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ORIGINAL ARTICLE

Impact of electronic medical records and COVID-19 on adult Goals-of-Care document completion and revision in hospitalised general medicine patients

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Key words
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ABSTRACT

Background: Conversion from paper-based to electronic medical records (EMR) may affect the quality and timeliness of the completion of Goals-of-Care (GOC) documents during hospital admissions and this may have been further impacted by the COVID-19 pandemic.

Aims: To determine the impact of EMR and COVID-19 on the proper completion of GOC forms and the factors associated with inpatient changes in GOC.

Methods: We conducted a cross-sectional study of adult general medicine admissions (August 2018–September 2020) at Dandenong Hospital (Victoria, Australia). We used interrupted time series to model the changes in the rates of proper GOC completion (adequate documented discussion, completed ≤2 days) after the introduction of EMR and the arrival of COVID-19.

Results: We included a total of 5147 patients. The pre-EMR GOC proper completion rate was 27.7% (overall completion, 86.5%). There was a decrease in the proper completion rate by 2.21% per month (95% confidence interval (CI): −2.83 to −1.58) after EMR implementation despite an increase in overall completion rates (91.2%). The main reason for the negative trend was a decline in adequate documentation despite improvements in timeliness. COVID-19 arrival saw a reversal of this negative trend, with proper completion rates increasing by 2.25% per month (95% CI: 1.35 to 3.15) compared with the EMR period, but also resulted in a higher proportion of GOC changes within 2 days of admission.

Conclusions: EMR improved the timeliness and overall completion rates of GOC at the cost of a lower quality of documented discussion. COVID-19 reversed the negative trend in proper GOC completion but increased the number of early revisions.

Introduction

The Goals-of-Care (GOC) form is a resuscitation planning tool used by most Australian hospitals to help guide discussions surrounding limitations of treatment and cardiopulmonary resuscitation.[1,2] The GOC form provides the patient and their substitute decision-maker the opportunity to express preferences and for clinicians to individualise their resuscitation efforts focussed on the individual's choices and clinical situation. For optimal utility, the proper completion of the GOC form requires both a timely discussion and adequate documentation of the discussion. We previously found that proper completion of GOC forms occurred in approximately one-third of all general medicine admissions in our hospital. Although the proper use of such forms improved with hospital readmissions, it remained suboptimal in younger and less comorbid patients.[3]

The replacement of traditional paper-based medical records with electronic medical records (EMR) has the potential to improve GOC form completion, partly

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attributed to better staff education and automated reminders.[4] Our hospital implemented an EMR system with a 1-week transition period in the fourth week of August 2019. The GOC form completion process is now entirely digital, with GOC completion status displayed on the 'doctors view' of the inpatient list, moving away from the paper-based form located at the front of a patient's file. As of February 2020, the coronavirus (COVID-19) pandemic triggered an increased focus on the timeliness of patient GOC assessment and the completion of GOC-equivalent forms.[5,6] Similarly, at the beginning of March 2020, our organisational expectation for GOC form completion shifted from the pre-pandemic expectation of completion within 48 h of admission to completion of GOC forms prior to transfer from the Emergency Department to the wards.

We hypothesise that the implementation of EMR and the influence of the COVID-19 pandemic have affected our rates of proper GOC completion. However, these recent changes do not guarantee that proper completion of GOC (defined as both timely and with adequate discussion and documentation) has improved. Completion of GOC in haste may compromise the adequacy of the discussion as a tradeoff to more timely completion. We have also previously noticed that changes in GOC status during admission occurred in 71% of patients, with 67% of these experiencing a categorical shift rather than modification of specific conditions.[3] However, we have not previously determined the who, why and when of these GOC changes and whether EMR or COVID-19 has influenced these factors. These changes might either be necessary or they might reflect a poor quality or complete lack of discussion of GOC during admission.

The primary aim of the present study was to determine how the implementation of EMR and the impact of the COVID-19 pandemic have affected our rates of proper completion of GOC forms. The secondary aim was to provide a descriptive analysis of the inpatient GOC changes and to determine factors associated with categorical changes.

Methods

Study design and setting

We conducted a single-centre, cross-sectional study at Dandenong Hospital, a 520-bed acute hospital within the Monash Health network in Victoria, Australia, in the southeastern region of Melbourne. Before the COVID-19 pandemic, the general medicine service consisted of a 24-bed acute assessment unit and four ward-based units managing 24 patients each, with overflows managed in outlier wards. During the COVID-19 pandemic, the service was restructured to include a 20-bed COVID-19 assessment unit and a 24-bed COVID-19 treating unit, in addition to four regular 24-bed ward-based units. General medicine was staffed by five full-time and 15 sessional consultants, working with four general medicine advanced trainees, 11 medical registrars and 18 residents/interns. Our annual number of admissions was 5980 and 6194 for the 2018/2019 and 2019/2020 fiscal years respectively, with 12.2% of patients managed by a COVID-19 admission or management unit early in the pandemic. Hospital bed occupancy by general medicine was approximately 120–140 beds, with a median of 16–18 daily admissions reported monthly.

Ethics approval

This study was approved by the Monash Health Human Research Ethics Committee as a quality assurance and evaluation activity (Monash reference: RES-20-0000-376Q; Ethical Review Manager reference: 65011; approved 27 May 2020). Patient consent was waived for the present study, which used data generated from routine clinical practice.

Participants

We used the main hospital database to identify adult patients (age ≥18 years) admitted under the general medicine service from 1 August 2018 to 30 September 2020, with a length of stay of at least 1 day. From the list of eligible patients, a random sample of 200 patients for each calendar month was selected using a computer algorithm. Patients were excluded if they were admitted directly from the emergency department to the hospital-in-the-home programme, or if they were transferred from another healthcare service rather than being directly admitted to our hospital.

Study time periods

The three time periods that define the 26 months of analysis time were: (i) pre-EMR (baseline), August 2018 to August 2019, duration 13 months; (ii) post-EMR (pre-COVID-19), September 2019 to February 2020, duration 6 months; and (iii) post-EMR (post-COVID-19), March 2020 to September 2020, duration 7 months. The transition from period 1 to period 2 occurred over 1 week at the end of August 2019. The first COVID-19 infected patient in Victoria was identified at Monash in late January 2020, but only a handful of confirmed infections were further identified in February 2020. Thus, the full impact of the first wave of the COVID-19 pandemic in Victoria was only evident at the beginning of March

2020, when significant restructuring, resource and staff reallocation and training occurred in hospitals for pandemic preparedness. For study modelling purposes, we regarded the transition from period 2 to period 3 as an instantaneous event occurring on 1 March 2020.

GOC forms and outcomes

Screenshots of the digital GOC form on EMR are shown in Supporting Information Figure S1. For the primary outcome, we defined timely as occurring within 2 days of the admission date. We defined an adequate discussion as the GOC form documenting either the 'Reason for' or 'Discussed with' section being filled in with either the patient or substitute decision-maker checkbox being ticked (or if 'Previously discussed' was chosen as the reason for the decision being reached, this same criterion must have been reached on a prior GOC form for the same selected level of GOC (A–D)). We defined the main outcome measure of proper completion as a GOC form that fulfils both the timely and adequate discussion criteria. For the secondary outcome of changes in GOC status during inpatient management, we determined the timing of the changes (relative to admission), the reason (such as further discussion or clarification, change in clinical status, or change of mind) and the person or team implementing the changes (such as patient, treating team, Medical Emergency Team (MET) or intensive care unit (ICU) staff).

Statistical analysis

We used Chi-squared (χ^2) analysis to determine the association between categorical variables and the study period. To further quantify the effect of EMR introduction and the impact of the COVID-19 pandemic on the rates of proper GOC completion, we used an interrupted time series (ITS) approach. The ITS model uses an ordinary least squares regression method with Newey-West standard errors to account for autocorrelation. An assessment of autocorrelations was performed visually using a correlogram and partial correlogram, and statistically using the Cumby-Huizinga (Breusch-Godfrey) general test for autocorrelation. To compare the non-parametric distributions for the time interval between GOC forms, we used the Kruskal-Wallis test and Dunn's multiple comparison test with Bonferroni's adjustment. All data analysis was performed with STATA 16 (StataCorp, TX, USA). A $P < 0.05$ was considered statistically significant.

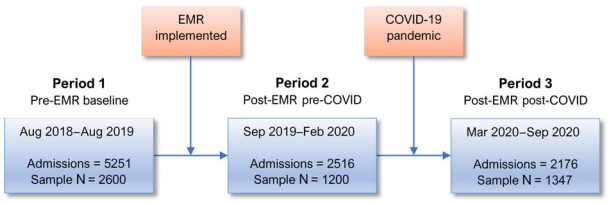

Figure 1 Study flow diagram showing the number of admissions in each study time period and number of patients randomly sampled for analysis, relative to the impact of introduction of the electronic medical records (EMR) and the COVID-19 pandemic.

Results

Patient characteristics

A total of 5147 patients was included in the study (Fig. 1). A summary of the patient characteristics is shown in Table 1. Overall, there were no differences in age, sex distribution and non-English-speaking status between patients across the three periods (Fig. S2). The number of comorbidities and the Charlson comorbidity scores were not different across the three periods (Fig. S2) even though there were fewer patients with chronic obstructive pulmonary disease in the COVID-19 period compared with baseline (16.7% vs 22.6%; $P < 0.001$). The COVID-19 period was also associated with relatively fewer direct admissions to the ICU compared with baseline (6.8% vs 10.7%; $P < 0.001$) and fewer MET calls (6.5% vs 11.4%; $P < 0.001$). The average hospital length of stay and mortality rate was stable across the entire study period and was not affected by COVID-19. However, there was a transient decline in hospital admissions during the first wave of the COVID-19 pandemic in Victoria compared to baseline admissions (Fig. S2). This dip was not seen with the second wave of the pandemic in Victoria.

Admission GOC

During the study, the overall GOC non-completion rate was 10.2%. There was clear evidence that compared with baseline, the odds of non-completion declined significantly during the EMR period (odds ratio (OR) = 0.62; 95% confidence interval (CI): 0.50 to 0.78; $P < 0.001$) and again during the COVID-19 period (OR = 0.36; 95% CI: 0.27 to 0.47; $P < 0.001$). The details of the admission GOC are summarised in Table 2. The better completion rate during the EMR period was associated with a higher proportion of patients allocated to GOC category A compared with baseline. However, the better completion rate during the COVID-19 period was associated with an increase in GOC categories B and C compared with the EMR period. In the EMR and COVID-19 periods, there was an increasing proportion

Table 1 Characteristics of patients by study era

Characteristic	All patients ($N = 5147$)	Baseline ($n = 2600$)	EMR ($n = 1200$)	COVID-19 ($n = 1347$)
Age, median (IQR) (years)	73 (60–83)	74 (60–83)	72 (58–82)	74 (60–83)
Female, *n* (%)	2635 (51.2)	1354 (52.1)	617 (51.4)	664 (49.3)
Non-English speaking, *n* (%)	1135 (22.1)	613 (23.6)	263 (21.9)	259 (19.3)
Diabetes, *n* (%)	1696 (33.0)	851 (32.7)	381 (31.8)	464 (34.4)
Obesity, *n* (%)	786 (15.3)	368 (14.2)	208 (17.3)	210 (15.6)
COPD, *n* (%)	1082 (21.0)	587 (22.6)	270 (22.5)	225 (16.7)
Heart failure, *n* (%)	1080 (21.0)	567 (21.8)	242 (20.2)	271 (20.1)
Ischaemic heart disease, *n* (%)	863 (16.8)	465 (17.9)	199 (16.6)	199 (14.8)
Dementia, *n* (%)	555 (10.8)	276 (10.6)	119 (9.9)	160 (11.9)
Charlson score, mean (SD)	5.1 (3.0)	5.2 (3.1)	4.9 (3.0)	5.0 (3.0)
Chronic pain, *n* (%)	335 (6.5)	194 (7.5)	74 (6.2)	67 (5.0)
Neuromuscular disease, *n* (%)	160 (3.1)	76 (2.9)	45 (3.8)	39 (2.9)
No. comorbidities, mean (SD)	2.1 (1.6)	2.1(1.7)	2.0 (1.6)	2.0 (1.5)
Direct ICU admissions, *n* (%)	508 (9.9)	277 (10.7)	140 (11.7)	91 (6.8)
Length of stay, median (IQR)	5.0 (3.0–8.9)	5.1 (3.0–9.0)	5.1 (3.1–8.9)	4.9 (2.8–8.6)
MET calls, *n* (%)	525 (10.2)	295 (11.4)	142 (11.8)	88 (6.5)
Mortality, *n* (%)	242 (4.7)	135 (5.2)	51 (4.3)	56 (4.2)

COPD, chronic obstructive pulmonary disease; EMR, electronic medical record; ICU, intensive care unit; IQR, interquartile range; MET, Medical Emergency Team.

Table 2 Details of admission Goals-of-Care (GOC) form completion

Admission GOC	All patients ($N = 5147$)	Baseline ($n = 2600$)	EMR ($n = 1200$)	COVID-19 ($n = 1347$)
Admission GOC category, *n* (%)				
Not done	527 (10.2)	350 (13.5)	106 (8.8)	71 (5.3)
A: No limitation	2422 (47.1)	1160 (44.6)	611 (50.9)	651 (48.3)
B: Not for CPR	1475 (28.7)	726 (27.9)	3258 (27.1)	424 (31.5)
C: Conservative	698 (13.6)	347 (13.4)	154 (12.8)	197 (14.6)
D: Palliative	25 (0.5)	17 (0.7)	4 (0.3)	4 (0.3)
Previous GOC available, *n* (%)	2940 (57.1)	1521 (58.5)	682 (56.8)	737 (54.7)
Adequate discussion, *n* (%)	2019 (43.7)	1102 (49.0)	468 (42.8)	449 (35.2)
Adequate reason, *n* (%)	2418 (52.3)	1221 (54.3)	550 (50.3)	647 (50.7)
Adequate reason and discussion, *n* (%)	1407 (30.5)	765 (34.0)	333 (30.4)	309 (24.2)
Completed within 2 days, *n* (%)	4325 (84.0)	2030 (78.1)	1050 (87.5)	1245 (92.4)
Proper completion, *n* (%)	1341 (26.1)	718 (27.6)	319 (26.6)	304 (22.6)
Person completing initial GOC, *n* (%)				
Intern or resident	889 (19.2)	347 (15.4)	221 (20.2)	321 (25.1)
Registrar	3655 (79.1)	1855 (82.4)	866 (79.2)	934 (73.1)
Consultant	57 (1.2)	28 (1.2)	7 (0.6)	22 (1.7)
Other	20 (0.4)	20 (0.9)	0 (0)	0 (0)
GOC discussed with consultant, *n* (%)	390 (8.4)	192 (8.5)	103 (9.4)	95 (8.4)

of forms completed by the unit intern or resident and a reciprocal decline in completion by the registrar. Nevertheless, the overall rates of discussion with the unit consultant were still low, averaging 8.4%, which was not significantly different across all three periods.

Proper completion of GOC

Overall, the proper completion rate of the GOC forms on admission was only 26.1% over the study period. There was evidence that compared with baseline, the odds of proper completion declined during the COVID-19 period (OR = 0.76; 95% CI: 0.65 to 0.89; $P = 0.001$) but not during the EMR period (OR = 0.95; 95% CI: 0.81 to 1.11; $P = 0.51$). The lower proper completion rate occurred despite an increase in the odds of GOC form completion within 2 days during the EMR period (OR = 1.97; 95% CI: 1.62 to 1.39; $P < 0.001$), which further increased during COVID-19 (OR = 3.42; 95% CI: 2.74 to 4.28; $P < 0.001$) compared with baseline. We

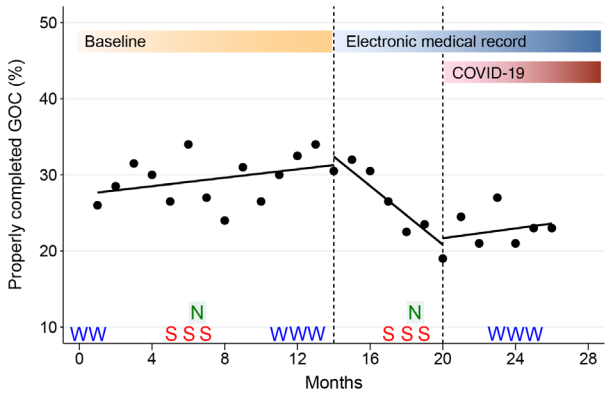

Figure 2 Interrupted time series analysis of the proper completion rates of Goals-of-Care (GOC) forms for patients admitted under General Medicine, demonstrating the effect of the introduction of electronic medical records and the impact of the arrival of the COVID-19 pandemic. The horizontal text bars at the top of the graph indicate the division of the three study time periods. (●), Observed; (——), linear prediction. N, commencement of a new training year for interns and medical registrars; S, summer months; W, winter months.

further identified that the main reason for the lower rates of proper completion was the decline in the documentation of discussion and reason for the GOC allocation with the introduction of EMR, and the further decline in the documentation of an adequate discussion on the GOC form during the COVID-19 period (Table 2).

ITS analysis

As shown in Figure 2, the level of the monthly proper completion rates of GOC forms was estimated at 27.7% in the beginning of the study and there was no significant trend in the baseline monthly rates prior to the introduction of EMR (coefficient = 0.28; 95% CI: −0.13 to 0.68; $P = 0.17$). Following EMR introduction, there was a significant decrease in the monthly proper completion rates by 2.21% per month (95% CI: −2.83 to −1.58; $P < 0.001$). After the arrival of the COVID-19 pandemic, there was a reversal of this downward trend, with a positive change in proper completion rates compared with the EMR period of 2.25% per month (95% CI: 1.35 to 3.15; $P < 0.001$). There was no significant difference in the slope of the regression line during the COVID-19 period compared with the baseline period (coefficient = 0.32; 95% CI: −0.26 to 0.90; $P = 0.26$). Thus, proper completion rates were stabilised at a lower rate in the 6 months after COVID-19 compared with baseline after a significant drop following the introduction of EMR. Proper completion rates showed no

Table 3 Details of first change in Goals-of-Care (GOC) form after initial form completed

First GOC change†	All patients ($N = 392$)	Baseline ($n = 195$)	EMR ($n = 98$)	COVID-19 ($n = 99$)
Time interval from initial GOC, *n* (%)‡				
≤2 days	145 (37.2)	57 (29.5)	39 (39.8)	49 (49.5)
3–7 days	171 (43.9)	101 (52.3)	33 (33.7)	37 (37.4)
>7 days	74 (19.0)	35 (18.1)	26 (26.5)	13(13.1)
Median (IQR) time to change (days)‡	2.0 (1.0–6.0)	3.0 (1.0–6.0)	2.5 (1.0–8.0)	2.0 (0.0–4.0)
Adequate reason and discussion, *n* (%)	306 (78.1)	158 (81.0)	76 (77.6)	72 (72.7)
Person completing GOC change, *n* (%)				
Intern or resident	324 (82.7)	157 (80.5)	81 (82.7)	86 (86.7)
Registrar	44 (11.2)	23 (11.8)	14 (14.3)	7 (7.1)
Consultant	16 (4.1)	10 (5.1)	3 (3.1)	3 (3.0)
Other	8 (2.0)	5 (2.6)	0 (0)	3 (3.0)
Party initiating GOC change, *n* (%)				
Patient	14 (3.6)	13 (6.7)	1 (1.0)	0 (0)
Next of kin/substitute decision maker	16 (4.1)	8 (4.1)	3 (3.1)	5 (5.1)
Treating medical team	316 (80.6)	144 (73.9)	84 (85.7)	88 (88.9)
ICU review at MET call or Code Blue	23 (5.9)	17 (8.7)	4 (4.1)	2 (2.0)
Other/unknown	23 (5.9)	13 (6.7)	6 (6.1)	4 (4.0)
GOC category change				
B: Not for CPR to C – Conservative	154 (39.3)	70 (35.9)	44 (44.9)	40 (40.4)
C: Conservative to D – Palliative	89 (22.7)	45 (23.1)	20 (20.4)	24 (24.2)
A: No limit to B – Not for CPR	73 (18.6)	40 (20.5)	18 (18.4)	15 (15.2)
Other changes	76 (19.4)	40 (20.5)	16 (16.3)	20 (20.2)
Change discussed with consultant, *n* (%)	224 (57.0)	111 (56.9)	57 (58.2)	56 (56.0)

†Patients with missing admission GOC excluded.

‡Two patients did not have a documented date for the admission Goals-of-Care, so the denominator for these percentages is based on a total $n = 390$ (baseline, $n = 193$).

CPR, cardiopulmonary resuscitation; EMR, electronic medical record; ICU, intensive care unit; IQR, interquartile range; MET, Medical Emergency Team.

seasonal patterns. Following the commencement of the new training year for interns and registrars in late January to February, there was a transient drop in the proper completion rates in March, but it was not sustained (Fig. 2).

GOC category change

Of the 4620 patients with a completed GOC on admission, the GOC category was changed once in 325 (7.0%) patients during their admission and changed more than once in 65 (1.4%) patients. The proportion of patients experiencing a GOC category change was not significantly different in the three periods ($\chi^2 = 2.64$; d.f. = 4; $P = 0.62$). However, GOC changes appeared to be happening earlier when comparing baseline with EMR and comparing EMR with COVID-19. There was a clear association between each period and the proportion of patients who experienced a GOC category change within 2 days ($\chi^2 = 18.5$; d.f. = 4; $P = 0.001$). Furthermore, the median time to GOC change had declined from baseline to EMR introduction, and further declined from EMR to COVID-19 (Table 3). When comparing the overall distribution of the time intervals for GOC change, we noted that the most significant change occurred with COVID-19 ($\chi^2 = 3.42$; d.f. = 1; $P = 0.001$) and that the impact of EMR was not statistically significant ($\chi^2 = 0.46$; d.f. = 1; $P = 0.97$), as shown in Figure S3.

The adequacy of documentation of reason and discussion for a GOC change was not significantly different across the three periods ($\chi^2 = 2.66$; d.f. = 2; $P = 0.26$). Most changed forms were completed by the unit intern or resident, which is consistent with the finding that the party triggering the change in GOC was predominantly the treating unit (73.9% at baseline). There was also an association between each period and the party triggering GOC change ($\chi^2 = 19.8$; d.f. = 8; $P = 0.01$), with relatively fewer changes initiated by patients, next of kin or ICU staff during the COVID-19 period compared with baseline. The most frequent category change was from B to C, which is the removal of MET calls and transition to a conservative approach. GOC changes were more likely to be discussed with the unit consultant compared with the completion of the admission GOC form (57.0% vs 8.4%), but this was not influenced by EMR or COVID-19. However, changes were more likely to be discussed with the consultant if the admission GOC was discussed with the consultant (70.0% vs 54.2%; $P = 0.015$).

Discussion

In this cross-sectional study of 5147 general medicine admissions spanning 26 months, we gained some useful insights into the impact of EMR introduction on GOC completion. The arrival of the COVID-19 pandemic and its impact on healthcare systems also provided us a unique opportunity to observe how strategies designed to cope with the pandemic also affected GOC completion. We confirmed that the estimated baseline rate of proper GOC form completion was low at 28%, which is lower than our previous reported estimate of 35% based on a 3-month analysis.[3] However, there was no specific trend in the 13 months leading up to EMR implementation. The rates of GOC non-completion improved with the implementation of EMR and the arrival of COVID-19. However, the rate of proper completion declined after EMR implementation, and the main barrier to proper completion was inadequate documentation of a discussion despite an improvement in timeliness. EMR implementation did not occur in proximity to the commencement of the new training year for interns and registrars, and the changes in proper completion rates after EMR introduction were clearly beyond that of normal variation observed at baseline.

As observed in the present study, electronic reminders can improve completion of GOC documentation when combined with education.[4] However, a better completion rate does not guarantee timeliness or adequacy of documentation, which is how we defined proper completion in this study. The issue of inadequate documentation of GOC discussion has also been observed in other studies[1] and is contrary to the expectation that an EMR system would improve documentation overall. One possible contributor to inadequate documentation in EMR is the phenomena of click fatigue and alert fatigue, given the *discussed with* section is a simple tick box selection, and the *supervising consultant* section has a predictive text selection of all the consultants within the organisation. However, making every digital field of the GOC form mandatory also risks contributing further to alert and click fatigue, resulting in alerts or the process itself being cancelled without further cognitive processing,[7–9] and potentially contribute to a decline in overall performance due to frequent task interruption.[7,10]

We noted that consultants were involved in less than 10% of admission GOC discussions. This is not unique to our hospital, and a low level of involvement of senior physicians in the documentation of GOC or equivalent forms has been noted in other centres.[11,12] There is evidence that doctors appreciate the importance of GOC discussion and documentation, but there are many who prefer to shift the responsibility to others.[13–16] Some believe that writing a limited resuscitation order could result in their patient receiving suboptimal care, while others cited the lack of time and confidence in having these type of discussions.[16–18] A lack of confidence and

time is particularly concerning given the increasing tendency for interns and residents to complete the GOC forms.

As the lack of time is an important barrier to successful GOC discussions,[19] we hypothesised that pressures on COVID-19 assessment interrupted normal GOC discussion and documentation processes, particularly with the need for donning personal protective equipment, respiratory isolation and a directive to limit direct patient contact. The data proved our intuition were incorrect. The arrival of the COVID-19 pandemic created a positive trend, which provided a 'course correction' in the negative post-EMR trend in proper completion rates. During the COVID-19 pandemic, there was a strong organisational push to have GOC documentation completed in Emergency prior to ward transfer, and for units to carefully consider the GOC status in relation to MET calls given the exposure risk to staff who attended the MET calls, particularly in relation to aerosol-generating procedures such as nebulisers and non-invasive ventilation. Due to these measures, there was improvement in the timeliness of GOC completion and documentation, but at the expense of early inpatient revisions of GOC, which were mostly 'downgrades' from category B to category C. Unlike the admission GOC form, proper completion rates for revised GOC forms were over 70%. It is possible that these early revisions can be avoided if the initial admission GOC were optimised, and early consultant involvement may have been critical to achieve this.

The main strengths of the present study were the large number of admissions and GOC forms analysed, inclusion of a long baseline period and the use of time series rather than simple aggregate analysis of before/after data. A time series approach allowed determination of preexisting trends or seasonal variations in proper GOC completion leading up to the introduction of EMR. It allowed us to filter out the 'noise' of transient fluctuations (lasting days to weeks) due to staff turnover or examinations, and to detect the 'signal' of true change (lasting months). The present study has several limitations. We relied on the analysis of adequate GOC documentation, which is only a surrogate for the actual quality of GOC discussions between clinicians and patients or substitute decision-makers. Hence, some cases may have failed to meet our criteria for proper completion due to poor documentation rather than poor conduct of an adequate discussion. As an observational study, unknown confounders may not have been accounted for. Last, the results should only be generalised to general medicine patients as other units were not included.

Conclusions

EMR improved GOC completion rates and promoted timeliness, but negatively impacted the documentation of discussions and reasons for GOC choice, with the net effect of dropping proper completion rates as defined in the present study. As more interns and residents were completing GOC forms, we suspect that the quality of the discussion and documentation may be improved by mandating that medical registrars complete the GOC forms, in combination with greater discussions with the consultant at the time of admission. Changes to the EMR system to make each electronic field mandatory may improve proper completion and should be further evaluated. Of the strategies implemented during the COVID-19 pandemic, further study is needed to determine which might be effective and sustainable for optimising proper completion of GOC and avoid the need for early reclassification.

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References

1 Morgan DJR, Eng D, Higgs D, Beilin M, Bulsara C, Wong M *et al*. Advance care planning documentation strategies; goals-of-care as an alternative to not-for-resuscitation in medical and oncology patients. A pre-post controlled study on quantifiable outcomes. *Intern Med J* 2018; **48**: 1472–80.

2 Thomas RL, Zubair MY, Hayes B, Ashby MA. Goals of care: a clinical framework for limitation of medical treatment. *Med J Aust* 2014; **201**: 452–5.

3 Potenzi B, Lim AKH. Patient factors affecting the proper completion of a Goals-of-Care form in a general medicine hospital admission. *Intern Med J* 2019; **50**: 1232–9.

4 Haley EM, Meisel D, Gitelman Y, Dingfield L, Casarett DJ, O'Connor NR. Electronic goals of care alerts: an innovative strategy to promote primary palliative care. *J Pain Symptom Manage* 2017; **53**: 932–7.

5 Cheruku S, Dave S, Goff K, Park C, Ebeling C, Cohen L *et al*. Cardiopulmonary resuscitation in intensive care unit patients with

coronavirus disease 2019. *J Cardiothorac Vasc Anesth* 2020; **34**: 2595–603.
6 Curtis JR, Kross EK, Stapleton RD. The importance of addressing advance care planning and decisions about do-not-resuscitate orders during novel coronavirus 2019 (COVID-19). *JAMA* 2020; **323**: 1771–2.
7 Ancker JS, Edwards A, Nosal S, Hauser D, Mauer E, Kaushal R *et al*. Effects of workload, work complexity, and repeated alerts on alert fatigue in a clinical decision support system. *BMC Med Inform Decis Mak* 2017; **17**: 36.
8 Backman R, Bayliss S, Moore D, Litchfield I. Clinical reminder alert fatigue in healthcare: a systematic literature review protocol using qualitative evidence. *Syst Rev* 2017; **6**: 255.
9 Isaac T, Weissman JS, Davis RB, Massagli M, Cyrulik A, Sands DZ *et al*. Overrides of medication alerts in ambulatory care. *Arch Intern Med* 2009; **169**: 305–11.
10 Hussain MI, Reynolds TL, Zheng K. Medication safety alert fatigue may be reduced via interaction design and clinical role tailoring: a systematic review. *J Am Med Inform Assoc* 2019; **26**: 1141–9.
11 Smith RJ, Santamaria JD, Holmes JA, Faraone EE, Hurune PN, Reid DA. Use of resuscitation plans at a tertiary Australian hospital: room for improvement. *Intern Med J* 2017; **47**: 767–74.
12 Butler JV, Pooviah PK, Cunningham D, Hasan M. Improving decision-making and documentation relating to do not attempt resuscitation orders. *Resuscitation* 2003; **57**: 139–44.
13 Sritharan G, Mills AC, Levinson MR, Gellie AL. Doctors' attitudes regarding not for resuscitation orders. *Aust Health Rev* 2017; **41**: 680–7.
14 Yarnell C, Fowler R. The case for routine goals-of-care documentation. *BMJ Qual Saf* 2016; **25**: 647–8.
15 Kaldjian LC, Curtis AE, Shinkunas LA, Cannon KT. Review article: goals of care toward the end of life: a structured literature review. *Am J Hosp Palliat Med* 2009; **25**: 501–11.
16 Levinson M, Mills A, Barrett J, Sritharan G, Gellie A. Why didn't you write a not-for-cardiopulmonary resuscitation order?' unexpected death or failure of process? *Aust Health Rev* 2018; **42**: 53–8.
17 Morrison RS, Morrison EW, Glickman DF. Physician reluctance to discuss advance directives. An empiric investigation of potential barriers. *Arch Intern Med* 1994; **154**: 2311–8.
18 Visser M, Deliens L, Houttekier D. Physician-related barriers to communication and patient- and family-centred decision-making towards the end of life in intensive care: a systematic review. *Crit Care* 2014; **18**: 604.
19 Detering KM, Hancock AD, Reade MC, Silvester W. The impact of advance care planning on end of life care in elderly patients: randomised controlled trial. *BMJ* 2010; **340**: c1345.

Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web-site:

Figure S1. Screenshots of the digital Goals-of-Care document. The electronic medical records (EMR) digital Goals-of-Care document combines tick boxes and free-text fields. In this version, the yellow fields represent the minimum entries required to complete and save the document.
Figure S2. Trends for key confounders of Goals-of-Care completion. The mean age, Charlson score, comorbidities and the percentage of English-speaking patients remained stable across the baseline (months 0–14), electronic medical records (months 14–20) and COVID-19 (months 20–26) periods. The number of patients admitted to general medicine transiently dropped during the first wave of COVID-19 but returned to baseline without being affected by the second wave of COVID-19 in the state of Victoria.
Figure S3. Time to Goals-of-Care change according to study period. Histograms with kernel density estimates (blue lines) showing the distribution of the time interval from initial Goals-of-Care completion to first change in Goals-of-Care according to the study period. The distribution of time intervals indicated that Goals-of-Care changes were occurring much earlier during the COVID-19 period compared to baseline, or compared with the period after the introduction of electronic medical records (EMR).