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Interdisciplinary Plans of Care, Electronic Medical Record Systems, and Inpatient Mortality

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Abstract

Background Interdisciplinary plans of care (IPOCs) guide care standardization and satisfy accreditation requirements. Yet patient outcomes associated with IPOC usage through an electronic medical record (EMR) are not present in the literature. EMR systems facilitate the documentation of IPOC use and produce data to evaluate patient outcomes.

Objectives This article aimed to evaluate whether IPOC-guided care as documented in an EMR is associated with inpatient mortality.

Methods We contrasted whether IPOC-guided care was associated with a patient being discharged alive. We further tested whether the association differed across strata of acuity levels and overall frequency of IPOC usage within a hospital.

Results Our sample included 165,334 adult medical/surgical discharges for a 12-month period for 17 hospitals. All hospitals had 1 full year of EMR use antedating the study period. IPOCs guided care in 85% (140,187/165,334) of discharges. When IPOCs guided care, 2.1% (3,009/140,187) of admissions ended with the patient dying while in the hospital. Without IPOC-guided care, 4.3% (1,087/25,147) of admissions ended with the patient dying in the hospital. The relative likelihood of dying while in the hospital was lower when IPOCs guided care (odds ratio: 0.45; 99% confidence interval: 0.41–0.50).

Conclusion In this observational study within a quasi-experimental setting of 17 community hospitals and voluntary usage, IPOC-guided care is associated with a decreased likelihood of patients dying while in the hospital.

Keywords
- electronic medical record
- inpatient mortality
- health services research
- care plan

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Background and Significance

Interdisciplinary Plans of Care

The Joint Commission (TJC) and Centers for Medicare and Medicaid Services (CMS) mandate that hospitals coordinate care actions and decisions of clinical services through individualized plans of care.[1] Interdisciplinary plans of care (IPOCs) provide a vehicle to directly coordinate patient care provided by nurses, allied health providers, and patient families. The mandate for IPOC use is largely a method to increase engagement of patients and their families in goal-setting and interventions.[2] IPOCs build on evidence-based findings for noting patient goals and recording achievements or attempts toward them. For example, evidence suggests that prompt ambulation leads to shorter lengths of stay and lower risk of thromboses for a patient undergoing a complete joint replacement. IPOCs for total joint replacement (TJR) patients remind caregivers to note ambulation goals, document attempts, and record achievements.[3] IPOCs can be tailored to patient comorbidities within an overall care plan. For example, a TJR patient with impaired respiratory blood gas exchange may have oximetry and respiratory goals added to their IPOCs. IPOCs can also notify clinicians to inform family members of upcoming interventions or events for greater patient support system participation.

The process for developing and implementing IPOCs involves high-level hospital administration decision and sign-off, and is labor intensive. The development process requires the input of many parties (including medical and nursing leadership) and care areas (including dietary, respiratory, and pharmacy) within a given health system. The professionals composing the plans scour the literature and seek guidance from knowledge vendors to create patient condition-specific plans. The IPOC development effort results in a set of recommended goals for patients with specific medical conditions or planned procedures.

Before the widespread use of electronic medical record (EMR) systems, IPOCs were largely paper based leaving broader analysis of their effectiveness unapproachable. When programmed into EMR systems, IPOC-directed systematic documentation of noted goals and recorded progress leaves an audit trail with which to evaluate their effectiveness against quality outcomes including in-hospital death.

Inpatient Mortality

Acutely ill patients enter the hospital and some die during their stay. Factors like mode of arrival, reason for admission, comorbid conditions, age, sex, birth weight (for neonates), discharge date, and length of time on a mechanical ventilator contribute to the likelihood of a patient dying while in the hospital. The all-patient-relative diagnosis-related group (APR-DRG) classification system offers estimates of whether a patient will die based on the acuity factors. APR-DRGs are generated from a nation-wide all-payer sample of discharges and offer hospitals evidence needed for planning and analytic normalization for acuity and expected risks of mortality also known as level of acuity.[4] One measure of hospital care quality is whether more patients die than expected based on patient acuity or risk of mortality (ROM) as estimated by APR-DRG assignment.[5]

Across all hospitals in the United States, the inpatient mortality rate (number of deaths divided by the number of admissions for a given time period) has declined markedly in the first decade of this century. In 2000, 2.5% of inpatients died during their stay.[6] By 2010, this rate declined to 2.0% of encounters and 715,000 deaths across the United States.[6] This nation-wide decline in mortality rate could be attributed in part to greater adherence with care coordination practices and adoption of EMR systems. However, this attribution and assertion has not yet been assessed directly.

It is customary to declare a death while in the hospital to be a discharge. Usually length of stay (LOS) is calculated as discharge (or sometimes death) date minus admission date. If patients die while in the hospital, their lengths of stay are logically truncated to some shorter stay than would be the case had the patients been discharged alive.

Electronic Medical Record Systems

In the course of delivering inpatient care, vast amounts of data are generated. When the data were on paper documents, observations could get lost in the paper charts, contributing to poor patient outcomes, including death. Driven in part to achieve more favorable outcomes, improved safety, and overall higher care quality, the HITECH (Health Information Technology for Economic and Clinical Health) Act of 2009 incentivized EMR system use.[7] When an EMR system is used for inpatient care, the observations and findings can be captured electronically and more easily queried to assess factors contributing to poor outcomes. More advanced EMR systems alert clinicians for recommended actions like noting goals and recording progress or attempts. An IPOC placed within an EMR can help coordinate care across multiple disciplines.

EMR systems have a predictable typology of notes and records, results entry, order entry, and decision support.[8,9] Notes and records allow clinicians to electronically document findings resulting from observation, to establish care goals for patients, and to record progress or attempts toward the goals. Order entry allows physicians to place orders electronically, based on their findings. Results entry facilitates test results entry, documented alongside notes and records. Decision support systems display potential interpretations, alerts, and clinical recommendations, derived primarily from structured data in orders and results.[10,11]

Patient care goals and prompts can be assembled within an EMR system in the form of an IPOC. When an IPOC is used to guide patient care, an EMR system can display noted goals to many care disciplines and prompt clinicians to record attempts and observations. All assigned caregivers can review records of progress toward goals, note care plans accordingly, and coordinate care. Within an EMR system, each patient's encounter record can receive a flag, stating whether an IPOC was used to guide care. IPOCs are principally structured notes for goals and records of progress that guide patient care.[12–17] In addition, they combine

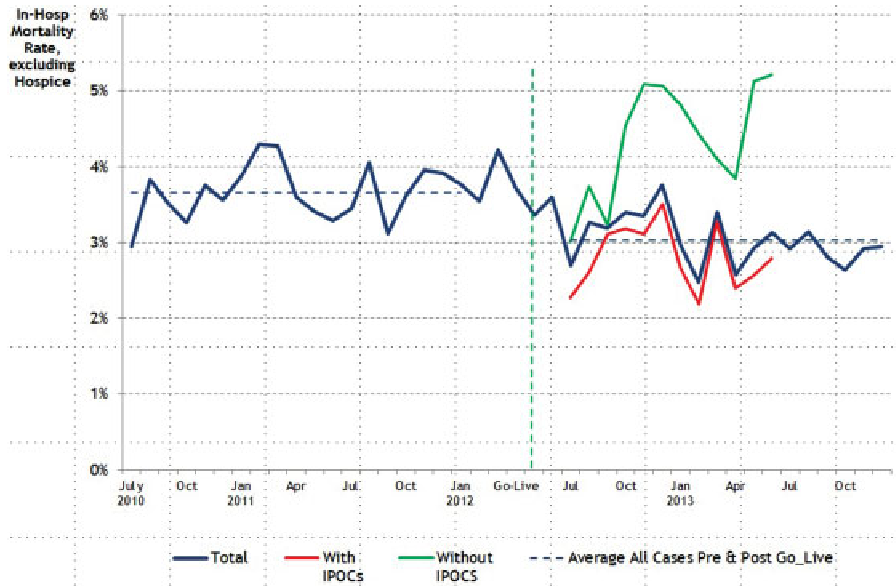

Fig. 1 Early indicator of IPOC association with reduced mortality in three hospitals. In-hospital mortality rate for adult medical–surgical patients, excluding hospice discharges, declined from 3.66 to 3.03% ($p < 0.001$).

evidence-based goals with multiple EMR typologies, like documentation structure and observations to inform electronic orders.

The TJC and CMS regulatory mandates for greater care planning and integration were final in 2009. Many EMR vendors and knowledge-management vendors have helped hospital systems comply with the mandates by implementing IPOC note and record functionality within their products. A review of the literature finds a few citations describing the IPOC development process; however, we found no citation presenting the outcomes of the new functionality and by proxy the mandate.[12–17] This study presents findings of enhanced patient outcomes associated with IPOC-guided care as documented through an EMR.

Prior Evidence

Amarasingham et al presented a cross-sectional survey of Texas hospital facilities from 2009. Their work attempted to correlate principal EMR typologies with outcomes including inpatient death.[9] The survey queried hospital clinical staff on the degrees to which facility EMR systems automated elements of the typology. The survey data were then merged with state hospital association reports of inpatient mortality per facility. The study reported a favorable correlation between greater automation of notes/records and lower inpatient mortality. Their ecological study design could not directly study notes, records, and patient death for specific discharges. Their work hints that noting and recording within an EMR might favorably impact inpatient mortality. A direct test within records of specific discharges, however, would yield stronger evidence on the impact.

Study Setting

Our study presents the experience of a nonprofit health system operating community hospitals in several states. Hospitals in the system began an EMR implementation journey with a round of three hospitals in 2007.[13,18,19] IPOCs were not immediately available in the first three hospitals. In a second EMR deployment round in 2009, IPOC availability and EMR usage coincided. In subsequent go-live rounds, IPOCs were available concurrently with the EMR implementation, but their use was discretionary. At the time of this study, IPOC use was voluntary in 18 hospitals for at least 2 years. The community hospitals included in this study represent urban, suburban, and rural settings across six states all using a single EMR vendor.

After the go-live date for each hospital, EMR use was mandated on all medical surgical patients. As each hospital began EMR use, the health system's clinical leadership monitored changes in key performance indicators including hospital-acquired conditions, LOS, patient satisfaction, and inpatient mortality. For the first two rounds of implementation, the post-EMR inpatient mortality rate declined. Furthermore, when IPOCs guided care, inpatient mortality declined further. The notion for this study germinated from the consistency of the IPOC/no IPOC difference in patient mortality (►Fig. 1). Voluntary IPOC use created an observable phenomenon within a natural quasi-experimental study to directly test the Amarasingham[9] ecologic notes/record findings.

Objectives

The principal objective of this study is to evaluate whether IPOC-guided care as documented in an EMR is associated with inpatient mortality. To make the evaluation, we analyzed whether the relative likelihood (odds ratio [OR]) of dying while an inpatient is different between patients whose care was guided by IPOC contrasted with those without an IPOC.

Methods

A by-product of EMR use is a repository of administrative data (admission date, discharge date, discharge status, principal diagnosis, patient demographics, etc.) and clinical data (body mass index, medications administered, notes and records taken, IPOC guidance, etc.). We extracted from the repository all discharges for the 12 months ending June 30, 2013, for 18 hospitals whose go-live date (with IPOC availability) was on or before July 1, 2011. This lead-in period allowed each hospital to acclimate to EMR usage and clinicians time to acculturate to IPOCs guiding care. With the lead-in period, clinical leadership at all hospitals had enough time to influence practices, thereby equilibrating cultural difference between facilities. One of the 18 hospitals is a dedicated surgical facility. This facility offers elective, uncomplicated arthroplasty exclusively. There have been no deaths in this facility. Because this facility was not a general medical/surgical hospital and since the outcome of interest did not occur, we excluded it from further analysis.

We extracted one record per discharge, including a flag of whether an IPOC was used, and whether the patient died while in the hospital. Each discharge record included an APR-DRG expected risk of dying while in the hospital. We stratified APR-DRG-assigned expected ROM into five categories: Strata 1 (range: 0–1%), Strata 2 (>1–2.5%), Strata 3 (>2.5–5.0%), Strata 4 (>5.0–10%), and Strata 5 (>10%). The APR-DRG ROM strata cutoff points were naïve to any other factor. We constructed a logistic regression model with a dependent binary variable of dying while in the hospital contrasted with other independent factors including age, sex, type of service, type of admission financial class, and readmission status. All of these independent factors are used to formulate APR-DRG ROM or level of acuity strata for each discharge. Instead of the individual contributing factors, we used the APR-DRG ROM strata as a proxy variable for patient acuity to adjust the likelihood of dying. We further evaluated the relative likelihood of dying given IPOC-guided care using APR-DRG ROM stratum-specific ORs.

To assess the impact of readmissions, we constructed an indicator for each admission that looks back in time for any discharge antedating an index admission by no more than 30 days. This flag indicates that the index admission is a readmitted patient.

Since LOS is an important hospital operating metric, we include this variable in our analysis to describe any potential inter-relatedness with IPOCs guiding care.

To assess hospital or facility-level modification on our main patient mortality effect, we created a variable of three graduated categories of overall background IPOC usage. We divided the hospitals into three graduated categories of IPOC usage frequency: low (76–82%, $n = 6$ hospitals), medium (83–89%, $n = 5$ hospitals), and high (≥90%, $n = 6$ hospitals).

Results

Within the 12-month study period (ending June 30, 2013), there were 165,334 adult, medical/surgical, non-hospice inpatient encounters from 17 hospitals. Overall 2.5% (4,096/165,334) of encounters ended with a patient death. IPOCs guided care in 85% (140,187/165,334) of all encounters. Among the inpatient encounters where IPOCs guided care, 2.1% (3,009/140,187) ended with a patient death, versus 4.3% (1,087/25,147) of encounters not guided by IPOCs ending with a patient death (unadjusted OR: 0.45; 99% confidence interval [CI]: 0.41–0.50; ►**Table 1**).

IPOC usage frequency differed between the 17 hospitals available for this study. IPOC usage frequency ranged from 76 to 96% of discharges. Across the three categories, the likelihood of dying while IPOCs guide care was not significantly different with no evidence of a trend (►**Table 2**).

The arithmetic mean LOS among the set of 165,334 discharges was 4.34 days (SD: 8.6). When contrasted with the overall, LOS was a slightly higher +0.24 days while IPOCs guided care. Without IPOC guidance, LOS was considerably shorter (−1.48 days) than the overall average LOS. Patients who died had an LOS of 7.56 days which is considerably longer than those who were discharged alive (LOS: 4.27 days). Patients who died while receiving IPOC-guided care had a modestly longer (+0.04 days) stay. Patients who died without IPOC-guided care had a considerably shorter stay (−2.45 days) than the LOS among all those who died (►**Table 3**).

There were more female patients than male. Female patients were more likely to have IPOC-guided care (OR: 1.05; 99% CI: 1.02–1.08). Females were also less likely to die (OR: 0.84; 99% CI: 0.77–0.91).

Patients receiving care for a medical condition (contrasted with those for a surgical procedure) were less likely to have IPOC-guided care (OR: 0.68 99% CI: 0.67–0.71) and were more likely to die while an inpatient (OR: 2.4; 99% CI: 2.1–2.6).

Patients receiving elective or preplanned care were more likely to have IPOC-guided care (OR: 1.24; 99% CI: 1.20–1.28) and much less likely to die (OR: 0.19; 99% CI: 0.16–0.22).

When a patient has admissions within 30 days prior to index admission (readmit), clinicians are not more likely to choose IPOCs to guide care (OR: 1.05; 99% CI: 1.00–1.09). However, these patients are significantly more likely to die during the subsequent admission (OR: 2.0; 99% CI: 1.8–2.2).

Age, sex, type of care (medical vs. surgical) and type of admission (elective or not) are inputs into APR-DRG assignments.[5] These inputs collectively yield a combined level of acuity and ROM for an individual discharge. Using these inputs, we constructed five strata. The proportion of patients who died among the lowest risk strata was 0.1% (139/104,872). We chose the second risk lowest strata (ROM: 0.01–0.025%) as referent category to allow for meaningful and interpretable results. There is marked increase in the likelihood of dying across the strata. Patients from the highest ROM category were nearly 20 times more likely to die while in the hospital than those of a referent category. This single factor, constructed using APR-DRG, has the highest predictive value of anything we measured ($R^2 = 0.31$). Across the graduated levels of this APR-DRG ROM variable, there is 3.4-fold greater likelihood of dying with each

Table 1 Univariate and bivariate results

	Overall	IPOC used	IPOC not used	*p*	Deceased	Living	*p*
	Mean (SD)	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Age	64.4 (17.8)	65 (17.0)	61 (19.0)	< 0.01	74 (15.0)	64 (18.0)	< 0.01
Arithmetic mean LOS	4.34 (8.6)	4.58 (4.7)	2.8 (20.0)	< 0.01	7.56 (45.2)	4.27 (4.8)	< 0.01
Sex	***N* (Column %)**	***N* (Row %)**	***N* (Row %)**	**Odds ratio (99% CI)**	***N* (Row %)**	***N* (Row %)**	**Odds ratio (99% CI)**
Female	90,966 (55)	77,432 (85)	13,576 (15)	1.05 (1.02–1.08)	2,087 (2.3)	88,921 (97.7)	0.84 (0.77–0.91)
Male	74,368 (45)	62,755 (84)	11,571 (16)	Referent	2,009 (2.7)	72,317 (97.3)	
Medical/surgical service							
Medical	108,249 (65)	90,059 (83)	18,190 (17)	0.68 (0.67–0.71)	3,334 (3.1)	104,915 (96.9)	2.4 (2.1–2.6)
Surgical	57,085 (35)	50,128 (88)	6,957 (12)	Referent	762 (1.3)	56,323 (98.7)	Referent
Admission type							
Elective	37,849 (23)	32,863 (87)	4,986 (15)	1.24 (1.20–1.28)	223 (0.6)	37,626 (99.4)	0.19 (0.16–0.22)
Urgent + emergent	127,014 (77)	106,934 (84)	20,080 (16)	Referent	3,841 (3.0)	123,173 (97.0)	Referent
Missing + unknown + other	471 (<1)						
Financial group							
Medicare	100,637 (61)	86,810 (86)	13,875 (14)	Referent	3,197 (3.2)	97,910 (96.8)	Referent
Blue Cross/Commercial	43,300 (27)	35,981 (83)	7,345 (17)	0.78 (0.76–0.81)	537 (1.2)	42,936 (98.8)	0.38 (0.34–0.43)
Public Aid	13,112 (8)	10,869 (82)	2,251 (18)	0.77 (0.74–0.81)	261 (2)	12,912 (98)	0.62 (0.52–0.73)
Uninsured + other	8,285 (5)	5,948 (79)	1,764 (21)	0.54 (0.51–0.57)	101 (1.3)	7,480 (98.7)	0.41 (0.30–0.56)
Admission during prior 30 days (readmission)							
Admitted	20,624 (13)	17,592 (85)	3,032 (15)	1.05 (1.00–1.09)	903 (4.4)	19,721 (95.6)	2.0 (1.8–2.2)
No admissions	144,710 (87)	122,595 (85)	22,115 (15)	Referent	3,193 (2.2)	141,517 (97.8)	Referent
Risk of mortality (APR-DRG)							
>0.10	15,749 (10)	13,895 (88)	1,854 (12)	1.18 (1.11–1.26)	2,990 (0.2)	12,759 (99.80)	19.4 (16.1–23.4)
>0.05–0.10	12,357 (8)	10,931 (88)	1,426 (12)	1.21 (1.13–1.29)	523 (0.04)	11,834 (99.96)	4.3 (3.5–5.4)
>0.025–0.05	11,153 (7)	9,741 (88)	1,412 (12)	1.09 (1.01–1.17)	236 (0.02)	10,917 (99.98)	2.2 (1.7–3.2)
>0.01–0.025	21,302 (13)	18,393 (87)	2,909 (13)	Referent	208 (0.01)	21,094 (99.99)	Referent
0–0.01	104,773 (63)	87,151 (83)	17,622 (17)		139 (0.001)	104,634 (99.99)	
				Test for trend *p*-value = 0.5748			

(*Continued*)

Table 1 (*Continued*)

	Overall	IPOC used	IPOC not used	*p*	Deceased	Living	*p*
	Mean (SD)	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
In-hospital mortality							
Deceased	4,096 (2.5)	3,053 (73)	1,043(27)	0.45 (0.41–0.50)			
Living	161,238 (97.5)	139,728 (85)	21,563 (15)	Referent			
IPOC used							
IPOC	139,675 (85)						
No IPOC	22,606 (15)						

Abbreviations: APR-DRG, all-patient–relative diagnosis-related-group; IPOC, interdisciplinary plans of care; LOC, length of stay.

Table 2 IPOC usage frequency by hospital

IPOC usage frequency group	Hospital code	Discharges	Discharges with IPOC-guided care	IPOC usage frequency	Deaths	Relative likelihood of dying with IPOC-guided care	
						By hospital odds ratio (99% CI)	By IPOC frequency group Odds ratio (99% CI)
Low	24	321	220	69%	11	0.80 (0.16–4.04)[a]	0.50 (0.43–0.58)
	22	8,820	6,276	71%	242	0.58 (0.41–0.81)	
	26	10,511	7,898	75%	246	0.61 (0.43–0.86)	
	9	5,829	4,433	76%	153	0.39 (0.26–0.60)	
	11	14,127	11,601	82%	298	0.38 (0.28–0.53)	
	4	12,851	10,498	82%	285	0.59 (0.42–0.83)	
Medium	16	11,691	9,879	85%	282	0.44 (0.32–0.62)	0.46 (0.40–0.54)
	12	11,254	9,865	88%	309	0.44 (0.31–0.63)	
	28	11,110	9,771	88%	474	0.55 (0.41–0.75)	
	1	25,073	22,072	88%	528	0.45 (0.34–0.58)	
	8	3,609	3,196	89%	96	0.30 (0.17–0.54)	
High	3	3,080	2,759	90%	24	0.58 (0.14–2.35)	0.29 (0.24–0.36)
	18	7,745	6,953	90%	129	0.21 (0.13–0.34)	
	2	3,276	2,961	90%	54	0.61 (0.23–1.62)[a]	
	23	4,369	4,058	93%	99	0.17 (0.10–0.31)	
	25	14,633	13,884	95%	378	0.24 (0.17–0.34)	
	19	17,035	16,404	96%	488	0.27 (0.19–0.39)	

Abbreviations: CI, confidence interval; IPOC, interdisciplinary plans of care.
[a]Not significant.

Table 3 Length of stay by discharge status and IPOC guidance

Arithmetic mean length of stay (d)	IPOC used	IPOC not used	p
Deceased	7.66 (SD 7.60)	5.38 (SD 40.62)	0.004
Living	4.44 (SD 4.61)	2.67 (SD 5.75)	<0.0001
	$p < 0.001$	$p < 0.001$	

Abbreviations: IPOC, interdisciplinary plans of care; SD, standard deviation.

increase in strata (OR: 3.4; 99% CI: 3.3–3.5). Across the five APR-DRG ROM strata, the rate of IPOC usage ranged from 83 to 88% encompassing the overall IPOC usage rate of 85%, presenting no appreciably greater likelihood of IPOC usage within any strata. Across the top three APR-DRG ROM strata, there is a slight increase in likelihood of clinicians choosing IPOCs but no evidence for a trend (Cochran-Armitage trend test p-value = 0.575).

To further elucidate our findings, we analyzed the likelihood of dying while IPOCs guide care within each individual APR-DRG ROM strata (►Table 4). Within the strata, IPOC-guided care presented the lowest likelihood of dying among patients with the highest mortality risk (OR: 0.26; 99% CI: 0.24–0.27). There is no evidence of a trend across the strata.

We constructed a multivariate logistic regression model of IPOC-guided care and APR-DRG ROM strata as proxy for the likelihood of dying and compared the multivariate/adjusted model with the unadjusted model. As stated previously, the unadjusted OR for the likelihood of dying with IPOC-guided care was 0.48 or half the odd as contrasted to non–IPOC-guided care. In the model adjusted for APR-DRG ROM strata, the relative likelihood decreased to 0.25 (OR: 0.25; 99% CI: 0.22–0.28; ►Table 5). This two-variable model has slightly more predictive power than either factor alone ($R^2 = 0.33$; ►Table 5).

We further assessed influence of hospital background IPOC usage frequency on the likelihood of dying with IPOC-guided care. To the model with APR-DRG ROM, we added the graduated hospital usage frequency levels. In this second multivariate model, we find no change in the likelihood of dying with/without IPOC-guided care or in the APR-DRG ROM adjustment (►Table 6).

In a post hoc analysis, we reanalyzed our main effect with 2,010/165,334 (1.2%) patients discharged to hospice removed. With these patients removed, the relative likelihood of dying while receiving IPOC-guided care remains unchanged.

Discussion

The results of our study lend direct support to the Amarasingham ecological finding of notes/record EMR typology affecting inpatient mortality.[9] We find an association of IPOC-guided care and a lower likelihood of a patient dying while in the hospital.

Table 4 Risk of mortality stratum specific likelihood of inpatient death and IPOC-guided care

Risk of mortality strata (APR-DRG based)	IPOC-guided care	Inpatient death	Discharged alive	Stratum-specific odds ratio (99% CI)
>0.10	Yes	2,213	11,691	0.26 (0.24–0.27)
	No	779	1,077	
>0.05–0.10	Yes	392	10,546	0.36 (0.33–0.40)
	No	131	1,260	
>0.025–0.05	Yes	166	9,567	0.31 (0.26–0.35)
	No	70	1,267	
>0.01–0.025	Yes	155	18,250	0.45 (0.39–0.53)
	No	53	2,858	
0–0.01	Yes	84	87,142	0.30 (0.19–0.48)
	No	55	17,578	

Abbreviations: CI, confidence interval; IPOC, interdisciplinary plans of care.

Table 5 Adjusted model with IPOC and APR-DRG ROM strata as proxy for acuity

	Unadjusted odds ratio (99% CI)		Adjusted odds ratio (99% CI)
In-hospital mortality	0.48 (0.45–0.51)		0.25 (0.22–0.28)
Risk of mortality (APR-DRG)		3.43 (3.29–3.58)	3.54 (3.41–3.71)
	$R^2 = 0.01$	$R^2 = 0.31$	$R^2 = 0.33$

Abbreviations: APR-DRG, all-patient–relative diagnosis-related-group; CI, confidence interval; IPOC, interdisciplinary plans of care.

Table 6 Additional explanative model adding IPOC usage frequency category

	Unadjusted odds ratio (99% CI)			Adjusted odds ratio (99% CI)
In-hospital mortality	0.48 (0.45–0.51)			0.25 (0.22–0.28)
Risk of mortality (APR-DRG)		3.43 (3.29–3.58)		3.57 (3.43–3.73)
IPOC usage Frequency category			1.04 (1.01–1.08)	1.03 (1.00–1.07)
	$R^2 = 0.01$	$R^2 = 0.31$	$R^2 = 0$	$R^2 = 0.33$

Abbreviations: APR-DRG, all-patient–relative diagnosis-related-group; CI, confidence interval; IPOC, interdisciplinary plans of care.

Our data show the probability of clinicians choosing IPOCs to guide care does not increase appreciably for sicker patients with no evidence of a trend. This finding indicates that while reasons for choosing IPOC-guided care may vary, the choice is not proportional with increased ROM across the APR-DRG ROM strata. Clinicians are also not more apt to choose IPOCs to guide care for previously admitted patients who are potentially sicker than those presenting for their first admission. Although the risk of dying is most pronounced among sicker patients, clinicians are not more likely to choose IPOC-guided care for them. When IPOCs are chosen, however, the likelihood of dying is decreased more significantly for more acute patients than for less acute patients.

The relationship of LOS with either IPOC use or inpatient mortality is complex. The complexity presents as bidirectional effect modifications. If a patient is in the hospital for a long time, there is a greater probability that clinicians will choose an IPOC to guide care. However, if IPOC-guided care hastens recovery, sicker patients who have IPOC-guided care might not die while in the hospital, or live longer before they die, increasing LOS. On the other hand, less acute patients might recover and be discharged more quickly, decreasing LOS. In the end, the relationship between LOS, IPOC guidance, and likelihood of dying is complex and adds little to our overall findings. Further work should consider timing of IPOC initiation, aggressiveness of IPOC recommendations, and, potentially, clinician adherence to these recommendations. Future work might apply time-to-event analysis approaches to disentangle our IPOC and LOS findings.

APR-DRG is a complex variable with multiple inputs factoring into an assignment applied after discharge. These multiple inputs mirror the factors for a patient dying while admitted. Future analyses of IPOC use and inpatient mortality might consider using these input factors as independent variables with special emphasis on factors present upon admission. Using input factors might elucidate occult or latent aspects of the mortality risk calculations and their relationship to our findings. Future analyses might cluster the goals and achievements of IPOCs, and quantify which more prominently contribute to mortality/IPOC association.

We anticipated that the acclimation and acculturation of IPOCs and EMRs into routine care delivery might influence overall care delivery, possibly through overtones of attentiveness in other care opportunities. We anticipated that commonplace IPOC usage would show an overall increase in the impact of IPOC guidance on the likelihood of dying. However, IPOC usage frequency added no predictive capacity to the overall model beyond APR DRG ROM. While hospital management practices (of which IPOC usage frequency is reflective) may truly influence quality measures like mortality, our assessment may be too blunt to appreciate the impact. This compelling observation, absent in our data, should inform future work on this topic.

The study setting for this work gave clinicians the option to choose IPOC-guided care. Our case set constituted patients for whom clinicians voluntarily used IPOCs to guide care during the episode. Our control set consisted of patients for whom clinicians did not choose an IPOC. It is possible that the underlying factors behind the clinician decision to use an IPOC are the greater contributor to our findings rather than the activity of noting/recording while using an IPOC. Future studies of these findings should present hospital management practices with a clustering of similar hospitals to control for these influences.

Our study included patients who left the hospital alive or who died while in the hospital. It was outside the scope of our data to include patients who died soon after leaving the hospital. This lack of follow-up mortality data is a limitation to our findings. Additionally, our work is limited to IPOCs as documented within the EMR. IPOC usage before EMR availability or outside of EMR was beyond the scope of this study.

Our work took a retrospective view of readmission looking at past admissions. Future work might assess the impact of future admissions given IPOC use in a past admission.

Conclusion

In this observational study within a quasi-experimental setting of 17 community hospitals and voluntary usage, IPOC-guided care is associated with a decreased likelihood of patients dying while in the hospital. Our findings suggest that CMS and TJC mandates and one typology of EMR usage might increase quality of inpatient care as measured through lower inpatient mortality.

Clinical Relevance Statement

IPOC use as documented in an EMR improves patient mortality. The higher the risk of death, the greater the improvement.

Conflict of Interest

None declared.

Protection of Human and Animal Subjects

This study was approved by the Institutional Review Board of Mercy Health, Grand Rapids, Michigan, United States (Study Number: 14–0120–01-TH) including a waiver of consent.

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