

**Patient harm and institutional avoidability of out-of-hours discharge from intensive care:  
An analysis using mixed methods**

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## **Re-prints**

Re-prints will not be ordered.

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## **ABSTRACT**

### **Objective**

Out-of-hours discharge from ICU to the ward is associated with increased in-hospital mortality and ICU readmission. Little is known about why this occurs. We map the discharge process and describe the consequences of out-of-hours discharge to inform practice changes to reduce the impact of discharge at night.

### **Design**

This study was part of the REFLECT mixed methods study. We defined out-of-hours discharge as 16:00 - 07:59h. We undertook 20 in-depth case record reviews where in-hospital death after ICU discharge had been judged 'probably avoidable' in previous retrospective structured judgement reviews, and 20 where patients survived. We conducted semi-structured interviews with 55 patients, family members and staff with experience of ICU discharge processes. These, along with a stakeholder focus group, informed ICU discharge process mapping using the Human Factors-based Functional Analysis Resonance Method (FRAM).

### **Setting**

Three UK NHS hospitals, chosen to represent different hospital settings.

### **Subjects**

Patients discharged from ICU, their families and staff involved in their care.

### **Interventions**

None.

### **Measurements and Main Results**

Out-of-hours discharge was common. Patients and staff described out-of-hours discharge as unsafe due to a reduction in staffing and skill mix at night. Patients discharged

out-of-hours were commonly discharged prematurely, had inadequate handover, were physiologically unstable and did not have deterioration recognised or escalated appropriately. We identified five interdependent functions key to facilitating timely ICU discharge: multi-disciplinary team decision for discharge; patient prepared for discharge; bed meeting; bed manager allocation of beds; and ward bed made available.

## **Conclusion**

We identified significant limitations in out-of-hours care provision following overnight discharged from ICU. Transfer to the ward before 16:00 should be facilitated where possible. Our work highlights changes to help make day time discharge more likely. Where discharge after 16:00 is unavoidable, support systems should be implemented to ensure the safety of patients discharged from ICU at night.

**Study Registration:** [ISRCTN14658054](#)

## INTRODUCTION

The link between out-of-hours discharge to the ward from ICU (during the same hospitalisation) and subsequent in-hospital mortality has long been recognised [1,2]. Our recent international meta-analysis demonstrated a strong association between discharge out-of-hours from ICU and both in-hospital mortality and readmission [3]. However, to our knowledge, no evidence exists to explain why those discharged at night are at higher risk of poor in-hospital outcomes. It has been suggested that more patients may be discharged to the ward overnight with limitations in their treatment [4]. However, we demonstrated a similar association with readmission to ICU, suggesting patients discharged at night remain for active treatment [3], meaning care directed to treatment and cure of a condition. This association has also been suggested to be due to premature discharge because of high occupancy, with patients being moved before they are ready to accommodate admissions [1,5]. This link may also indicate that ward care is suboptimal at night [3]. It is currently unclear to what extent premature discharge, high bed occupancy or reduced care provision at night contribute to the association between out-of-hours discharge from ICU and poor outcomes. To inform changes to address this increased risk, further knowledge is required about the process of care following out-of-hours ICU discharge [6,7].

The work reported here formed part of the REFLECT (REcovery FoLLowing intensive CarE Treatment) project, a UK-based mixed methods study examining the care of patients discharged from ICU to hospital wards [8]. The overall aim of this programme is to develop a multi-component intervention to reduce post-ICU in-hospital mortality. In previous published work we found out-of-hours discharge (defined as after 16:00) to occur in nearly 70% of patients whose care we reviewed [9], and this was identified as a common problem

in care delivery. As out-of-hours discharge was a strong independent theme throughout the data collected, this paper reports findings from the primary REFLECT data and Functional Analysis Resonance Method (FRAM) focus group related to out-of-hours discharge.

## **MATERIALS AND METHODS**

### **Definitions**

There is no consensus on the definition of out-of-hours discharge from ICU. In international literature, start times range from 16:00 to 22:00 and end times from 05:59 to 09:00 [1,10–11]. In the UK, the common definition of 22:00 is not based on organisational changes in care provision and may be considered arbitrary [12]. In our previous systematic review, discharge after 16:00 was both commonly used to define out-of-hours, and associated with increased mortality and ICU readmission [3]. This definition is consistent with the change from home team to on-call medical cover around 17:00, which is usual practice in the UK [13]. Patients must arrive before this time if they are to be seen by their medical team. We therefore defined out-of-hours discharges as those occurring between 16:00 and 07:59.

Premature discharge was defined as occurring for those patients experiencing ongoing clinical problems at ICU discharge which did not respond to ward-based therapy within the first 48 hours of transfer, in line with published definitions [14].

Probably avoidable death was defined as those having a greater than 50% chance of preventability if changes had been made to the care delivered [15].

## **Primary data collection**

The REFLECT study was granted ethical approval by Wales REC 4 (reference 17/WA/0139), and registered (ISRCTN14658054). Data were collected at three NHS trusts.

### *Retrospective case record review*

A retrospective case record review (RCRR) of 300 patients discharged from ICU who did not survive to hospital discharge using the Structured Judgement Review method [15], has previously been reported [9].

### *In-depth reviews*

In the RCRR we judged 20 post-ICU deaths as ‘probably avoidable’ [9]. We undertook in-depth analysis of these 20 deaths, using an established framework [16], to find common contributory problems in care and their underlying human factors. We also analysed an equal number of survivor cases, to offer contrast with non-survivors (supplemental file 1, figure 1). A summary of the methodology can be found in the protocol [8] and supplemental file 2.

### *Qualitative interviews*

We conducted thematic analysis [17] of semi-structured interviews with 25 patients and family members and 30 staff members involved in the ICU discharge process about their experiences (supplemental file 1, figure 1). Further details of the approach taken are published elsewhere [8], and summarised in supplemental file 2.

Findings from these in-depth analyses and interviews relating to out-of-hours discharge are presented here, including a vignette drawn from the RCRR, to offer context.

## **Functional Resonance Analysis Method**

The FRAM method is widely used in safety reviews in industry and increasingly in healthcare [18–20]. The FRAM maps what needs to occur to ensure the intended outcome is achieved (i.e. discharge before 16:00) [20]. It focuses on the functions within a process (see table 1 for definitions). For each of these functions, the key conditions for each function to be successful are identified, defined as: ‘input’, ‘output’, ‘precondition’, ‘resource’, ‘control’ and ‘time’ [20]. Functions link to form a process, often with the ‘output’ of one function becoming the ‘input’ of the next. The FRAM results in clear understanding of the steps required in a process and the conditions that have to be in place to complete these steps successfully [19,21]. We conducted a FRAM for each of the common problems in care identified, including ward-based mobilisation [22].

This FRAM, focusing on ICU to ward discharge, was informed by the primary data from the REFLECT study, and input from stakeholders. A Human Factors (HF) scientist with experience facilitating FRAMs (LM) led the meeting. Key staff members (external to the study team) from the three REFLECT study sites, including an ICU consultant, an ICU follow-up practitioner with a nursing background, and a senior ICU nurse, took part. Two research team members with in-depth knowledge of the primary data and ICU and ward-based nursing and physiotherapy clinical experience also attended. At the start of the session an information package was presented to the group, including relevant prior research and data from the REFLECT study.



183

184           The HF scientist commenced the FRAM by reiterating the focus on the ‘ideal world’  
185 situation – i.e. discharging a patient from ICU ‘in-hours’ (before 16:00). Group members  
186 suggested a function in the ICU discharge process. A facilitated discussion of this function  
187 took place to identify each condition (inputs, pre-conditions, etc.). From this, further  
188 functions and their conditions were identified, and links between the functions developed.

189

190           The HF scientist documented the developing framework on whiteboards using sticky  
191 notes colour-coded to match the framework. This was refined through discussion, with  
192 changes made to functions, lines redrawn and further functions added. The process ended  
193 when the group were happy that all functions and associated conditions directly related to  
194 the process had been captured. The final FRAM model was transcribed from the white  
195 boards into FRAM visualiser software (<https://functionalresonance.com/FMV/index.html>).

196

## 197 **RESULTS**

### 198 **Primary data collection**

#### 199 *Higher acuity of illness in out-of-hours discharges*

200           Of the 40 cases reviewed in-depth, 28 were discharged out-of-hours. Five of the six  
201 discharges assessed as ‘premature’ occurred overnight and were followed by either death or  
202 readmission to ICU within 24 hours (table 2). Premature discharge was judged to have  
203 contributed to four ‘probably avoidable’ deaths. The vignette (table 3) presents a typical  
204 case of premature discharge. Premature discharges were also described in interviews as  
205 occurring more frequently at night, due to high bed occupancy, and to more often result in  
206 readmission to ICU (table 4, quotes 1 and 2).

207

208           For 12/28 patients discharged overnight, their initial ward Early Warning Score (EWS)  
209 was high (exceeding the threshold for protocolised escalation), suggesting failure to  
210 optimise prior to discharge (table 2). EWS are a weighted scoring system based on vital signs  
211 including heart rate, oxygen saturations and blood pressure [23], (supplemental file 3  
212 presents an example EWS). Only two of these high EWS were escalated, with between three  
213 and nine hours to the next documented EWS (see vignette). In comparison, only 2/12 in-  
214 hours discharges had a high EWS on arrival, and both were escalated according to local  
215 protocol.

216

#### 217 *Reduced patient safety at night*

218           Interviewed staff suggested decreased out-of-hours staffing and skill mix made  
219 night-time discharges more challenging and possibly less safe than during the day. In  
220 addition, the lack of specialist staff at night indicated a reduction in the safety net of support  
221 available compared with the day (Table 4, quotes 3 and 4). Patients described night-time  
222 discharge as frightening and unsettling, at a time when they were already vulnerable. Fewer  
223 staff on shift may have contributed to the perception of chaos described by one patient  
224 (quote 5). Out-of-hours was mostly discussed in reference to night, but there were also  
225 differences identified at weekends, particularly in the availability of clinical specialist and  
226 physiotherapy support (quote 6).

227

#### 228 *Continuity of information and care*

229           A total of 16/28 out-of-hours discharges had problems with handover  
230 documentation, similar to 8/12 in-hours discharges (table 2). The most frequent

documentation problem for discharges out-of-hours was absence of a medical plan directing management of ongoing problems. In particular, ongoing problems associated with high EWS on arrival or premature discharge were rarely identified in the medical handover (see vignette, table 3). In staff interviews medical reviews were deemed important to continuity of care (table 4, quotes 3, 6 and 7). However, in-depth reviews showed a medical review of any level within six hours of transfer was less likely to occur for discharges out-of-hours (7/28) compared with in-hours (9/12). Where review did occur, this was commonly by the most junior members of the medical team (4/7 reviews at night were by foundation year doctors). This led to more problems with the management of high EWS and premature discharges overnight (table 4, quotes 1, 2, and 4).

#### *Unavoidability of out-of-hours discharges*

Staff and patients perceived out-of-hours ICU discharge as unavoidable due to high bed occupancy and delayed patient flow through the hospital (quotes 8 and 9), with staff voicing concern about the subsequent impact on patient safety and experience (quotes 1 to 8).

Overall, care provision at night was perceived as challenging due to reduced staffing and skill mix, and high workload. Staff described this as impacting their ability to manage patients who were identified as potentially being discharged before they were ready, due to high bed occupancy. These challenges augmented the perception of vulnerability experienced by patients being transferred from ICU to the ward.

#### **FRAM**

Five functions were identified as essential to facilitating discharge from ICU before 16:00. Figure 1 presents a simplified outline of these functions, with a more detailed representation including all elements in supplemental file 4, table 1.

#### **Function 1: Multi-disciplinary team decision for discharge**

Confirming a patient was ready for ICU discharge was identified as a multi-disciplinary team (MDT) decision. Patient-based pre-conditions included: not requiring organ support or drugs only administered in ICU; and assessed by physiotherapist as ready for discharge. This decision was usually made during morning ward rounds, which may not occur until late morning depending on the unit workload.

The timing of this decision was perceived to have consequences for ward bed identification. Where the discharge decision was made the evening before, this facilitated earlier communication with the bed manager.

#### **Function 2: Patient prepared for discharge**

Function two was also identified as an MDT process. The key pre-condition identified was handover documentation prepared by nurses, doctors and physiotherapists. Drug charts, fluid balance and vital signs charts must also be transposed into ward-friendly formats and drugs reviewed by the ICU pharmacist. This preparation requires knowledge of the ward environment and what is deliverable on the ward.

Key resources include nursing time to complete and collate documentation, remove invasive lines and monitoring, and liaise with the ward.

279

280 **Function 3: Bed meeting**

281           A hospital-wide mandated morning bed meeting is held at all three organisations, to  
282 discuss discharges and bed availability. This relies on discharge information which is  
283 dependent on ICU and ward round decision-making (function 1).

284

285 **Function 4: Bed manager allocation of beds**

286           Based on bed meeting information, staffing levels, and ICU bed needs (i.e. elective  
287 surgery and A&E admissions), a ward bed may be allocated for the ICU patient ready for  
288 discharge.

289

290 **Function 5: Bed made available on the ward**

291           Once a bed has been allocated, ICU and ward staff negotiate a discharge time and  
292 ICU inform the ward of any special requirements such as a side room (for infection control)  
293 or equipment (e.g. feed pumps, moving and handling equipment).

294

295           This function is time-dependent on discharge of the patient occupying the ward bed,  
296 in turn reliant on the ward round, discharge medication preparation, and availability and  
297 appropriateness of the discharge lounge (central hospital area for patients waiting for  
298 hospital discharge).

299

300 **Final Output: patient discharged from ICU before 16:00**

The final outcome relies on the timely output of all the key functions, which rely on all pre-conditions, resources and inputs being in place. Though the functions are not entirely linear, delay of any activity or pre-condition will impact the time of discharge.

## **DISCUSSION**

Using data from three NHS hospitals, we outlined the consequences of discharge from ICU to the ward after 16:00. Out-of-hours discharge was common at all hospitals and linked to poorer handover and a delay to first medical review. Patients discharged at night were more likely to have a high EWS on ward arrival, indicating higher acuity, which was rarely escalated overnight. Almost all premature discharges occurred out-of-hours and consequences for these patients were profound. Both staff and patients voiced concerns about discharge at night, identified as a time of high workload and low skill mix. The combination of higher acuity of illness, a reduction in staffing and skill mix, and poorer handover of information, compounds the challenges of receiving patients from ICU overnight. To examine how ICU discharge during the day may be facilitated, the process for discharging a patient from ICU to the ward was mapped in consultation with stakeholders. Examining this process identified five key functions essential to facilitating discharge from ICU before 16:00.

### **Strengths and limitations**

This study had several strengths. Data were collected from three NHS trusts, as part of a larger project, which was registered and the protocol published [8]. The three sites were selected to offer contrasting characteristics such as hospital and ICU capacity, and post-ICU care provision.

As the focus of the REFLECT study incorporated the whole post-ICU ward stay, data on out-of-hours discharge was somewhat limited. Future work including contextual data on bed occupancy, patient flow, organisational stress, staffing levels and delays to hospital discharge may offer further insight into reasons for out-of-hours discharge [24]. In this work we focused on the effects discharge out-of-hours, rather than including weekends, as previous database work suggests that these two periods differ in their effects [25]. We will consider the effects of weekend discharge in future work.

Limitations of RCRR include reliance on documentation (risking loss of data and context) and hindsight bias [15,26]. By conducting interviews alongside the RCRR we took steps to ameliorate this risk. Furthermore, care processes related to out-of-hours discharge, including written handover, time of discharge, and EWS measurement and response were clearly documented and therefore less likely to be affected by these limitations.

Although this work was conducted solely in the UK, our meta-analysis found no difference in the association between out-of-hours discharge and poor outcome between countries, indicating this is an international problem [3]. This work is therefore likely to be relevant to countries with similar healthcare systems to the UK.

The FRAM approach differed from our planned prioritisation exercise in the protocol as we identified fewer distinct problems in care than anticipated. This allowed stakeholder involvement to focus on developing our understanding of each problem. The FRAM stakeholder group was relatively small but was informed by primary data from interviews

with 55 patients, family members and staff, 300 structured judgement reviews and 40 in-depth reviews.

## **Comparison with other literature**

Our work provides context to the association identified by our meta-analysis between out-of-hours discharge and poor outcome [3], including examining the definition of “out-of-hours”. In-line with findings from our previous RCRR, both interviewee responses and in-depth reviews demonstrated that ward provision changed significantly at around 17:00. Out-of-hours care provision was limited by reduced staff ratios, increased workload and poorer skill mix. Our choice of 16:00 as the beginning timepoint of out-of-hours discharge was supported by our primary data which showed patients should arrive on the ward with sufficient time for their home medical team to review and address any initial problems before care provision changed. Defining out-of-hours discharge from ICU between 16:00 [10,27] and 18:00 [2,4,28-29] is common in international literature.

The high frequency of ‘problems in care’ occurring out-of-hours identified by in-depth reviews suggests significant failure of care provision overnight. Combining this with interview data offered contextual information underlying these problems. Patients discharged out-of-hours rarely received a medical review on arrival. When they did, this was usually by the most junior doctors. This suggests lack of experience may have contributed to poor outcome out-of-hours. A before-and-after study of a ‘Hospital At Night’ multi-disciplinary deterioration response initiative [30] found an increase in senior medical review may improve patient outcomes. Infrequent observations despite high EWS at night have



previously been reported and attributed to high workload or limitations in clinical judgement due to inexperience of nursing and medical staff [31-33].

Interviewed staff perceived out-of-hours discharge as inevitable due to the need to create beds for incoming patients. This was supported by the high proportion of discharges occurring after 16:00 and the complexity identified in the FRAM. In-depth reviews identified several overnight premature discharges experiencing significant ongoing medical problems. Both out-of-hours and premature discharge from ICU have been identified as indicators of ICU capacity strain [34], with negative consequences for patients [35-38].

The FRAM illuminated structural issues in processes of care, amenable to changes. We identified five functions where delay would increase the risk of failure to reach the end goal of discharge before 16:00. Timing of the ICU discharge decision (function 1) relies on the timing of the morning ward round, which often occurs after the bed meeting (function 3). Making the discharge decision (function 1) the evening before ICU discharge facilitates timely information flow to the bed meeting (function 3) and therefore earlier ward bed allocation (function 4). It also gives more time to prepare the ICU patient for discharge (function 2). Finally, it allows longer for the ward to prepare a bed for the incoming patient (function 5), including facilitating discharge of ward patients to create capacity and sourcing specialist equipment. The only function where timing is immovable is the bed meeting (function 3), as it is embedded in organisational practice. Process changes need to accommodate these established practices to succeed, and the impact of delays should be acknowledged and planned for.

Although the FRAM identified strategies to support discharge before 16:00, both this work and previous literature have shown it is likely some out-of-hours discharges will be unavoidable due to limited bed capacity [1,5,39]. This has been identified as an important ethical dilemma for ICU staff, emphasising the difficulty in balancing the needs critically ill patients within limited capacity [40]. Where out-of-hours discharges have to occur, our work shows clinicians should ensure clear communication of any ongoing clinical problems in discharge documentation, a comprehensive medical review on ward arrival, and appropriate response to high EWS. These actions may be provided by the receiving ward team and/or supported by ICU clinicians where this is not possible.

## **CONCLUSION**

This study identified significant limitations in out-of-hours care provision for patients discharged from ICU overnight. Transfer to the ward before 16:00 should be facilitated where possible. Our work highlights four alterable functions where changes will help make day-time discharge more likely. Where discharge after 16:00 is unavoidable, clear acknowledgement of ongoing clinical problems in discharge documentation, a medical review on ward arrival and careful monitoring of EWS should be implemented to ensure the safety of patients discharged from ICU at night.

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## **Conflicts of interest**

PW was Chief Medical Officer for Sensyne Health until March 2020, and has shares in the company. No other authors declare any conflicts of interest.

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## REFERENCES

1. Goldfrad C, Rowan K. Consequences of discharges from intensive care at night. *Lancet* 2000;355:1138–42.
2. Pilcher D V, Duke GJ, George C, Bailey MJ, Hart G. After-hours discharge from intensive care increases the risk of readmission and death. *Anaesth Intensive Care* 2007;35:477–85.
3. Vollam S, Dutton S, Lamb S, Petrinic T, Young JD, Watkinson P. Out-of-hours discharge from intensive care, in-hospital mortality and intensive care readmission rates: A systematic review and meta-analysis. *Intensive Care Med* 2018;44:1115–29.
4. Santamaria JD, Duke GJ, Pilcher D V, Cooper DJ, Moran J, Bellomo R. The timing of discharge from ICU and subsequent mortality: A prospective multi-center study. *Am J Respir Crit Care Med* 2015;191:1033–9.
5. Beck DH, McQuillan P, Smith GB. Waiting for the break of dawn? The effects of discharge time, discharge TISS scores and discharge facility on hospital mortality after intensive care. *Intensive Care Med* 2002;28:1287–93.
6. Azevedo LCP, de Souza IA, Zygun DA, Stelfox H, Bagshaw SM. Association between nighttime discharge from the intensive care unit and hospital mortality: A multi-center retrospective cohort study. *BMC Health Serv Res* 2015;15:378
7. Christiansen CF, Flaatten H. Out-of-hours discharge from intensive care: certain about uncertainty. *Intensive Care Med* 2018;44:1545–7.
8. Vollam S, Gustafson O, Hinton L, Morgan L, Pattison N, Thomas H, et al. Protocol for a mixed-methods exploratory investigation of care following intensive care discharge: The REFLECT study. *BMJ Open* 2019;9:e027838
9. Vollam S, Gustafson O, Young JD, Attwood B, Keating L, Watkinson P. Problems in care and avoidability of death after discharge from intensive care: A multi-centre retrospective case record review study. *Crit Care* 2021;25:10.
10. Utzolino S, Kaffarnik M, Keck T, Berlet M, Hopt UT. Unplanned discharges from a surgical intensive care unit: Readmissions and mortality. *J Crit Care* 2010;25:375–81.
11. Iapichino G, Morabito A, Mistraretti G, Ferla L, Radrizzani D, Reis Miranda D. Determinants of post-intensive care mortality in high-level treated critically ill patients. *Intensive Care Med* 2003;29:1751–6.
12. National Institute for Health and Care Excellence Clinical Guideline 50: Acutely ill patients in hospital. London: NICE; 2007.
13. British Medical Association, Safe handover: Safe Patients. Guidance on Clinical Handover for Clinicians and Managers. 2004;BMA:London.
14. Al-Jaghbeer MJ, Tekwani SS, Gunn SR, Kahn JM. Incidence and etiology of potentially preventable ICU readmissions. *Crit Care Med*. 2016;44(9):1704–9.
15. Hutchinson A. Using the structured judgement review method A guide for reviewers.

- 472 London: Royal College of Physicians; 2017.
- 473 16. Hogan H, Healey F, Neale G, Thomson R, Black N, Vincent C. Learning from  
474 preventable deaths: exploring case record reviewers' narratives using change  
475 analysis. *J R Soc Med* 2014;107:365–75.
- 476 17. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res* 2006;3:77-101.
- 477 18. Raben DC, Viskum B, Mikkelsen KL, Hounsgaard J, Bogh SB, Hollnagel E. Application  
478 of a non-linear model to understand healthcare processes: using the functional  
479 resonance analysis method on a case study of the early detection of sepsis. *Reliab*  
480 *Eng Syst Saf* 2018;177:1–11.
- 481 19. Pickup L, Atkinson S, Hollnagel E, Bowie P, Gray S, Rawlinson S, et al. Blood sampling  
482 - Two sides to the story. *Appl Ergon* 2017;59:234-42.
- 483 20. Clay-Williams R, Hounsgaard J, Hollnagel E. Where the rubber meets the road: Using  
484 FRAM to align work-as-imagined with work-as- done when implementing clinical  
485 guidelines. *Implement Sci* 2015;10:1–8.
- 486 21. Hollnagel E. FRAM: The Functional Resonance Analysis Method. Florida: CRC Press;  
487 2017.
- 488 22. Gustafson OD, Vollam S, Morgan L, Watkinson P. A human factors analysis of missed  
489 mobilisation after discharge from intensive care: A competition for care?  
490 *Physiotherapy* 2021;113:131-7.
- 491 23. Royal College of Physicians. National Early Warning Score (NEWS) 2. London: RCP;  
492 2017.
- 493 24. Coffey A, Leahy-Warren P, Savage E, Hegarty J, Cornally N, Day MR, et al.  
494 Interventions to promote early discharge and avoid inappropriate hospital  
495 (Re)admission: A systematic review. *Int J Environ Res Public Health* 2019;16.
- 496 25. Yang S, Wang Z, Liu Z, Wang J, Ma L. Association between time of discharge from ICU  
497 and hospital mortality: a systematic review and meta-analysis. *Crit Care*.  
498 2016;20:390.
- 499 26. Hogan H. The problem with preventable deaths. *BMJ Qual Saf* 2016;25:320–3.
- 500 27. Uusaro A, Kari A, Ruokonen E. The effects of ICU admission and discharge times on  
501 mortality in Finland. *Intensive Care Med* 2003;29:2144–8.
- 502 28. Gantner D, Farley K, Bailey M, Huckson S, Hick s P & Pilcher D. Mortality related to  
503 after-hours discharge from intensive care in Australia and New Zealand, 2005-2012.  
504 *Intensive Care Med* 2014;40:1528-35.
- 505 29. Laupland KB, Misset B, Souweine B, Tabah A, Azoulay E, Goldgran-Toledano D et al.  
506 Mortality associated with timing of admission to and discharge from ICU: a  
507 retrospective cohort study. *BMC Health Serv* 2011;11:321.
- 508 30. Beckett D, Gordon C, Paterson R, Chalkley S, Stewart C, Jones, M. et al. Improvement  
509 in out-of-hours outcomes following the implementation of Hospital at Night. *QJM*  
510 2009;102:539–46.

31. Recio-Saucedo A, Maruotti A, Griffiths P, Smith GB, Meredith P, Westwood G. et al. Relationships between healthcare staff characteristics and the conduct of vital signs observations at night: results of a survey and factor analysis. *Nurs Open*, 2018;5:621–33.
32. Hands C, Reid E, Meredith P, Smith GB, Prytherch DR, Schmidt PE et al. Patterns in the recording of vital signs and early warning scores: compliance with a clinical escalation protocol. *BMJ Qual Saf*, 2013;22;719–26.
33. Gordon CF & Beckett DJ. Significant deficiencies in the overnight use of a Standardised Early Warning Scoring system in a teaching hospital. *Scot Med J* 2011;56:15-8.
34. Bagshaw SM, Opgenorth D, Potestio M, Hastings SE, Hepp SL, Gilfoyle E, et al. Healthcare Provider Perceptions of Causes and Consequences of ICU Capacity Strain in a Large Publicly Funded Integrated Health Region: A Qualitative Study. *Crit Care Med*. 2017;45:e347–56.
35. Wilcox ME, Harrison DA, Patel A, Rowan KM. Higher ICU Capacity Strain Is Associated with Increased Acute Mortality in Closed ICUs. *Crit Care Med*. 2020;709–16.
36. Eriksson C, Stoner R, Eden K, Newgard C, Guise J . The Association Between Hospital Capacity Strain and Inpatient Outcomes in Highly Developed Countries: A Systematic Review. *J Gen Intern Med*. 2017;32(6):686–96.
37. Rewa OG, Stelfox HT, Ingolfsson A, Zygun DA, Featherstone R, Opgenorth D, et al. Indicators of intensive care unit capacity strain: A systematic review. *Crit Care*. 2018;22(1):86.
38. Elliott M, Worrall-Carter L, Page K. Factors contributing to adverse events after ICU discharge: A survey of liaison nurses. *Aust Crit Care* 2013;26:76–80.
39. Rodriguez-Carvajal M, Mora D, Doblas A, Garcia M, Dominguez P, Trisancho A, et al. Impact of the premature discharge on hospital mortality after a stay in an intensive care unit. *Med Intensiva* 2011;35:143–9.
40. Oerlemans AJ, van Sluisveld N, van Leeuwen E, Wollersheim H, Dekkers W & Zegers M. Ethical problems in intensive care unit admission and discharge decisions: A qualitative study among physicians and nurses in the Netherlands. *BMC Med Ethics* 2015;16:9.

## FIGURE LEGENDS

Figure 1: Key functions in the process of discharging a patient from ICU to the ward