 – **What was found?** There was a strong continuous association between increasing consultant experience and early discharge from the acute medical unit without a resultant increase in readmission or post discharge death. There was no association between consultant experience and inpatient mortality.

4 - **What is the implication for practice now?** Retention of experienced consultants within acute medical unit services is of value in maintaining patient flow and provides opportunity for shared learning and peer to peer support.

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Data availability statement

The component datasets used here are available via the Public Benefits Privacy Panel for Health at <https://www.informationgovernance.scot.nhs.uk/pbphsc/> for researchers who meet the criteria for access to confidential data. All source code used for variable derivation, analysis, and plot generation is available at <https://github.com/marcus-lyall/>

Governance approval

The study received local Caldicott Guardian approval reference 2284.

Table 1

label	levels	Not discharged	AMU discharge	Total	OR (univariable)	OR (multilevel)
consultant experience (5y)	Median (IQR)	1.2 (0.7 to 2.0)	1.3 (0.7 to 2.0)	1.2 (0.7 to 2.0)	1.08 (1.07-1.10, p<0.001)	1.06 (1.01-1.11, p=0.010)
consultant gender	female	20723 (42.5)	6878 (37.8)	27601 (41.2)	-	-
	male	28034 (57.5)	11294 (62.2)	39328 (58.8)	1.21 (1.17-1.26, p<0.001)	1.14 (1.00-1.30, p=0.057)
AIM CCT	Not AIM accredited	37080 (76.1)	14211 (78.2)	51291 (76.6)	-	-
	AIM accredited	11677 (23.9)	3961 (21.8)	15638 (23.4)	0.89 (0.85-0.92, p<0.001)	0.95 (0.82-1.11, p=0.524)
age (years)	Median (IQR)	75.0 (60.0 to 84.0)	66.0 (49.0 to 79.0)	73.0 (57.0 to 83.0)	0.98 (0.98-0.98, p<0.001)	0.98 (0.98-0.98, p<0.001)
sex	Female	26950 (55.3)	9604 (52.9)	36554 (54.6)	-	-
	Male	21807 (44.7)	8568 (47.1)	30375 (45.4)	1.10 (1.07-1.14, p<0.001)	1.11 (1.07-1.15, p<0.001)
deprivation quintile	1	7382 (15.1)	2789 (15.3)	10171 (15.2)	-	-
	2	12985 (26.6)	4571 (25.2)	17556 (26.2)	0.93 (0.88-0.98, p=0.012)	0.97 (0.91-1.03, p=0.315)
	3	7909 (16.2)	3056 (16.8)	10965 (16.4)	1.02 (0.96-1.09, p=0.466)	1.06 (1.00-1.13, p=0.068)
	4	7820 (16.0)	3005 (16.5)	10825 (16.2)	1.02 (0.96-1.08, p=0.583)	1.06 (0.99-1.13, p=0.086)
	5	12661 (26.0)	4751 (26.1)	17412 (26.0)	0.99 (0.94-1.05, p=0.808)	1.10 (1.04-1.17, p=0.001)
weekend admission	weekday	37239 (76.4)	13668 (75.2)	50907 (76.1)	-	-
	weekend	11518 (23.6)	4504 (24.8)	16022 (23.9)	1.07 (1.02-1.11, p=0.002)	1.09 (1.05-1.14, p<0.001)
AKIN score	0	39884 (82.3)	16053 (89.5)	55937 (84.3)	-	-
	1	6422 (13.3)	1593 (8.9)	8015 (12.1)	0.62 (0.58-0.65, p<0.001)	0.67 (0.63-0.72, p<0.001)
	2	1250 (2.6)	184 (1.0)	1434 (2.2)	0.37 (0.31-0.43, p<0.001)	0.36 (0.31-0.42, p<0.001)
	3	878 (1.8)	98 (0.5)	976 (1.5)	0.28 (0.22-0.34, p<0.001)	0.30 (0.24-0.37, p<0.001)
Charlson index	0	33381 (68.5)	14081 (77.5)	47462 (70.9)	-	-
	1	11191 (23.0)	3045 (16.8)	14236 (21.3)	0.65 (0.62-0.67, p<0.001)	0.89 (0.84-0.93, p<0.001)
	>=2	4185 (8.6)	1046 (5.8)	5231 (7.8)	0.59 (0.55-0.64, p<0.001)	0.91 (0.84-0.98, p=0.014)

label	levels	Not discharged	AMU discharge	Total	OR (univariable)	OR (multilevel)
number of previous admissions (5y)	Median (IQR)	2.0 (1.0 to 5.0)	1.0 (0.0 to 4.0)	2.0 (0.0 to 5.0)	0.98 (0.98-0.98, p<0.001)	0.98 (0.97-0.98, p<0.001)
disease code	Circulatory system	6576 (13.5)	2573 (14.2)	9149 (13.7)	-	-
	Digestive system	2995 (6.1)	840 (4.6)	3835 (5.7)	0.72 (0.66-0.78, p<0.001)	0.60 (0.55-0.66, p<0.001)
	Diseases of the blood*	430 (0.9)	290 (1.6)	720 (1.1)	1.72 (1.47-2.01, p<0.001)	1.58 (1.34-1.85, p<0.001)
	Endocrine, nutritional and metabolic	1429 (2.9)	848 (4.7)	2277 (3.4)	1.52 (1.38-1.67, p<0.001)	1.32 (1.19-1.47, p<0.001)
	Genitourinary system	2897 (5.9)	858 (4.7)	3755 (5.6)	0.76 (0.69-0.83, p<0.001)	0.72 (0.65-0.79, p<0.001)
	Infectious and parasitic diseases	2840 (5.8)	1037 (5.7)	3877 (5.8)	0.93 (0.86-1.02, p=0.109)	0.78 (0.71-0.85, p<0.001)
	Injury, poisoning	3238 (6.6)	1018 (5.6)	4256 (6.4)	0.80 (0.74-0.87, p<0.001)	0.81 (0.75-0.89, p<0.001)
	Mental, Behavioural and Neurodevelopmental	2052 (4.2)	608 (3.3)	2660 (4.0)	0.76 (0.68-0.84, p<0.001)	0.70 (0.63-0.78, p<0.001)
	Musculoskeletal system	1697 (3.5)	751 (4.1)	2448 (3.7)	1.13 (1.03-1.25, p=0.013)	1.04 (0.94-1.15, p=0.418)
	Neoplasms	1440 (3.0)	137 (0.8)	1577 (2.4)	0.24 (0.20-0.29, p<0.001)	0.23 (0.19-0.27, p<0.001)
	Nervous system	1123 (2.3)	1218 (6.7)	2341 (3.5)	2.77 (2.53-3.04, p<0.001)	2.05 (1.86-2.26, p<0.001)
	Not elsewhere classified	7799 (16.0)	5071 (27.9)	12870 (19.2)	1.66 (1.57-1.76, p<0.001)	1.56 (1.47-1.66, p<0.001)
	other	221 (0.5)	239 (1.3)	460 (0.7)	2.76 (2.29-3.34, p<0.001)	2.13 (1.75-2.59, p<0.001)
	Respiratory system	12626 (25.9)	2334 (12.8)	14960 (22.4)	0.47 (0.44-0.50, p<0.001)	0.43 (0.41-0.46, p<0.001)
	Skin and subcutaneous tissue	1394 (2.9)	350 (1.9)	1744 (2.6)	0.64 (0.57-0.73, p<0.001)	0.47 (0.41-0.53, p<0.001)

Table 1: Binary logistic regression output of AMU admissions. Dependant variable is discharge before the end of on call period. Consultant experience is per 5 years from admission to the specialist register. AIM CCT = Certificate of completion of acute internal medicine training. AKIN = Acute kidney injury network score. Number of previous admissions (5y) = number of unscheduled hospital care admissions in the previous 5 years. With the exception of age, all other variables are represented as n (column

percentage for variable). Univariate and multilevel regression analysis adjusted for patient, clinician and hospital factors displayed.

Table 2

Years Consultant experience	discharges (per 1000 AMU admissions (95% CI))	30-day inpatient mortality (per 1000 AMU admissions (95% CI))	7-day readmissions (per 1000 AMU admissions (95% CI))	Deaths within 30 days of discharge (per 1000 AMU admissions (95% CI))	patients remaining in community care (per 1000 AMU admissions (95% CI))
0	243 (212 - 277)	33 (26 - 41)	11 (9 - 15)	1 (1 - 2)	225 (197 - 257)
5	254 (224 - 288)	33 (26 - 42)	12 (10 - 16)	1 (1 - 3)	235 (207 - 266)
10	266 (233 - 301)	33 (26 - 42)	13 (10 - 17)	2 (1 - 3)	245 (215 - 278)
15	277 (241 - 317)	34 (26 - 42)	14 (11 - 19)	2 (1 - 3)	256 (222 - 293)
20	289 (247 - 336)	34 (26 - 43)	15 (11 - 20)	2 (1 - 4)	266 (227 - 310)
25	302 (253 - 356)	34 (26 - 44)	16 (11 - 23)	2 (1 - 5)	277 (232 - 328)

Table 2: Predicted outcomes of a 1000 AMU admission sample estimated from model marginal effects. Displayed as events/1000 AMU admissions (95% CI).