

The effect of intermediate care units on patient and hospital utilisation outcomes: a systematic literature review

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Abstract

Introduction Intermediate care units (IMCUs) provide a level of care between general wards and intensive care units (ICUs), offering enhanced monitoring and selected organ support at lower staffing intensity than ICUs. Their expansion across countries has prompted growing interest about their effectiveness, cost-efficiency, and optimal patient selection. However, existing evidence regarding their impact has been inconsistent, in part due to the substantial heterogeneity in IMCU organisation, nomenclature, and clinical purpose. This systematic review synthesises comparative evidence published between 2013 and 2025 to evaluate the contribution of ICMUs to patient outcomes and hospital resource use.

Aims and objectives The review aimed to assess IMCU effects on mortality, length of stay (LOS), hospital readmissions, ICU readmissions, costs, and adverse events in adult patient populations.

Methods Three databases were systematically searched for comparative studies in Organisation for Economic Co-operation and Development (OECD) countries. Screening was performed in duplicate, and data were extracted using a standardised template. Methodological quality was evaluated with relevant NIH assessment tools.

Results Twenty-eight studies met inclusion criteria. The findings across studies were heterogeneous. Mortality patterns did not point in a single direction: some research suggested potential benefits of IMCU care, others reported no clear differences or highlighted potential risks. These discrepancies were often linked to differences in case-mix and admission criteria. LOS outcomes were similarly inconsistent, with some studies associating IMCUs with shorter hospital stays, and others reporting minimal or no improvement. Readmission rates generally did not differ substantially between IMCU patients and those managed in alternative levels of care, and advantages in reducing ICU readmissions were uncommon. In contrast, cost savings were more consistently observed, with many studies indicating lower hospital expenditure when patients were managed in IMCUs, though occasionally accompanied by unfavourable clinical trade-offs in specific patient groups. Adverse event rates were generally comparable across settings.

Discussion Overall, IMCU effects on mortality and LOS remain inconclusive due to methodological and organisational heterogeneity. However, evidence for cost savings is more consistent. IMCUs appear beneficial for

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selected moderate-risk populations, but their suitability for high-risk patients is uncertain. Standardised definitions, clearer admission criteria, and improved reporting are essential to strengthen future evidence.

Clinical trial number Not applicable.

Keywords Intensive care units · Critical care nursing · Intermediate care facility · Systematic literature review

Introduction

Intermediate care units (IMCUs), also referred to as step-down or high-dependency units, have increasingly become a topic of interest and debate as healthcare systems search for effective ways to optimise patient flow and allocate critical care resources [1–3]. IMCUs provide a level of care that is more intensive than that of a general hospital ward - particularly in terms of staffing ratios, monitoring capabilities, and available therapeutic interventions - while remaining less resource-intensive than full intensive care units (ICUs) [4, 5]. Designed for patients who are not critically ill but still require close monitoring, frequent assessments, and complex treatments, IMCUs aim to deliver an appropriate and efficient alternative to ICU admission [2, 4].

In clinical practice, IMCUs serve two primary functions. First, as step-down units, they facilitate the earlier transfer of patients who no longer need the full capabilities of an ICU but are not yet ready for discharge to a general ward. Second, as step-up units, they allow timely admission of patients whose condition surpasses the monitoring and treatment capacity of a general ward but does not meet the threshold for ICU-level care. These dual roles support continuity of care and help prevent both premature ICU discharges and unnecessary ICU admissions [5–7].

Although IMCUs are widely implemented internationally, the existing literature demonstrates substantial variability in how these units are structured, staffed, and utilised [1, 6, 8–13]. This diversity makes it difficult to compare outcomes across organisations and has contributed to inconsistent findings regarding their impact on efficiency, costs, and patient outcomes. Factors such as differences in patient populations, case-mix, unit capabilities (e.g. respiratory support without mechanical ventilation), and local models of care may explain these discrepancies [6].

Recent systematic reviews highlight the increasing importance of IMCUs, particularly in the context of rising hospital demand and constraints on ICU capacity [3]. During the COVID-19 pandemic, IMCUs played a crucial role by providing continuous monitoring for semi-critical patients and helping alleviate ICU overcrowding [14]. Studies indicate that IMCUs contribute to improved continuity of care and may enhance patient comfort while supporting more efficient use of specialised resources [3]. Emerging evidence also suggests that IMCUs may help reduce avoidable ICU admissions while maintaining comparable clinical outcomes [15, 16]. For example, prospective and quasi-experimental studies have reported reduced ICU transfer rates, shorter hospital stays, and stable 30-day mortality following the introduction or optimisation of IMCU services [3, 6, 15]. While these findings are promising, their generalisability remains limited due to wide heterogeneity across IMCU models and study designs [3, 6, 15].

Given the expanding use of IMCUs and the absence of a recent comprehensive synthesis encompassing a broad range of clinical populations and unit types, an updated systematic review of their effectiveness is warranted. Therefore, the present review aims to provide an overview of the published evidence on the effectiveness, efficiency, and clinical impact of IMCUs.

Methods

This systematic literature review was conducted as part of a broader study supporting the ongoing re-evaluation of intensive care organisation in Belgium [1].

Definition of intermediate care units

For the purpose of this review, IMCUs were defined as hospital care settings that provide a level of care intermediate between general wards and ICUs. These units are intended for patients who require closer monitoring and more intensive treatment than can be provided on a general ward, but who do not require the full range of organ support and resources available in an ICU [1, 2, 13]. IMCUs are commonly referred to as high-dependency units or step-down units and may function as both step-up units for deteriorating patients and step-down units for patients recovering from critical illness [2].

Search strategy

A comprehensive search was carried out on 16 January 2025 across three major bibliographic databases: Ovid Medline, Embase, and the Cochrane Database of Systematic Reviews. An experienced information specialist from the Belgian Health Care Knowledge Centre (KCE) refined and validated the search strategy. The initial strategy was developed for Ovid Medline and subsequently adapted to the syntax and indexing of Embase and Cochrane to ensure methodological consistency and optimal sensitivity. Full search strategies are provided in Appendix 1.

In order to be considered eligible, studies needed to have a comparative design and be published in English, Dutch, French, or Spanish. To ensure the results were relevant for the Belgian context, only studies conducted in OECD countries were included. Exclusions comprised letters, editorials, commentaries, studies lacking a comparative design. Systematic reviews were also excluded from study selection, but were utilised for cross-referencing additional primary studies. A summary of the inclusion and exclusion criteria is provided in Table 1, following the PICOTS framework.

Study selection and data-extraction

After exporting and deduplicating bibliographic records using the Rayyan QRCI tool, all titles and abstracts retrieved through database searches were screened independently by two reviewers (KVH and JD). Full texts

Table 1 Inclusion and exclusion criteria

	Inclusion criteria	Exclusion
P	Adult patients requiring intermediate, step-down or step-up care	Paediatric populations (patients aged < 18 years) Patients cared for exclusively on general wards without any intermediate- or ICU-level care
I	Intermediate care units, step-down units, step-up units or high-dependency units	Units not functioning as IMCUs (e.g. routine general wards, palliative care cares, rehabilitation wards)
C	Standard ICU care or standard hospital care	Studies without a comparator group (ICU or general ward)
O	Primary: mortality, length of stay, hospital readmission, ICU readmission during IMCU stay, costs Secondary: adverse events	Studies not reporting any relevant clinical or utilisation outcomes (e.g. studies focused solely on staffing models, predictive scores, patient satisfaction, or workflow)
T	Studies published between 1 January 2013–16 January 2025	Studies published before 2013
S	Studies with comparative design: e.g. pre-post observational studies, randomised clinical trials (RCTs)	Studies without a comparator group (ICU or general ward) Systematic literature reviews (although screened for additional primary studies) Case reports, case series, qualitative studies, simulation studies

of potentially eligible articles were then assessed in duplicate, with disagreements resolved through discussion. A standardised extraction template was used to collect study characteristics, patient populations, intervention descriptions, outcomes, and key findings by one reviewer, and cross-checked by the second reviewer.

Effect estimates were extracted as reported in the original studies. These included relative measures such as odds ratios, risk ratios, and hazard ratios, as well as absolute measures including mortality proportions, length of stay (LOS), readmission rates, and cost differences. Where available, both crude and adjusted estimates were recorded. Given the heterogeneity in outcome definitions, measurement approaches, and reporting formats across studies, no standardised effect measure was applied.

Assessment of methodological quality

The methodological quality and risk of bias of the included studies were evaluated using the National Institutes of Health (NIH) tools, tailored to the specific study design in question [17–20]. Two independent reviewers (KVH and JD) conducted the assessment of methodological quality. Quality ratings were not used to exclude studies but were considered when interpreting the overall strength and consistency of the evidence.

Data presentation and synthesis

The results of the included studies were summarised in structured evidence tables. Table 2 provides an overview of study characteristics, including design, population, intervention, and methodological quality. Table 3 presents a synthesis of study findings by outcome, indicating the direction and statistical significance of reported effects. In addition, a detailed narrative summary of results was provided for each outcome category (mortality, length of stay, readmissions, costs, and adverse events) to facilitate comparison across studies.

Due to substantial clinical and methodological heterogeneity across the included studies; particularly in terms of patient populations, IMCU definitions, study designs, comparators, and outcome measures, a quantitative meta-analysis was not performed. Instead, a structured narrative synthesis was conducted.

Studies were grouped according to the predefined outcome domains (mortality, length of stay, hospital readmissions, ICU readmissions, costs, and adverse events). Within each domain, findings were compared based on the direction and statistical significance of observed effects. The synthesis focused on identifying patterns, consistencies, and discrepancies in findings across studies, while taking into account methodological quality and potential sources of heterogeneity.

To enhance transparency and structure, the narrative synthesis was conducted in line with established guidance for synthesis without meta-analysis [21]. Studies were grouped not only by outcome domains, but also by methodological quality and, where possible, by similarities in organisational characteristics of the IMCU (e.g. step-down vs. step-up function, clinical population).

Greater interpretive weight was given to studies assessed as having higher methodological quality (i.e. those rated as “good” using the NIH tools), particularly when consistent findings were observed across these studies. Findings from lower-quality studies were considered supportive but interpreted with caution, especially when inconsistent with higher-quality evidence.

Results

The search across three bibliographic databases yielded 1675 publications. After merging the results and removing duplicates, 1635 titles and abstracts were screened. Of these, 1570 were excluded. The full texts of 65 publications were subsequently assessed for eligibility, resulting in 28 included studies. A detailed overview of the study selection process is provided in Fig. 1 [22].

Reasons for exclusion at the full-text stage were not consistently documented in detail. However, studies were most commonly excluded because they did not evaluate intermediate care units in relation to ICU care, lacked a comparative design, did not report relevant outcomes, included ineligible study populations, or were conducted outside OECD countries, in accordance with the predefined eligibility criteria.

This systematic review was conducted and reported in accordance with the PRISMA 2020 statement [23]. The completed PRISMA 2020 checklist is provided in Appendix 2.

Characteristics of the included studies

The studies were conducted across a diverse range of settings, including the USA ($n=9$), Japan ($n=6$), Canada ($n=2$), Denmark ($n=2$), Spain ($n=2$), the Netherlands ($n=2$), France ($n=1$), Italy ($n=1$), Scotland ($n=1$), and Australia ($n=1$) (Table 2). One study included multiple countries (17 in total). A broad spectrum of study designs was represented: eleven applied a retrospective cohort design, while four utilised either a retrospective pre-post design or an observational cohort design each. Three studies followed a randomised controlled trial (RCT) approach, and each of the remaining studies adopted distinct methods, including a comparative study with matched case-control subgroup design, prospective observational design, retrospective controlled design and pre-post prospective design.

Nomenclature

The studies included in the analysis employed the following terms when referring to intermediate care: intermediate care unit (IMCU, $n=12$), step-down unit (SDU, $n=6$), high-dependency unit (HDU, $n=6$), high-acuity unit (HAU, $n=1$), and high-acuity post-operative unit ($n=1$). The term IMCU was mostly used in European studies and in three from the USA. SDU terminology appeared mainly in studies from the USA ($n=5$) and Canada ($n=1$). HDU was used in studies from Scotland ($n=1$) and Japan ($n=5$). Six studies specified the focus of the unit (respiratory, surgical, medical, neurological).

Study populations

The included studies covered various medical conditions and surgical contexts, including medical and/or surgical patients ($n=2$), low-risk patients with aneurysmal subarachnoid haemorrhage, primary intracerebral haemorrhage or peritoneal cancer undergoing cytoreductive surgery with hyperthermic intraperitoneal chemotherapy ($n=3$), patients experiencing acute respiratory failure, acute exacerbation of chronic obstructive pulmonary disease (COPD), or community-acquired pneumonia ($n=1$), mechanically ventilated patients with pneumonia ($n=1$) or Medicare beneficiaries aged 65 years old ($n=1$), patients with septic shock ($n=3$), with diabetic ketoacidosis ($n=1$), with COVID-19 ($n=2$), patients undergoing emergency abdominal surgery ($n=2$), transsphenoidal microsurgical resection of sellar lesions ($n=1$) or cardiac surgery ($n=1$), patients with acute myocardial infarction (AMI, $n=1$), patients undergoing elective or unplanned noncardiac surgery ($n=1$), trauma patients ($n=1$), and adult patients (not further defined, $n=5$). One study did not specify its study population.

Methodological quality

Based on quality assessment tools, eleven studies were rated as good, eight as fair, and nine as low. The overview of the quality assessment per study can be found in Table 2.

The effects of IMCU on the different patient outcomes and hospital resource use are synthesised in Table 3, which provides a visual overview by outcome and by study. More detailed results for each outcome and each study can be found in Appendix 3.

Table 2 Overview of the included studies

Author (year)	Country	Design	Intervention	Population	Meth- odolog- ical quality
Amiruddin et al. (2018) [8]	UK (Scotland)	Pre-post retrospective study	Introduction of a medical high-dependency unit (HDU)	Medical and surgical patients	Poor
Capuzzo et al. (2014) [25]	Austria, Belgium, Czech Republic, Denmark, France, Germany, Greece, Ireland, Italy, Norway, Poland, Portugal, Romania, Spain, Switzerland, Turkey, UK	Observational multinational cohort study	Introduction of IMCUs to ICUs	Adult patients	Good
Chartrain et al. (2017) [26]	USA	Pre-post retrospective study	Introduction of a step-down unit (SDU) transfer protocol	Low-risk patients with aneurysmal subarachnoid haemorrhage	Poor
Confalonieri et al. (2015) [27]	Italy	Comparative study with matched case-control subgroup design	Introduction of a respiratory IMCU	Patients with acute respiratory failure, acute exacerbation of chronic obstructive pulmonary disease (COPD), or community-acquired pneumonia	Poor
Endo et al. (2022) [28]	Japan	Retrospective cohort study	Introduction of HDU	Adult patients with septic shock	Fair
Fernando et al. (2019) [29]	Canada	Retrospective cohort study	Introduction of SDU	Adult patients with diabetic ketoacidosis	Fair
Galdeano Lozano et al. (2022) [30]	Spain	Prospective observational cohort study	Introduction of a respiratory IMCU	COVID-19 patients during the first wave of the pandemic	Poor
Gershengorn et al. (2020) [31]	USA	Retrospective cohort study	Introduction of a medical IMCU	Medical patients	Good
Hansted et al. (2020) [32]	Denmark	Randomised clinical trial	Introduction of intermediate care for at least 48 h after emergency abdominal surgery	Patients undergoing emergency abdominal surgery (major laparoscopy or laparotomy)	Fair
Harlan et al. (2024) [46]	USA	Retrospective cohort study	Introduction of IMCU in rural areas versus urban areas	Medicare beneficiaries aged 65 years and old who received mechanical ventilation	Good
Hunsaker et al. (2021) [48]	USA	Observational cohort study	Introduction of an ICU-based surgical SDU	Patients undergoing transsphenoidal microsurgical resection of postoperatively managed sellar lesions (surgically resected pituitary adenomas)	Poor
Labata et al. (2018) [33]	Spain	Pre-post retrospective study	Introduction of an IMCU	Postoperative cardiac surgery patients	Fair
Laws et al. (2020) [49]	USA	Retrospective controlled cohort study	Introduction of a neurologic SDU	Low-risk patients suffering primary intracerebral haemorrhage	Good
Lekwijit et al. (2020) [34]	USA	Retrospective cohort study	Discharge to SDU after discharge from ICU instead of discharge to general unit	Adult patients	Poor

Table 2 (continued)

Author (year)	Country	Design	Intervention	Population	Meth- odolog- ical quality
Ludbrook et al. (2023) [43]	Australia	Observational cohort study	Introduction of a high-acuity postoperative unit (advanced recovery room care)	Patients undergoing elective or unplanned noncardiac surgery and scheduled for postoperative care in a standard surgical ward for at least 2 postoperative nights	Good
Mitra et al. (2020) [35]	Canada	Pre-post retrospective study	Introduction of high-acuity unit (HAU)	Patients with more acute care and closer monitoring than a general hospital unit	Poor
Ohbe et al. (2021) [45]	Japan	Retrospective cohort study	Introduction of HDU	Mechanically ventilated patients with pneumonia	Good
Ohbe et al. (2022 a) [37]				COVID-19 patients with invasive mechanical ventilation	Good
Ohbe et al. (2022 b) [36]				Patients hospitalised for AMI	Good
Ohbe et al. (2023) [44]				Patients hospitalised for sepsis	Good
Plate et al. (2018) [38]	The Netherlands	Observational cohort study	Introduction of surgical IMCU	Trauma patients	Poor
Schwartz et al. (2022) [39]	USA	Retrospective cohort study	Introduction of IMCU	Low-risk patients with peritoneal cancer who underwent cytoreductive surgery with hyperthermic intraperitoneal chemotherapy	Poor
Solberg et al. (2014) [40]	The Netherlands	Pre-post prospective study	Introduction of IMCU	Not reported (NR)	Fair
Sykora et al. (2020) [50]	USA	Retrospective cohort study	Introduction of IMCU	Adult patients	Good
Thietart et al. (2022) [41]	France	Randomised prospective multicentre (N=24) clinical trial	Evaluation of the 6-month outcome after admission to the ICU, IMCU or acute medical ward	Adult patients aged 75 years or older	Fair
Umegaki et al. (2024) [47]	Japan	Multicentre (N=900) cross-sectional study	Impact of high care units on patients with sepsis	Adult patients with sepsis	Good
Vester-Andersen et al. (2015) [42]	Denmark	Multicentre (N=7 university-affiliated secondary referral hospitals) randomised clinical trial	IMCU after high-risk emergency abdominal surgery	High-risk patients who had emergency abdominal surgery	Fair
Yang et al. (2020) [51]	USA	Retrospective cohort study	Specialty SDU for the management of complex head and neck patients	Head and neck free flap reconstruction patients	Fair

Table 3 Overview of the impact of IMCUs on selected outcomes

	Method- ological quality	Mortality	LOS	Hospital readmissions	ICU readmissions	Costs	Adverse events
Amiruddin et al. (2018) [8]	Poor	NS	↑	.	.	.	.
Capuzzo et al. (2014) [25]	Good	↓	.	.	.	.	.
Chartrain et al. (2017) [26]	Poor	NS	NS	NS	NC	.	NS
Confalonieri et al. (2015) [27]	Poor	↓	↓	.	↓	.	.
Endo et al. (2022) [28]	Fair	↑	NS	.	.	.	.
Fernando et al. (2019) [29]	Fair	NS	↓	.	.	.	.
Galdeano Lozano et al. (2022) [30]	Poor	NC	NC	.	.	.	.
Gershengorn et al. (2020) [31]	Good	NS	NS	.	.	.	.
Hansted et al. (2020) [32]	Fair	NS	.	.	.	.	.
Harlan et al. (2024) [46]	Good	↑ NS	NC	.	.	.	.
Hunsaker et al. (2021) [48]	Poor	.	NS ↓	.	.	↓ NS	NS
Labata et al. (2018) [33]	Fair	NS	↓	NS	NS	.	NS
Laws et al. (2020) [49]	Good	.	↓	.	NS	.	.
Lekwijit et al. (2020) [34]	Poor	NS	NS	NS	NS	.	.
Ludbrook et al. (2023) [43]	Good	NS	NS	NS	.	.	NS ↓
Mitra et al. (2020) [35]	Poor	↓	NS	.	.	.	.
Ohbe et al. (2021) [45]	Good	↑	↓	.	.	↓	NS
Ohbe et al. (2022 a) [37]	Good	↑	NS ↑	.	NC	↓	.
Ohbe et al. (2022 b) [36]	Good	NS	NS	.	.	↓	.
Ohbe et al. (2023) [44]	Good	↓ NS ↑	NC	.	.	↓	.
Plate et al. (2018) [38]	Poor	NC	.	.	NC	NC	.
Schwartz. et al. (2022) [39]	Poor	NS	↓	NS	.	.	.
Solberg et al. (2014) [40]	Fair	↑ NS	NA	.	NS	↓	.
Sykora et al. (2020) [50]	Good	.	↑	.	.	.	.
Thietart et al. (2022) [41]	Fair	NC ↓ NS	.	.	.	.	.
Umegaki et al. (2024) [47]	Good	↑	↓ NS	.	.	.	.
Vester-Andersen et al. (2015) [42]	Fair	NS	.	.	NS	.	NS
Yang et al. (2020) [51]	Fair	.	↓	NS	.	.	NS

LOS: length of stay, NS: not significant, NC: no comparison

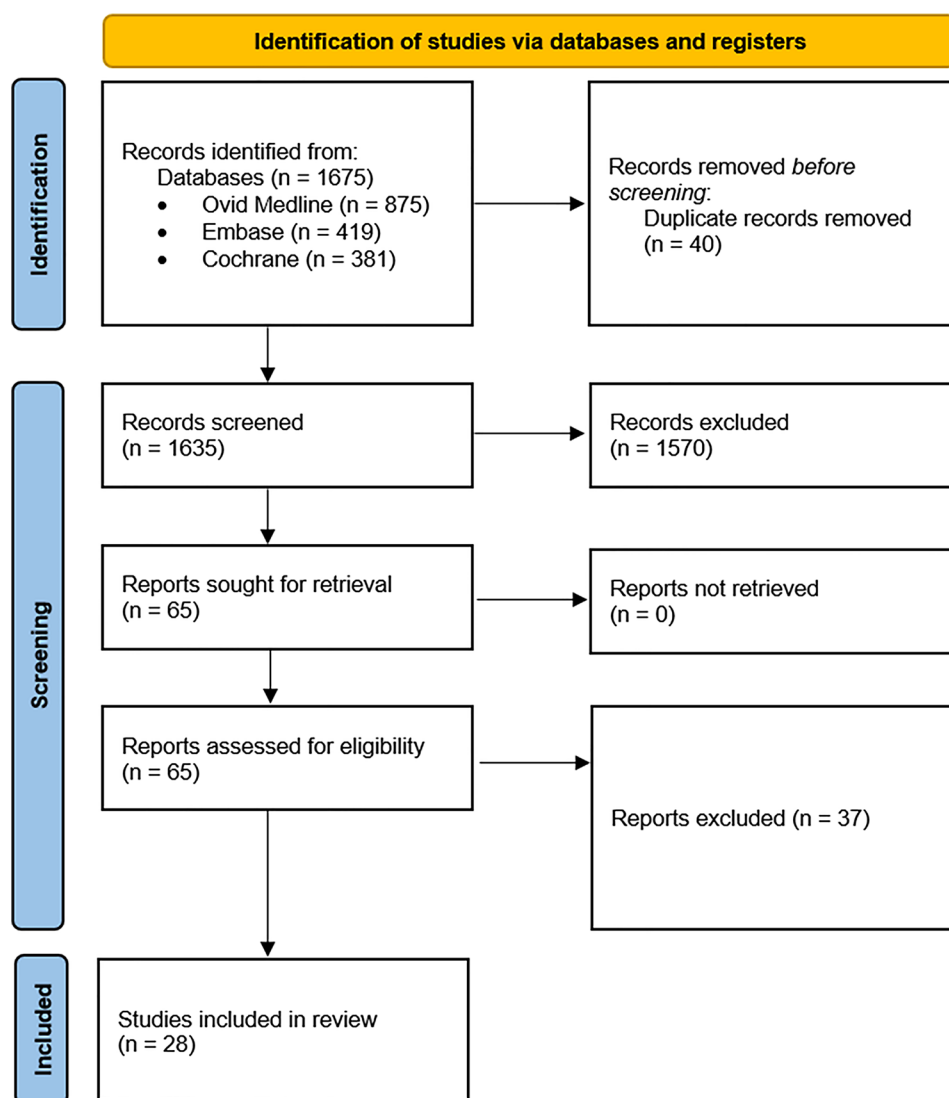
↓: significant reduction, ↑: significant increase

Mortality

Twenty-four studies assessed the impact of IMCU introduction on mortality [24–47]. Findings were mixed. Four studies reported a decrease in the mortality rate [25, 27, 35, 41]. Although Capuzzo et al. [25] found a higher crude hospital mortality in ICUs with an IMCU (24.5%) compared to those without (20.5%, $p = 0.017$), adjusted analyses revealed significantly lower mortality (odds ratio (OR) 0.63 (95%CI 0.45 to 0.88, $p = 0.007$). Furthermore, Confalonieri et al. [27] found that respiratory IMCU patients had a significantly lower in-hospital mortality rate (5.4% vs. 19.1%, $p = 0.0001$) than those admitted to internal medicine units, and this result remained significant even after controlling for potential confounders. The risk of mortality in patients with acute respiratory failure, acute exacerbation of COPD, or community-acquired pneumonia was significantly higher in the internal medicine unit than in the respiratory intermediate care unit (OR 6.90, 3.19, and 6.7, respectively, $p < 0.04$). Thietart et al. [41] observed a better 6-month survival among geriatric IMCU patients than medical ward patients (hazard ratio [HR] 1.31, 95%CI 1.04 to 1.63). However, this 6-month survival rate did not differ significantly between ICU patients and IMCU patients (HR 1.17, 95%CI 0.95 to 1.46).

Twelve studies found no statistically significant impact of IMCUs on mortality. These included studies across different patient types (medical, surgical, respiratory, sepsis, and others). Some additionally reported mortality without performing statistical comparisons [24, 26, 29, 31–34, 36, 39–43].

Fig. 1 PRISMA flow diagram of the study selection process



Six studies observed increased mortality associated with IMCU care in certain settings or populations [28, 37, 40, 45–47]. For instance, COVID-19 patients requiring invasive mechanical ventilation in Japan showed lower in-hospital mortality rates within 30 days when admitted to the ICU than those treated in the HDU (18.3% vs. 24.2% after propensity score matching, $p = 0.018$, risk difference, -5.8%, 95%CI -10.9% to -0.8%) [37].

One study reported differences based on the Sequential Organ Failure Assessment (SOFA) score, with HDUs performing comparably for moderately ill sepsis patients (SOFA 5–11), but less favourably for those with SOFA ≥ 12 [44].

Length of stay

Twenty-two studies studied the impact of establishing an IMCU on LOS [25–31, 33–37, 39, 40, 43–45, 47–51]. Eight of these publications found a favourable effect on hospital LOS [27, 29, 33, 35, 39, 45, 49, 51]. Confalonieri et al. [27] found a considerable decrease in hospital LOS for patients suffering from acute respiratory failure, acute exacerbation of COPD, or community-acquired pneumonia admitted to a respiratory IMCU compared to those admitted to an internal medicine unit (9.3 vs. 12.1 days, respectively; $p = 0.0001$). Similarly, a decrease in average hospital LOS was found among adult patients with diabetic ketoacidosis, postoperative cardiac surgery

patients, low-risk patients suffering from primary intracerebral haemorrhage or peritoneal cancer who underwent cytoreductive surgery with hyperthermic intraperitoneal chemotherapy, mechanically ventilated patients with pneumonia, and patients who underwent head and neck free flap reconstruction [29, 33, 35, 39, 45, 49, 51]. However, two studies identified a significant increase in hospital LOS for patients admitted to an IMCU [25, 50]. Capuzzo et al. [25] observed that patients admitted to a mixed ICU-IMCU had a longer LOS than those admitted to an ICU without IMCU (median 3.5, IQR 1.9 to 6.9 vs. median 2.6, IQR 1.8 to 4.3, respectively; $p < 0.001$). Furthermore, Sykora et al. [50] identified a significant increase in LOS for patients admitted to an IMCU compared to those admitted to a general unit (50.3 h for medical-surgical patients, 108.3 h for patients needing a higher level of care, 70.7 h for patients admitted to an IMCU, $p < 0.001$).

Six studies reported significant reductions in ICU LOS for patients undergoing transsphenoidal microsurgical resection of sellar lesions, postoperative cardiac surgery patients, low-risk patients suffering from primary intracerebral haemorrhage or suffering from peritoneal cancer who underwent cytoreductive surgery with hyperthermic intraperitoneal chemotherapy and sepsis patients [33, 35, 39, 47–49]. This decrease in ICU LOS is inherently plausible, considering that the implementation of a new step-up or step-down unit is anticipated to diminish the requirement for extended hospitalisations in the ICU.

Nine of the included studies reported no significant difference in hospital LOS [26, 28, 31, 34, 36, 37, 40, 43, 47]. Three additional studies reported LOS metrics without statistical testing [30, 44, 46].

Hospital readmission rate

The impact of the introduction of an IMCU on the hospital readmission rate was evaluated in six studies [26, 33, 34, 39, 43, 51]. Across these studies, no significant differences were found following IMCU introduction, regardless of patient type (postoperative, medical, surgical oncology, or neurosurgical).

ICU readmission rate

Nine studies assessed ICU readmissions [26, 27, 33, 34, 37, 38, 40, 42, 49]. However, only one of these studies showed a statistically significant reduction in ICU readmissions for patients suffering from acute respiratory failure, acute exacerbation of COPD, or community-acquired pneumonia who were admitted to a respiratory IMCU [27]. Patients admitted to this respiratory IMCU exhibited a lower likelihood of being readmitted to the ICU compared to those admitted to an internal medicine unit (6% vs. 12%, $p = 0.001$). Furthermore, three studies reported a non-significant decrease [34, 40, 42], one study observed a non-significant increase [49], and one found similar readmission rates after IMCU introduction [33]. However, this difference was not significant ($p = 0.420$). Lastly, three studies reported data without statistical testing [26, 37, 38].

Costs

Seven studies assessed costs, with most reporting cost savings following IMCU introduction compared with ICU care [36–39, 44, 45, 48]. In particular, Hunsaker et al. [48] and Plate et al. [38] investigated the introduction of surgical IMCUs for patients undergoing transsphenoidal microsurgical resection of sellar lesions or trauma patients, respectively. Hunsaker et al. [48] reported a 12.5% overall cost reduction for patients admitted to an IMCU compared to those admitted to an ICU. Although facility utilisation showed a modest decrease of 8.9% ($p = 0.02$) for IMCU patients, it represented a notable cost reduction. Furthermore, apart from imaging costs, other subtotals were also significantly lower for IMCU patients. Plate et al. [38] estimated a total cost saving of US\$ 1 772 785 over four years due to the presence of an IMCU for trauma patients (no statistical comparison), equaling US\$ 393 952 per year. This trend was also observed in recent studies that focused on IMCUs for invasive mechanically ventilated patients with COVID-19 or pneumonia, patients with AMI, and those undergoing cytoreductive surgery with hyperthermic intraperitoneal chemotherapy for peritoneal cancer [36, 37, 39, 44, 45]. In the

latter population, cost reduction was mainly driven by lower indirect fixed costs (median difference: US\$ 5 330, $p < 0.01$), rather than direct variable costs (median difference: US\$ 3 315, $p = 0.13$) [39].

Adverse events

Seven studies evaluated the impact of the introduction of an IMCU on a broad range of adverse events [26, 33, 42, 43, 45, 48, 51]. Most observed no significant difference in adverse event rates between IMCU and comparison groups. One study reported a significant reduction in medical emergency response complications in the days following noncardiac surgery with 3.7% for patients admitted to the high-acuity postoperative unit (95%CI -7.3 to -0.3, $p = 0.030$) [43].

Discussion

The aim of this systematic literature review was to synthesise the available evidence on the impact of IMCUs on key patient and hospital outcomes: mortality, LOS, hospital readmission in 30 days, ICU readmission during IMCU stay, costs, and adverse events. Previous reviews have highlighted inconsistent findings regarding the effectiveness and cost-efficiency of IMCUs, often focusing on specific patient groups or types of units [6, 8–13]. In contrast, the present review offers a more general synthesis of IMCU effectiveness across all adult patient populations and unit structures.

A total of 28 studies were included, displaying substantial variability in methodological quality, design, and context. Eleven studies were considered ‘good’, eight as ‘fair’, and nine as ‘low’ quality, underscoring a notable risk of bias. Heterogeneity was evident across multiple dimensions: the patient populations studied, admission criteria, nomenclature used for intermediate care, unit organisation, study designs, and healthcare system settings. Many studies used pre–post designs, which are sensitive to temporal changes in unit functioning, staffing, or case mix, and several included small or narrowly defined samples. Taken together, these factors limit comparability across studies and hinder the ability to draw firm, generalisable conclusions about the overall impact of IMCUs.

Given the substantial heterogeneity across studies in terms of patient populations, IMCU organisation, and study design, a structured narrative synthesis approach was applied. Greater interpretive weight was given to studies rated as having higher methodological quality (i.e. “good” according to NIH tools), particularly when consistent patterns emerged across these studies. Findings from studies with fair or low methodological quality were used to contextualise variability but interpreted with greater caution.

In line with structured approaches to narrative synthesis, findings were interpreted by grouping studies according to outcome domains, while taking into account methodological quality and differences in IMCU organisation. In this context, greater interpretive weight was given to studies rated as higher quality, particularly when consistent findings were observed across these studies, while results from lower-quality studies were considered with greater caution. To improve the evidence base, greater standardisation in IMCU definitions, admission criteria, and reporting practices is needed. Future research should incorporate more robust, prospective designs and clearly defined unit characteristics.

Consistent with previous literature [6, 8–13], the findings of this review regarding mortality and LOS were largely inconclusive. Of the 24 studies that examined different types of mortality, results ranged from beneficial effects ($n = 4$ [25, 27, 35, 41]), to no effect ($n = 14$ [24, 26, 29, 31–34, 36, 39–44]), and even negative associations ($n = 7$ [28, 37, 40, 44–47]), following IMCU introduction [24–46]. These results are mainly negative for in-hospital mortality and related to the implementation of HDUs. However, one large multi-country study demonstrated adjusted mortality benefits associated with IMCUs but concurrently reported longer hospital and ICU LOS [25]. Importantly, when focusing on studies with higher methodological quality, findings more often pointed towards no significant difference or context-dependent effects rather than consistent mortality benefits. Several studies also identified worse outcomes in high-risk populations, suggesting that IMCU care may not be appropriate for

the most severely ill patients. These mixed results likely reflect differences in case-mix, admission criteria, and clinical appropriateness of IMCU use.

LOS outcomes were similarly inconsistent. Some studies reported shorter hospital stays, while others found no improvement or even longer LOS. Reductions in ICU LOS were reported more frequently and are consistent with the expected step-down function of IMCUs. However, among higher-quality studies, no clear and consistent effect on overall hospital LOS emerged. As with mortality, these findings are likely influenced by differences in patient populations and IMCU organisation.

Most studies found no significant effect of IMCUs on hospital readmissions or adverse events [26, 33, 34, 39, 42, 43, 45, 48, 51]. This pattern was relatively consistent across studies, including those with higher methodological quality. These mixed and often non-significant findings likely reflect the underlying heterogeneity of study populations, differences in unit function (e.g. step-down vs. step-up), and the comparators used (ICU vs. general ward vs. rural or urban settings). Differences in patient severity and the clinical appropriateness of IMCU admission also likely contribute to the observed variability.

In contrast, findings related to costs were more consistent. The majority of studies reported cost savings following the introduction of IMCUs compared with ICU care, particularly for postoperative patients, trauma patients, mechanically ventilated patients, and individuals with conditions such as septic shock, pneumonia, COVID-19, or acute AMI [36–39, 44, 45, 48]. Notably, this pattern was also observed across several higher-quality studies, strengthening confidence in this finding. These savings were often driven by reduced ICU utilisation and lower staffing intensity. However, some studies also demonstrated that lower costs may come at the expense of less favourable clinical outcomes, as seen in the study of COVID-19 patients requiring invasive mechanical ventilation, where IMCU care was associated with higher mortality and longer LOS [37]. This highlights the need for careful triage to ensure that IMCU care is provided to patient groups for whom it is clinically appropriate.

The evidence suggests that IMCUs may be particularly beneficial for moderately ill patients who do not require full ICU support. For example, among septic shock patients, IMCU care appeared comparable to ICU care for individuals with SOFA scores between 6 and 11, while those with $\text{SOFA} \geq 12$ demonstrated significantly better outcomes in ICUs [44]. With IMCUs associated with lower total hospital costs, routing appropriate intermediate-risk patients to these units may provide a cost-effective alternative when supported by adequate staffing and monitoring capabilities. These findings, particularly from higher-quality studies, suggest that the effectiveness of IMCUs is highly dependent on appropriate patient selection and alignment between patient needs and unit capabilities.

Finally, despite the diversity of IMCU models described in the literature, detailed reporting of organisational features was often limited. The most consistently reported characteristic was the patient-to-nurse ratio, which ranged from 1.5:1 to 5:1, most commonly 4:1 or 2:1. According to international classification of the World Federation of Societies of Intensive and Critical Care Medicine, these ratios align with level I and level III ICUs respectively [52]. Other important organisational features (such as available monitoring technology, staffing expertise, admission criteria, and therapeutic capabilities) were poorly described across studies. More detailed unit descriptions in future research will be essential for understanding how structural characteristics influence outcomes and for identifying which IMCU formats are most effective.

Limitations

This review has some limitations. Although a comprehensive search strategy was used and study selection and data extraction were conducted in duplicate, the restriction to OECD countries and to publications in English, Dutch, French, or Spanish may have limited inclusion of some relevant studies. In addition, no formal quantitative synthesis or assessment of publication bias was performed due to the heterogeneity of study designs and outcomes.

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Data availability All data used in this review are derived from published studies. Extracted data and extraction templates are available from the corresponding author upon reasonable request.

Declarations

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Consent for publication Not applicable.

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Competing interests The authors declare no competing interests.

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