Decision Aids in the ICU: a scoping review

Yuling Lei, Qi Zhou, Yuexian Tao

ABSTRACT

Objective The purpose of this scoping review was to synthesise the effectiveness and acceptability of decision aids for critically ill patients and family members in the intensive care unit (ICU).

Methods A systematic search of four electronic databases and grey literature was undertaken to identify relevant studies on the application of decision aids in the ICU, without publication date restriction, through March 2023. The methodological framework proposed by Arksey and O’Malley was used to guide the scoping review.

Results Fourteen papers were ultimately included in this review. However, only nine decision aids were available, and it is noteworthy that many of these studies focused on the iterative development and testing of individual decision aids. Among the included studies, 92% (n=13) were developed in North America, with a primary focus on goals of care and life-sustaining treatments. The summary of the effect of decision aid application revealed that the most common indicators were the level of knowledge and code status, and some promising signals disappeared in randomised trials.

Conclusions The complexity of treatment decisions in the ICU exceeds the current capabilities of existing decision aids. There is a clear gap in decision aids that are tailored to different cultural contexts, highlighting the need to expand the scope of their application. In addition, rigorous quality control is very important for randomised controlled trials, and indicators for assessing the effectiveness of decision aids need to be further clarified.

INTRODUCTION

Critical care medicine has made considerable advances in recent years, resulting in improved survival rates for patients with the most severe diseases. However, this progress has also highlighted the growing need for a family-centred model of care. Patients admitted to intensive care units (ICUs) are vulnerable and suffer from a variety of diseases with multiple concurrent problems. Medical decisions and end-of-life decisions in the face of an uncertain disease trajectory can be complex and time-sensitive.

Unfortunately, despite efforts to provide comprehensive information to families, studies have identified information gaps between physicians and patients, leading to an inconsistent understanding of treatment and lower-quality decision-making. Furthermore, many patients and families report experiencing stress and decision conflicts during their time in the ICU, which can persist even after discharge. One study found that 70% of family members of ICU patients had anxiety symptoms and 35% had depressive symptoms. In addition, one-third of family members have PTSD (Post Traumatic Stress Disorder symptoms). These distressing symptoms can interfere with patients’ and surrogates’ understanding of the information provided by the physician, resulting in lower-quality decision-making. Ultimately, this exerts a significant impact on patient outcomes.

In response to the challenges faced in medical decision-making, decision aids (DAs) have been proposed as a tool to support clinicians and patients in making informed and evidence-based decisions. The core concept of DAs is defined by the International Patient Decision Aid Standards (IPDAS) as tools designed to help people engage in decisions about healthcare choices, provide information about choices, and help patients clarify their values and preferences. The most recent update, a Cochrane review, which included 105 randomised controlled trials (RCTs) with 31 043 participants, showed that DAs can improve users’ knowledge about choices, making them more aware of their values and perceive risks more accurately. DAs reduce decision conflict, increase satisfaction with medical communication, and do not worsen health outcomes compared with conventional treatment. Best practice guidelines also suggest the use of a shared decision-making approach to improve the quality of decision-making in the ICU.
Therefore, DAs play an important role in the treatment of critically ill patients.

To enhance the development of effective DAs for supporting ICU patients and their surrogates, a comprehensive systematic review of previously published DAs is of paramount importance. Therefore, the primary objective of this study was to conduct a rigorous scoping review that provides valuable insights. By doing so, we aimed to identify potential avenues for further research, ultimately striving to improve the decision-making experience for critically ill patients and surrogates.

**METHODS**

Our study was undertaken in accordance with the five stages of Arksey and O’Malley’s scoping review framework: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data and (5) collating, summarising and reporting the results. We also used the PRISMA-ScR checklist to ensure the quality of this scoping review (online supplemental file A). A protocol for this scoping review was published in Open Science Framework registries (registration DOI: https://doi.org/10.17605/OSF.IO/U5JWR).

**Step 1: identifying the research questions**

To complete the purpose of this study, the following research questions were identified:

1. What are the publication trends of DAs in the ICU?
2. What DAs are available for ICU patients and their surrogates?
3. How effective are these DAs?
4. What is the degree of usability and acceptance of DAs?

**Step 2: identifying relevant studies**

A systematic search of the PubMed/Medline, Web of Science, Embase and Scopus databases and grey literature was undertaken from inception to March 2023. Databases were searched using search terms derived from MeSH and subject headings, such as “Intensive Care Units” or “ICU” or “Critically ill patients” and “Decision Support Techniques” or “Decision Support Technic” or “Decision Support Model” or “Decision Aids” in the title or abstract of records. The search strategy and search strings were developed by the research team. The full search strategy is provided in online supplemental file B.

**Step 3: study selection**

We followed the predetermined inclusion and exclusion criteria to guide selection in this scoping review. The protocol was included to expand the understanding of the application of DAs in the ICU. The inclusion criteria were as follows: (1) The study setting was in the ICU (including neonatal ICU, neurological ICU and emergency ICU); (2) The study topic was a DA used by patients or surrogate decision-makers and (3) The study design included RCTs, observational studies, case-control studies, and qualitative studies and protocols. The exclusion criterion was non-English language studies. We added a study to the category of studies awaiting classification until we were able to obtain the full text. There was no limit on the publication date to ensure that all evidence was captured.

All results were exported into EndNote V.20, and duplicates were removed. Then, the results were imported into Rayyan (https://rayyan.ai) for blinded title and abstract screening. Two authors (YL and QZ) screened the title and abstract; one (YL) focused on shared decision-making, and the other (QZ) had experience in evidence-based medicine. Disagreements were settled by the third author (YT).

**Step 4: charting the data**

A data extraction form was created to extract relevant information from the selected studies, which included the following categories: (1) authors/year/country, (2) setting, (3) sample, (4) method, (5) participants, (6) format, (7) component, (8) outcomes and (9) IPDAS. The data were extracted independently by two authors (YL and QZ), and discrepancies were eliminated after negotiation. The third author (YT) reviewed all the data.

**Step 5: collating, summarising and reporting the results**

All extracted data were used for discussion by the research team until they were consistent with the purpose of the scoping review. Two methods of data analysis were used in this study: (1) descriptive analysis, including the number of studies, publication trends and distribution and (2) content analysis, in which qualitative data were brought together to construct descriptive themes.
Patient and public involvement

None.

RESULTS

Overview of included studies

A total of 2731 articles were retrieved from four electronic databases. After duplicates were removed, 1082 records were screened by title and abstract. From a review of 32 full-text articles, 14 were ultimately included in this scoping review, as shown in the PRISMA flow chart diagram (figure 1).

Ten studies25–32 were conducted in the USA, followed by Canada33–35 (n=3), and only one study36 was conducted in China. Of the 14 included studies, there were 5 RCTs,27 29 30 32 34 4 mixed-method studies,28 35–37 2 observational studies,26 38 1 qualitative study33 and 2 quasi-experimental studies.25 31 Only one study35 did not evaluate the effect of DA application. Online supplemental table 1 presents an overview of the studies’ traits.

Publication trends

The earliest study was published in 2012, and the greatest number of studies were published in 2021, with three studies.29 36 38 Six studies25–30 36–38 were published in the last 3 years. Trends are illustrated in figure 2.

DAs available in the ICU

In the set of 14 studies selected for this review, it is noteworthy that only 9 DAs are available in the ICU, with a substantial portion of these studies demonstrating the iterative development and testing of individual DAs.25–30 37 These DAs have primarily focused on end-of-life care and life-sustaining treatments. Six studies focused on goals of care,25–30 34 37 38 three studies developed DAs for CPR,25 31–33 three studies for prolonged mechanical ventilation,25–27 one study for neonatal parents,35 and another study for renal replacement therapy.36

Presentation of DAs in the ICU

These tools are primarily based on the Ottawa Decision Support Framework (ODSF) and are available in paper-based or web-based presentations. Three DAs29 31 32 presented a family-centred video that described the ICU setting and the process of CPR or defibrillation. One study30 used a more advanced tool based on computers or tablets, providing an interactive process that prepared for the family meeting by video. Additionally, four studies26 27 33 35 used web-based platforms to facilitate the embedding of predictive models. These models automatically analysed patient data to generate a personalised patient report, aiding in shared decision-making. In three studies,30 57 58 the clinical outcomes of patients were presented in an icon array, with clear and visual graphics to facilitate decision-making.

The effectiveness of DAs in the ICU

The ODSF was used to guide the development of DAs.39 This framework was used to summarise the results section of the included literature. Based on the ‘Decision Outcomes’ section of the ODSF, we divided the studies into three themes: (1) decision quality, (2) quality of decision-making process and (3) impact, and we categorised the content into seven subthemes (table 1). Six studies25 27 29–32 explored the effects of DAs on patients and surrogates, with knowledge, preferences and health as the outcome indicators most frequently used to assess DAs. It is worth highlighting that several smaller or mixed-method trials indicated that DAs showed a promising signal in their results25 31 32, but most effects did not persist in a randomised manner.27 29 30 In particular, the series of studies conducted by Cox et al25 demonstrated that the use of DAs led to reduced clinician-surrogate discordance, decreased hospital costs, improved decision conflict, and enhanced quality of communication and comprehension (p<0.05) when assessed in a before-and-after study design. However, on evaluation in a randomised manner, the results showed a notable difference only in decision conflict (p=0.041).27

Five studies25 27 30–32 validated the effect of DAs on the quality of decisions, including knowledge and decision preferences. There was no statistically significant difference in the code status change, but all studies demonstrated that DAs could improve knowledge.

Four studies25 27 29 30 explored the effects of DAs on the quality of the decision process, including decision stages, expectations and satisfaction. Clinician-surrogate concordance and quality of communication were the most commonly used indicators. We found divergent findings: although DAs slightly improved discordance and decision quality, they did not reach significant differences in these two studies.27 29

Three studies25 27 30 explored the effectiveness of DAs on impact, including health and health resources. Anxiety and depressive symptoms, PTSD, and mortality were the most common outcomes. One study30 reported a potential reduction in 3-month mortality associated with

Figure 2 Publication trends of DAs.
the use of DAs (p=0.05). Furthermore, it is worth noting that at long-term follow-up, surrogates that used DAs exhibited increased psychological distress, which may be attributed to the higher psychological distress experienced by caregivers of ICU survivors.

Usability and acceptability of DAs in the ICU

The results of five studies that employed the System Usability Scale to measure the usability of items indicated an average score greater than 80, with the highest score being 87.5/100. However, one of the studies found lower scores among users aged 56 and above, and the majority of users (93%) preferred a web-based interface. Furthermore, three studies investigated physicians’ attitudes towards DA use, with one study reporting positive feedback from physicians who found the DAs helpful in guiding communication with and understanding the opinions of agents. Comments included ‘brings forwards issues that may not be discussed’, and the DAs were highly recommended for use in family meetings.

DISCUSSION

In this scoping review, we synthesised currently published studies on DAs in the ICU and reported the current status of their application and evaluation of effectiveness. While many studies have systematically reviewed DAs, this is the first scoping review of medical decision-making among critically ill patients in the ICU.

Medical decision-making for critically ill patients requires careful consideration of various options and weighing their pros and cons, making it suitable for promoting shared decision-making in the ICU. Our findings indicate that DAs in the ICU mainly focus on life-sustaining treatment and goals of care, leaving ample room for further development. An illustrative example is that extracorporeal membrane oxygenation (ECMO) is often a last resort for critically ill patients and has shown an upward trend in recent decades, particularly after the Covid-19 pandemic. Despite its potential benefits, ECMO is a costly intervention, and individuals who survive ECMO treatment often encounter psychological or cognitive challenges while experiencing a diminished quality of life. These difficulties may be influenced by the level of family support and the quality of interactions with healthcare providers. Consequently, the development of DAs focused on ECMO could represent a crucial area for future research.

Our review showed a noticeable transition from traditional paper-based formats to web-based formats in DAs, accompanied by the integration of personalised predictive models to enhance the accuracy of predicted outcomes. Interestingly, studies found no significant impact of the DA format on decision quality. However, it is important to acknowledge that tablet-based DAs, although more convenient, may present challenges in terms of user-friendliness for older individuals. Therefore, both paper-based and web-based formats should take into consideration the user experience of the ageing population to ensure accessibility and usability. In addition, the integration of artificial intelligence (AI) holds great potential in the design of DAs. Notably, a study demonstrated that AI-enabled DAs can effectively enhance decision quality and shared decision-making without significantly prolonging consultation time. Moreover, AI has the capability to continuously monitor the newest studies and stay up to date with the latest evidence-based medical evidence. Machine learning algorithms are extensively used to process large volumes of data for predicting ICU mortality. This is particularly important, as prognostic uncertainty is one of the primary factors contributing to psychological stress experienced by surrogates.

Although some meta-analyses show disagreement in the effects of DAs on several outcome indicators, it is widely accepted that DAs have potential benefits. For example, two meta-analyses focusing on DAs in cancer showed that they can significantly increase users’ knowledge, reduce decision conflict and improve decision satisfaction. In contrast, another meta-analysis that included 14 RCTs found that DAs did not improve knowledge...
or decision conflict. Our findings align with previous research, demonstrating that certain promising signals diminished when examined in randomised studies. It is important to recognise that the utilisation of DAs alone may not sufficiently alleviate the psychological distress experienced by surrogates of critically ill patients. Therefore, integrating DAs with complementary interventions aimed at addressing prolonged grief symptoms among surrogates is warranted. Many studies support the idea that multitemn, structured communication improves outcomes for relatives.64–65 Additionally, ensuring stringent quality control measures in randomised experiments is crucial to prevent potential contamination between clinicians and optimise study outcomes. Ultimately, integration of the best medical evidence with patient values is key for making high-quality surrogate decision choices. Thus, the evaluation of DAs should prioritise their alignment with patient preferences and values, as relying solely on measures of knowledge and decision conflict may not be sufficient. One such example is the utilisation of eight questions designed to prompt agents to contemplate how various impairments impact a patient’s quality of life.54 These questions serve as a guide to stimulate thoughtful consideration of patient values. Consequently, it is recommended that tools based on this framework be developed to facilitate the evaluation of the value clarification process. In addition, brain-computer interfaces may help unresponsive patients express preferences,57,58 and extremely promising and novel devices may be widely available in the future.

This review found that 92% (n=13) of DAs were developed in North America; however, preferences regarding end-of-life care are culturally sensitive.59 In Asia, Confucianism and filial piety play an influential role, individuals’ end-of-life wishes are greatly influenced by family members,60 and death is a taboo topic in some regions.61 Therefore, availability is limited by the lack of localised DAs, and there is a necessity to develop DAs in multiple languages according to national culture.

In addition, despite the positive attitudes of users and physicians towards DAs,62 discussions regarding patient values and preferences remain inadequate in clinical practice.63,64 A cross-sectional study that surveyed 13 ICUs in the USA found that only 8.2% of ICU physicians incorporated patient preferences in actual treatment situations.65 While time constraints may be a barrier to the use of DAs, a systematic evaluation that included 63 studies showed that applying shared decision-making does not necessarily require longer consultation times. To reduce the risk of increased consultation duration, a theory-based, multi-level implementation approach may be helpful. Communication skills can also influence the use of DAs, and some models have been developed to guide communication, such as the communication-centred epistemic model of shared decision-making59 and the model for collaborative decision-making.60

Strengths and limitations
This study was reported strictly in line with PRISMA-ScR guidelines, and the study protocol was registered in the Open Science Framework to ensure transparency of the process. A comprehensive review of DAs was conducted to reveal the gap between further research and clinical practice.

However, there are some limitations that need to be acknowledged. First, our search was limited to studies published in English, which may have led to the exclusion of relevant studies published in other languages. Second, some DAs were presented as web pages or published in non-indexed journals, and we could not access essential elements for summarisation, which may have led to incomplete data extraction. Third, the protocol was also included, which may have been missing some important data but expanded the scope of DAs. Despite these limitations, this scoping review provides valuable insights into the current state of DAs in the ICU and identifies areas for future research and development.

CONCLUSIONS
This scoping review provides a comprehensive synthesis of the application of DAs in the ICU. The implementation and advancement of DAs in the ICU hold promise for improving the quality of care and promoting a family-centred approach in critical care medicine. However, the majority of DAs focus on life-sustaining treatment and goals of care, representing only a small portion of the complex decision-making needs in the ICU, and there is also a lack of culturally adapted DAs. It is crucial to recalibrate and standardise evaluation indicators for DAs to facilitate more seamless development. Furthermore, effective implementation of DAs requires strengthening and integrating the key role of healthcare providers in the shared decision-making process in the ICU.

Contributors YL and YT developed the search strategy. YL and QZ were involved in study screening and data extraction. YT is the guarantor of the study and responsible for the study design, team coordination and supervised the research process. YL drafted the first version of the manuscript, and all authors critically revised the manuscript for intellectual content and approved the final version to be published.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. All data relevant to the study are included in the article or uploaded as online supplemental information.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability
REFERENCES


3. Cuypers M, Lamers RED, de Vries M, et al. Prostate cancer survivors with a passive role preference in treatment decision-making are less satisfied with information received: results from the PROFILES registry. *Urol Oncol* 2016;34:482.


## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

<table>
<thead>
<tr>
<th>SECTION</th>
<th>ITEM</th>
<th>PRISMA-ScR CHECKLIST ITEM</th>
<th>REPORTED ON PAGE #</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ABSTRACT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured summary</td>
<td>2</td>
<td>Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.</td>
<td></td>
</tr>
<tr>
<td><strong>INTRODUCTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>3</td>
<td>Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.</td>
<td>2</td>
</tr>
<tr>
<td>Objectives</td>
<td>4</td>
<td>Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.</td>
<td></td>
</tr>
<tr>
<td><strong>METHODS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol and registration</td>
<td>5</td>
<td>Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.</td>
<td>3</td>
</tr>
<tr>
<td>Eligibility criteria</td>
<td>6</td>
<td>Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.</td>
<td>4</td>
</tr>
<tr>
<td>Information sources*</td>
<td>7</td>
<td>Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.</td>
<td>2</td>
</tr>
<tr>
<td>Search</td>
<td>8</td>
<td>Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.</td>
<td>3-4</td>
</tr>
<tr>
<td>Selection of sources of evidence†</td>
<td>9</td>
<td>State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.</td>
<td>4</td>
</tr>
<tr>
<td>Data charting process‡</td>
<td>10</td>
<td>Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.</td>
<td>4</td>
</tr>
<tr>
<td>Data items</td>
<td>11</td>
<td>List and define all variables for which data were sought and any assumptions and simplifications made.</td>
<td>none</td>
</tr>
<tr>
<td>Critical appraisal of individual sources of evidence§</td>
<td>12</td>
<td>If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).</td>
<td>4</td>
</tr>
<tr>
<td>Synthesis of results</td>
<td>13</td>
<td>Describe the methods of handling and summarizing the data that were charted.</td>
<td></td>
</tr>
</tbody>
</table>
### RESULTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>ITEM</th>
<th>PRISMA-ScR CHECKLIST ITEM</th>
<th>REPORTED ON PAGE #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection of sources of evidence</td>
<td>14</td>
<td>Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.</td>
<td>5</td>
</tr>
<tr>
<td>Characteristics of sources of evidence</td>
<td>15</td>
<td>For each source of evidence, present characteristics for which data were charted and provide the citations.</td>
<td>none</td>
</tr>
<tr>
<td>Critical appraisal within sources of evidence</td>
<td>16</td>
<td>If done, present data on critical appraisal of included sources of evidence (see item 12).</td>
<td>7-10</td>
</tr>
<tr>
<td>Results of individual sources of evidence</td>
<td>17</td>
<td>For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.</td>
<td>11-13</td>
</tr>
<tr>
<td>Synthesis of results</td>
<td>18</td>
<td>Summarize and/or present the charting results as they relate to the review questions and objectives.</td>
<td></td>
</tr>
</tbody>
</table>

### DISCUSSION

| SUMMARY OF EVIDENCE | 19   | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | 14                  |
| LIMITATIONS         | 20   | Discuss the limitations of the scoping review process. | 16-17               |
| CONCLUSIONS         | 21   | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | 17                  |

### FUNDING

| Funding             | 22   | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | 17                  |

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where sources of evidence (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with information sources (see first footnote).

‡ The frameworks by Arksey and O’Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias” (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

PubMed

Search Query #1
((("Intensive Care Units"[Mesh]) OR (Intensive Care Unit[Title/Abstract])) OR (Unit, Intensive Care[Title/Abstract])) OR (ICU[Title/Abstract]) OR (critically ill patients[Title/Abstract])) OR (serious ill patients[Title/Abstract])

Search Query #2
(((((("Decision Support Techniques"[Mesh]) OR (Decision Support Technique[Title/Abstract])) OR (Technique?, Decision Support[Title/Abstract])) OR (Decision Support Technic?[Title/Abstract])) OR (Technic?, Decision Support[Title/Abstract])) OR (Models, Decision Support[Title/Abstract])) OR (Decision Support Model?[Title/Abstract])) OR (Decision Modeling[Title/Abstract])) OR (Decision Aids[Title/Abstract])) OR (Aid?, Decision[Title/Abstract])) OR (Decision Aid[Title/Abstract])) OR (Decision Analysis[Title/Abstract])) OR (Analyses, Decision[Title/Abstract])

Search Query #3
("Intensive Care Units"[Mesh]) AND (((((((("Decision Support Techniques"[Mesh]) OR (Decision Support Technique[Title/Abstract])) OR (Technique?, Decision Support[Title/Abstract])) OR (Decision Support Technic?[Title/Abstract])) OR (Technic?, Decision Support[Title/Abstract])) OR (Models, Decision Support[Title/Abstract])) OR (Decision Support Model?[Title/Abstract])) OR (Decision Modeling[Title/Abstract])) OR (Decision Aids[Title/Abstract])) OR (Aid?, Decision[Title/Abstract])) OR (Decision Aid[Title/Abstract])) OR (Decision Analysis[Title/Abstract])) OR (Analyses, Decision[Title/Abstract])

Web of Science

Search Query #1
((TI=(Intensive care unit*)) OR TI=(ICU)) OR TI=(critically ill patient*) and Preprint Citation Index (Exclude – Database)

Search Query #2
(((TI=(Decision Support Techniques)) OR TI=(Decision Support Model)) OR TI=(Decision Aid*)) OR TI=(Decision Analyses)

Search Query #3
(((TI=(Intensive care unit*)) OR TI=(ICU)) OR TI=(critically ill patient*)) and Preprint Citation Index (Exclude – Database)

Embase

Search Query #1
'decision support techniques'/exp OR 'decision support techniques' OR 'decision support model':ab,ti OR 'decision aids':ab,ti OR 'decision analyses':ab,ti

Search Query #2
'intensive care unit'/exp OR 'intensive care unit' OR icu:ab,ti OR 'critically ill
patient*:ab,ti
Search Query #3
#1 AND #2

**Scopus**

(TITLE(intensive care unit*) OR TITLE(ICU) OR TITLE(critically ill patient*)) AND
(TITLE("Decision Support Technique*") OR TITLE(Decision Support Model) OR
TITLE("Decision Aid*") OR TITLE("Decision Analyses"))

**Website**

https://decisionaid.ohri.ca/AZlist.html
Supplementary Table 1: Summary of the included studies

<table>
<thead>
<tr>
<th>Number</th>
<th>Authors (Year)</th>
<th>Country</th>
<th>Sample</th>
<th>Method</th>
<th>Participants</th>
<th>Format</th>
<th>Component</th>
<th>Outcomes</th>
<th>IPDAS</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>Cox et al. (25) (2012) USA</td>
<td>USA</td>
<td>53 surrogates 58 physicians</td>
<td>Quasi-experimental study</td>
<td>1) Age &gt; 19 2) Those who were most involved in medical decision-making for patients mechanically ventilated &gt; 10 d</td>
<td>Paper</td>
<td>1) Information on treatments and procedures 2) Individualized mortality</td>
<td>Reduced surrogate-physician discordance; Improved comprehension; decision conflict quality of communication (all $P &lt; .05$); Hospital costs were lower ($P = .044$); No significant difference in mortality ($P = .95$).</td>
<td>Yes</td>
<td>Develop a DA for surrogates of patients undergoing mechanical ventilation.</td>
</tr>
<tr>
<td>No. 2</td>
<td>Cox et al. (26) (2015) USA</td>
<td>USA</td>
<td>30 surrogates</td>
<td>Observational Study</td>
<td>Surrogate of critical illness survivor</td>
<td>Web</td>
<td>1) ProVent prediction model 2) Common ICU therapies</td>
<td>Excellent usability (mean SUS, 80 ± 10); Patients aged 56 years and older had lower scores than younger patients ($P = 0.03$).</td>
<td>Yes</td>
<td>Develop a Web-based DA for family members of patients receiving prolonged mechanical ventilation. Assess the impact of a DA on prognostic agreement between surrogates and clinicians regarding prolonged mechanical ventilation compared to usual care.</td>
</tr>
<tr>
<td></td>
<td>Cox et al. (27) (2019) USA</td>
<td>USA</td>
<td>277 patients 416 surrogates 427 clinicians</td>
<td>RCT</td>
<td>Those who were most involved in medical decision-making for patients</td>
<td>Web</td>
<td>1) Expectation of goals of care 2) Elicited family support needs 3) 1-year prognosis estimated</td>
<td>Improved decision conflict ($P = 0.041$); No significant difference in concordance ($P = 0.6$); Other surrogate and patient outcomes did not differ.</td>
<td>Yes</td>
<td>Assess the impact of a DA on prognostic agreement between surrogates and clinicians regarding prolonged mechanical ventilation compared to usual care.</td>
</tr>
<tr>
<td></td>
<td>Muehlschlegel et al. (37) (2020) USA</td>
<td>USA</td>
<td>16 surrogates</td>
<td>Mixed methods</td>
<td></td>
<td>Paper</td>
<td>1) IMPACT model presented by icon array 2) Ten pictures and</td>
<td>Excellent usability (median SUS 87.5)</td>
<td>Yes</td>
<td>Develop a goals-of-care DA for patients who are critically ill with TBI.</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Duration</td>
<td>Setting</td>
<td>Sample Size</td>
<td>Study Design</td>
<td>Study Details</td>
<td>Results</td>
<td>Conclusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>----------</td>
<td>---------</td>
<td>-------------</td>
<td>--------------</td>
<td>---------------</td>
<td>---------</td>
<td>------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goostrey et al. (38) (2021) USA</td>
<td>USA</td>
<td>2021</td>
<td>Observational study</td>
<td>20 surrogates</td>
<td>1) Age ≥ 18 2) English speaking</td>
<td>1) Background information 2) Disease-specific terminology 3) Disease-specific icon array</td>
<td>Excellent usability (median SUS 84/100)</td>
<td>Provide a DA for patients with intracerebral haemorrhage and acute ischaemic stroke.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muehlschlegel et al. (30) (2022) USA</td>
<td>USA</td>
<td>2022</td>
<td>RCT</td>
<td>41 Patients 66 surrogates</td>
<td>Surrogates of patients with AIS, ICH, TBI</td>
<td>1) Goals-of-care decision-making options 2) Survival treatment options 3) Individualized icon array</td>
<td>Fewer comfort care decisions ($P = 0.1$) and code status changes ($P = 0.02$); Reduced 3-month mortality ($P = 0.05$) 3-month psychological outcomes were worse among surrogates who had chosen continuation of care.</td>
<td>Assessed the feasibility, acceptability, and perceived usefulness of a DA for goals-of-care communication with surrogates for patients with severe acute brain injury after hemispheric AIS, ICH, or TBI. Help individuals navigate the complexities of surrogate decision-making in the ICU.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suen et al. (28) (2020) USA</td>
<td>USA</td>
<td>2020</td>
<td>Mixed methods</td>
<td>9 surrogates 4 physicians</td>
<td></td>
<td>1) Patient age &gt; 18 2) Risk of death &gt;40% 3) Mechanical ventilation ≥ 96 h</td>
<td>Highly usable (mean 83.5), acceptable (mean 4.2 ± 0.5), and effective (mean 4.3 ± 0.6).</td>
<td>Help individuals navigate the complexities of surrogate decision-making in the ICU.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suen et al. (29) (2021) USA</td>
<td>USA</td>
<td>2021</td>
<td>RCT</td>
<td>52 surrogates</td>
<td>1) Risk of death &gt; 40%</td>
<td>1) Family-centred videos</td>
<td>Highly usable (mean, 82.4/100), acceptable (mean, 4.5/60.9), and effective (mean, 4.3 ± 0.6).</td>
<td>Help surrogates prepare for clinician-family</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Study Reference</td>
<td>Location</td>
<td>Participants</td>
<td>Study Type</td>
<td>Intervention</td>
<td>Outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>-----------------</td>
<td>----------</td>
<td>--------------</td>
<td>------------</td>
<td>--------------</td>
<td>----------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>McCannon et al. (31) (2012) USA</td>
<td>Quasi-experimental study</td>
<td>50 surrogates</td>
<td>1) Age &gt; 21 2) English speaking 3) No vision impairment</td>
<td>Video</td>
<td>Improved knowledge (P = 0.008); CPR preference change: full code 78%, DNR 22% vs. full code 59%, DNR 41% (P = 0.23).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Frize et al. (35) (2013) Canada</td>
<td>Mixed methods</td>
<td>8 parents 5 neonatologists</td>
<td>1) Understand the NICU environment 2) Integrating a mortality model</td>
<td>Web</td>
<td>Use video images to supplement medical discussions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Wilson et al. (32) (2015) USA</td>
<td>RCT</td>
<td>208 patients and surrogates</td>
<td>1) Patient with CPR capacity 2) Their surrogates</td>
<td>Video</td>
<td>Improved knowledge and understanding, (P &lt; 0.0001); No significant difference in resuscitation preferences.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Plaisance et al. (33) (2018) Canada</td>
<td>Qualitative Study</td>
<td>15 patients 11 health professionals</td>
<td>1) Information on CPR and invasive mechanical ventilation 2) Integrated the GO-FAR calculator</td>
<td>Wiki</td>
<td>Adaptation of an existing CPR DA to create a Wikipedia-based DA.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: 2) Severe long-term functional impairment 2) Interactive questions effective (mean, 4.4/560.2). No significant difference in quality of communication or shared decision-making. 1) Sensitivity and specificity of decision trees 2) PPADS usability 1) Described CPR 2) Explained CPR preference options 3) 1-minute simulated code experience 1) Patient with CPR capacity 2) Their surrogates 1) Information on CPR and invasive mechanical ventilation 2) Integrated the GO-FAR calculator
<table>
<thead>
<tr>
<th>No.</th>
<th>Study</th>
<th>Country</th>
<th>Sample Size</th>
<th>Study Design</th>
<th>Participants</th>
<th>Phase II</th>
<th>Phase III</th>
<th>Outcomes</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Heyland et al. (34) (2018)</td>
<td>Canada</td>
<td>1000 patients</td>
<td>RCT (Protocol)</td>
<td>Surrogates of patients who were “nutritionally high risk” and/or those at risk of dying</td>
<td>1) Information on shared decision-making</td>
<td>1) Efficacy and feasibility</td>
<td>2) 6-minute walk distance</td>
<td>Evaluate two interventions that enable partnerships with families of critically ill patients</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3) Advice on coping with stress</td>
<td>4) Clarify decision preferences</td>
<td>5) Mortality</td>
<td>6) Length of stay</td>
<td>7) Anxiety and depression</td>
<td>8) Family satisfaction</td>
</tr>
</tbody>
</table>

NA=Not Acceptable; PPADS=Physician-Parent Decision Support; IPDA=International Patient Decision Aid; DA=Decision Aid; SUS=System Usability Scale; SF-36=36-item Short Form Survey; AIS=Acute Ischaemic Stroke; ICH=Primary Intracerebral Haemorrhage; TBI=Traumatic Brain Injury