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REVIEW ARTICLE

The effectiveness of clinical pathways in inpatient settings - an umbrella review

Anne Büscher[1] · **Joachim Kugler**[1]

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Abstract

Aim The aim of this research is to summarize the effectiveness of clinical pathways in inpatient settings in industrialized countries to gain implications for hospital management or identify further research needs.

Subject and methods Systematic literature reviews and meta-analyses published in English from 2010 to August 30, 2023, investigating the effectiveness of clinical inpatient pathways are identified, summarized, and synthesized. PubMed, Cochrane Library, and MEDLINE databases were searched.

Results The search identified a total of ten systematic reviews, of which seven also conducted meta-analyses. The results show substantial heterogeneity in the data. In total, data from 140 primary studies are included. The parameters that were most frequently examined are complication rates, impact on length of stay, readmission rates, mortality, documentation quality, and hospital and care costs.

Conclusion A positive impact of clinical pathways, including a reduced risk of complications, reduced length of stay, and a better documentation quality, can be summarized. However, the definition of the concept of clinical pathways already differs and the outcomes that were examined also differ in their definition and measurement. The results of this research on clinical pathways are not sufficient for transfer to the current situation. The results show an added value for patients, staff, and relatives, particularly for clinical pathways that involve frequent illnesses, are cost-intensive, and require a lot of communication between different professionals. Furthermore, it can be concluded that further research with randomized controlled trials is necessary to investigate the effectiveness of clinical pathways.

Keywords Umbrella review · Clinical pathway · Critical pathway · Inpatient · Effectiveness

Aim of the research

Clinical pathways have gained increasing importance in recent decades and have become a crucial tool in healthcare management. They have often been implemented internationally since introduction of the DRG system (Chawla et al. 2016; Rau et al. 2009; Willey 2011). These structured, interdisciplinary pathways, based on evidence-based medicine, are intended to enhance the quality of care and optimize the utilization of available resources (Rotter et al. 2019). Although care pathways are frequently applied, their effectiveness in clinical practice is a subject of debate. There are numerous studies examining the effectiveness of clinical pathways, but the results are inconclusive. Hence, it is essential to conduct a comprehensive assessment in the form of an umbrella review of the available literature to deduce whether clinical pathways indeed have an impact in the hospital setting. This could inform organizational implications for clinical management or identify further research needs.

Research question This umbrella study aims to answer the following research question: What is the impact of clinical pathways in inpatient settings?

Systematic literature reviews and meta-analyses published in the English language since the publication year 2010 up to and including August 30, 2023, which investigate the effectiveness of clinical pathways in the inpatient setting, are identified, summarized, and synthesized (Table 1).

✉ Anne Büscher
anne.buescher@mailbox.tu-dresden.de

[1] TU Dresden, Dresden, Germany

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Table 1 PICO schemee

P Population	Adult patients (≥ 18 years) in inpatient care
I Intervention	Adherence of clincial pathways
C Comparison	Conventional treatment
O Outcome	No restrictions
(S) Setting	Industrialized countries
(S) Study design	Systematic reviews and meta-analyses

Subject and methods

The decision to conduct an umbrella study was made because a substantial number of systematic reviews and meta-analyses on the impact of clinical pathways have already been published. To provide an evidence-based source for healthcare decision-makers, the results of these articles will be synthesized and made available through an umbrella study with quality assessment using AMSTAR (Shea et al. 2009).

Search strategy

Three databases were searched for scientific literature published since 2010 up to August 30, 2023. First, PubMed was selected. Additionally, the Cochrane Library provides one of the largest collections of systematic reviews in the medical literature. Furthermore, the MEDLINE database was chosen as the third database for the search. All databases were searched using MeSH terms. In addition, the reference lists of included studies were manually searched to identify further relevant literature.

In PubMed and MEDLINE, a search was conducted using the MeSH Major Topic "clinical pathway." Only meta-analyses and systematic reviews in English, published between 2011 and 2023, were considered. The search algorithms can be found in Tables 2 and 3.

Cochrane Library: Through the Advanced Search, the term "Clinical Pathways" was entered in the "Medical terms (MeSH)" search. No specific subheadings were selected in this search to ensure consistency across all databases. In the "MeSH Trees," all areas were selected via "Explode all trees."

Inclusion and exclusion criteria

The following inclusion criteria were applied during the search in the three databases: (1) systematic review or meta-analysis, (2) publication of the full text in English, (3) publication date from 2010 up to and including August 30, 2023. Additionally, further inclusion and exclusion criteria were established and are summarized in Table 4 .

Study selection

The selection of articles and the inclusion of studies were independently conducted by two authors. The study selection process is shown in Fig. 1 PRISMA model. Through

Table 2 PubMed search algorithm

Search number, Query, Sort By, Filters, Search Details, Results, Time
1,clinical pathway[MeSH Major Topic],"Meta-Analysis, Systematic Review, English, from 2010—2023",""""critical pathways""[MeSH Major Topic]",50,09:52:41

Table 3 MEDLINE Search algorithm

(MH = (Critical Pathways)) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Meta Analysis OR Systematic Review) AND SPECIES: (Humans) Indexes = MEDLINE Timespan = 2010–2023

Table 4 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
1. Industrialized countries	1. Developing and emerging countries
2. Somatic treatments and interventions	2. Psychiatric treatments
3. Adult patients (≥ 18 years)	3. Children and adolescent patients (< 18 years)
4. Focus on effectiveness of clinical pathways	4. Focus on definitions, examining facilitators and barriers etc
5. Inpatient setting	5. Outpatient setting

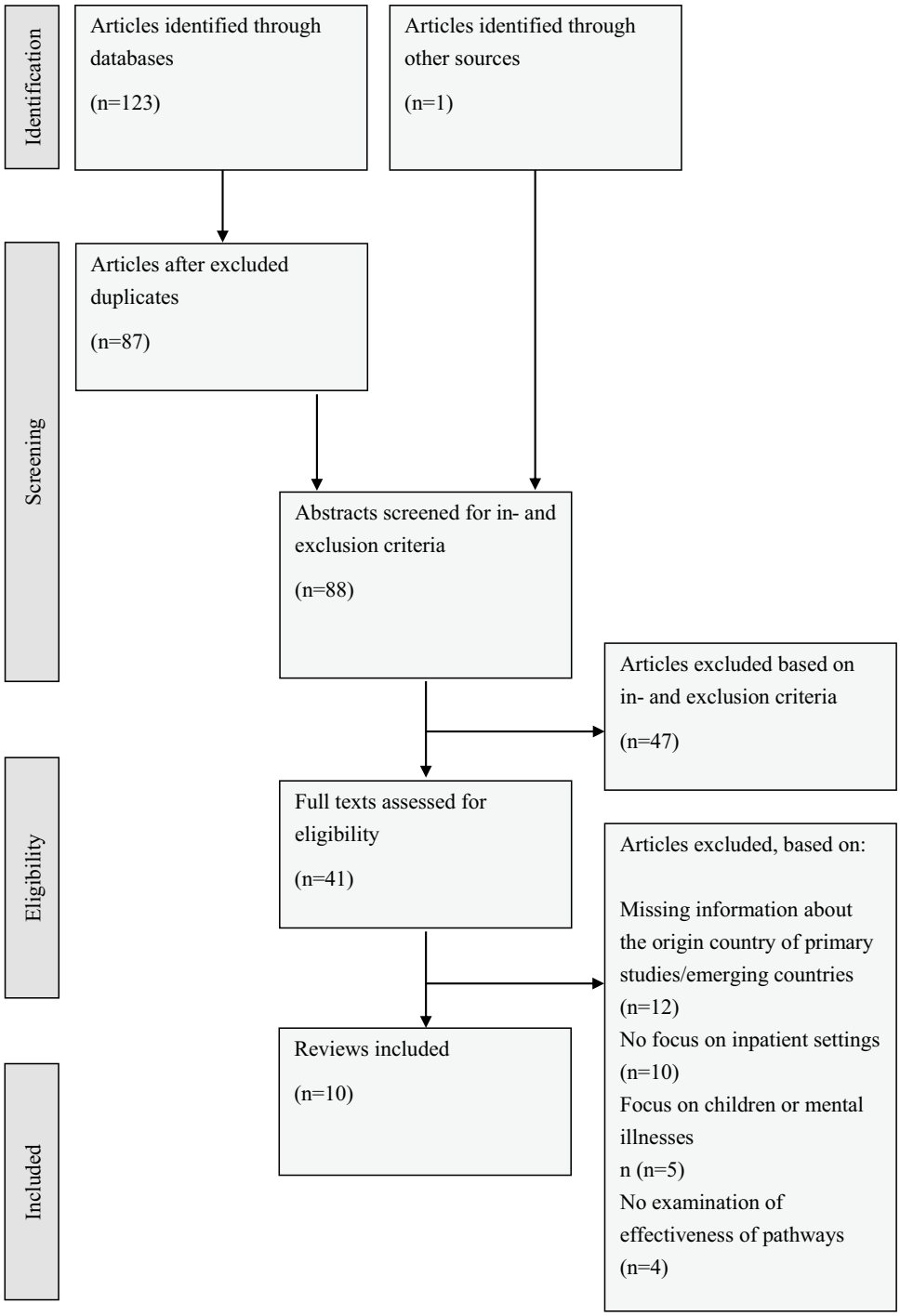

Fig. 1 PRISMA model

the systematic search, 123 articles were identified. An additional article was included that originated from the references of another article but did not appear in the database search. Duplicates were removed, resulting in 88 publications being screened for inclusion and exclusion criteria. Initially, these criteria were applied to the abstracts, resulting in 41 articles being assessed in full text based on the selected inclusion and exclusion criteria. During the full-text review, a total of 31 articles were excluded for various reasons related to the inclusion and exclusion criteria. As this is a review of other reviews, the criteria cannot be applied exclusively in this context. Thus, five articles were excluded, which included the majority of the studies but not exclusively, involving children, mentally ill individuals, or conducted in developing countries. Another ten articles were not included because the majority of included primary studies were not conducted in a hospital inpatient setting. Four additional studies included in the

reviews did not examine the effectiveness of clinical pathways but instead investigated barriers and facilitators of clinical pathways or examined the methods used for evaluating pathways. Twelve studies had to be excluded from consideration in this review because the identified articles provided an overview of characteristics but did not specify the country in which the studies were conducted. Since one of the inclusion criteria is that the studies must be conducted in industrialized nations to aggregate roughly comparable results, these review articles were excluded.

Quality assessment

The methodological quality of the articles considered in this review was assessed by both authors using the validated quality assessment tool AMSTAR. This instrument consists of 11 questions for quality evaluation (Shea et al. 2009). The quality assessment based on this checklist serves as a guide to evaluate the quality of the articles. The specific characteristics of the included studies will be described in more detail in the results section to facilitate a thorough discussion and evaluation in the discussion section.

Results

Characteristics of included primary studies

A total of 123 articles were screened, of which, after applying the inclusion and exclusion criteria, ten systematic review articles were identified. Seven of these studies also conducted meta-analyses. In these review articles, data from a total of 140 primary studies are summarized. The data used are considered highly heterogeneous, leading to challenges in summarizing the data comprehensively by the authors of the review articles. This heterogeneity also means that the results of this study can only be summarized considering this heterogeneous data.

Complications

The most frequently examined outcome in primary studies and summarized in the review articles was the effect of clinical pathways on complication rates, with seven out of ten studies focusing on this aspect. A variety of conditions, such as pulmonary complications or major bleeding during interventions, were investigated. While Gordon and Reiter (2015) do not find significant changes in the chance of complications, Vogt et al. (2012) reported a significant reduction in the likelihood of complications in one included study when patients were managed using a clinical pathway. Rotter et al. (2010), Plishka et al. (2019), Tyson and Chang (2016), Romiti et al. (2022), and Pucetti et al. (2022) demonstrated in their systematic reviews and meta-analyses a significantly reduced risk of complications when patients were managed along a clinical pathway. There were no significant results suggesting an increased number of complications.

Length of stay

The length of stay is summarized in five out of the ten systematic reviews based on primary studies (Gordon and Reiter 2015; Plishka et al. 2019; Pucetti et al. 2022; Rotter et al. 2010; Tyson and Chang 2016). A significant reduction in length of stay is observed in all of these studies. However, two primary studies in the review by Rotter et al. (2010) do not show a significant difference in length of stay between patients managed along a clinical pathway and the control group.

Readmission

Four out of the ten reviews present results on the effect of clinical pathways on readmission after discharge. Tyson and Chang (2016), in a meta-analysis of 13 primary studies, find no significant difference in readmission within 90 days. However, a significant reduction in readmissions within 30 days is observed. Plishka et al. (2019) shows a reduction in readmissions when clinical pathways are implemented (significant for overall readmission without time limit; not significant for readmission within 30 days). Some of the primary studies in Gordon and Reiter (2015) and the results from Pucetti et al. (2022) show non-significant results, indicating no difference.

Mortality

No significant results regarding the effect on mortality are found in three of the review articles. The meta-analyses examine this outcome, but they do not show a difference in the treatment of patients along a clinical pathway compared to a control group (Plishka et al. 2019; Pucetti et al. 2022; Vogt et al. 2012). Only Rometti et al. (2022) show a significant reduction in mortality when patients were managed along a clinical pathway.

Documentation quality

Two primary studies by Rotter et al. (2010) and one primary study by Phillips et al. (2011) demonstrated a significant improvement in documentation quality.

Hospital and healthcare costs

Two of the included reviews examined the difference in costs incurred by patients managed along a clinical pathway compared to the control group (Gordon and Reiter 2015; Rotter et al. 2010). The data are considered highly heterogeneous; however, both review articles show a reduction in healthcare costs when treatment is based on a pathway.

Quality assessment

The authors of the ten systematic reviews assessed the quality of their studies using different instruments. In summary, it can be said that these included primary studies were critically evaluated. The authors mainly criticized the study designs used in the primary studies, as primarily observational studies rather than intervention studies were conducted.

Discussion

Ten systematic reviews with data from 140 primary studies were identified. Despite data heterogeneity, consistent findings indicate reduced complications, shorter length of stay, decreased readmission rates, improved documentation quality, and lower healthcare costs associated with clinical pathways. The definition of the concept of clinical pathways already varies significantly, and the outcomes examined also differ in their definition and measurement. Consequently, in this review, it is not possible to make direct result comparisons; rather, the aim is to provide a comprehensive summary of the results from various studies.

The characteristics presented in Table 5 show that, in addition to the pathway concepts, relevant study parameters such as the number of study participants vary widely. Even though the studies were already selected so that the primary studies were mostly conducted in industrialized nations, a wide range of countries where the investigations were conducted is evident. The majority of studies were conducted in the USA, where a connection can be made with funding based on DRGs. Many studies conducted in Europe, especially in the UK, were linked to a state-funded healthcare system, where evaluating measures to reduce costs is particularly important. When examining the publication years of the primary studies, it is evident that there are 34 years between the first and the last primary study, which means that while the results can be summarized, they may not be directly applicable to the current situation. If the length of stay of patients was examined along a treatment pathway over 20 years ago, these results cannot be compared to the current situation, as lengths of stay have already been significantly reduced at the same time of further development of the DRG system. Additionally, the potential effects of clinical pathways may be more evident in systems from many years ago, where there were significantly higher costs and longer lengths of stay, compared to healthcare systems that have already been optimized in these terms.

The added value of clinical pathways

Nevertheless, this umbrella study shows that clinical pathways overall provide a significant added value. The systematic search yielded results from the publication year 2010 onward. In that year, the largest and most relevant review on the effectiveness of clinical pathways by Rotter et al. (2010) was published. This systematic review is one of the included studies of this umbrella review. The authors found significant results in 2010 indicating that the complication rate can be significantly reduced when patients are managed along a clinical pathway. These results are also supported by the findings of the review articles by Plishka et al. (2019), Pucetti et al. (2022), Romiti et al. (2022), and Tyson and Chang (2016). Rotter et al. (2010) also demonstrated that documentation quality is significantly better. These results are also confirmed by Phillips et al. (2011). The results of interviews in the review article by Chan et al. (2018) also suggest that documentation significantly improves when clinical pathways are used. The reduction in length of stay demonstrated by Plishka et al. (2019), Pucetti et al. (2022), and Tyson and Chang (2016) is in line with Rotter et al. (2010). Furthermore, these authors show a significant reduction in readmission of patients managed along a clinical pathway. Significant results are also present for the improvement of physical functioning, as demonstrated by Storm et al. (2019) and Tyson and Chang (2016).

In summary, the findings of Rotter et al. in 2010, marked by the high methodological rigor and representing the first review on this subject, have been confirmed in subsequent years by less comprehensive studies, affirming and validating the initial findings.

Critical evaluation of measured outcomes

Rotter et al. (2010) already critically questioned whether length of stay should be considered a quality indicator and thus measured as an outcome. Thirteen years later, it should even be considered whether the parameters measuring the effects of clinical pathways should be oriented more toward patients. Patients' perspectives are increasingly considered politically important and are gaining more importance in quality assurance. IQTIG (Institute for Quality Assurance and Transparency in Healthcare) introduced various patient

Table 5 Characteristics of included reviews

No.	Authors and publication year	Number of includes studies	Study population	Country	Publication years of primary studies	Study designs of primary studies	Condition	Outcomes	Quality assessment of authors	AMS TAR
1	Gordon et al. (2015)	10	1,116	USA (10)	1994 (1) 1995 (2) 1996 (5) 1997 (1) 1998 (1)	0 × RCT ➔ 0 %	Head and neck cancer surgery	**Length of stay (LOS)** 9 out of 10 studies show a statistically significant reduction in LOS **Healthcare costs** 5 out of 6 studies show a statistically significant reduction in healthcare costs. **Complications** 2 out of 4 studies show an increased complication rate (not significant). 2 out of 4 studies show a reduced complication rate (not significant). **Readmission within 30 days** 4 out of 10 studies show difference (not significant). **Case length** 1 out of 2 studies show a statistically significant reduction of case length. 1 out of 2 studies show a reduction of case length (not significant).	The included studies have potential for significant limitations because of the use of a before and after study design, and the lack of temporal controls.	0,6

Table 5 (continued)

No.	Authors and publication year	Number of includes studies	Study population	Country	Publication years of primary studies	Study designs of primary studies	Condition	Outcomes	Quality assessment of authors	AMSTAR
2	Rotter et al. (2010)	27	11,398	USA (13) Australia (4) Japan (3) UK (2) Canada (2) Thailand (1) Taiwan (1) Norway (1)	1987 (1) 1993 (1) 1995 (1) 1996 (1) 1997 (2) 1999 (1) 2000 (7) 2002 (4) 2003 (2) 2004 (3) 2005 (1) 2006 (3)	19 × RCT ➔ 70,37 %	Various internal medicine and surgery interventions	**LOS** 11 out of 18 studies show a significant reduction. 7 out of 18 studies show no significant difference. **Complications** Data from 5 studies in a meta-analysis show a significant reduction. **Quality of documentation** Data from 2 studies show a significant improvement. **Hospital costs** 7 out of 8 studies show a significant reduction.	The majority of the included studies adhere to the gold standard of randomized controlled trials (RCTs), with only those RCTs having a low to moderate risk of bias being accepted. The data is heterogeneous overall, and there are different definitions of outcomes, such as costs.	1
3	Chan et al. (2018)	1	540	Italy (1)	2014 (1)	1 × RCT ➔ 100 %	End of life care/ cancer	**Breathlessness** 1 out of 1 study shows statistically significantly better control of breathlessness. **Control of pain** 1 out of 1 study shows no difference in pain control (not significant). **Nausea and vomiting** 1 out of 1 study shows no difference in nausea and vomiting (not significant).	Authors grade quality of evidence as very low (low response rate, low adherence to protocol etc.) and because the data were derived from a single study with a small number of participants.	1

Table 5 (continued)

No.	Authors and publication year	Number of includes studies	Study population	Country	Publication years of primary studies	Study designs of primary studies	Condition	Outcomes	Quality assessment of authors	AMSTAR
4	Plishka et al. (2019)	13	1,179	USA (3) Ireland (2) Australia (2) China (2) Netherlands (1) Belgium, Italy, Portugal (1) Malaysia, Belgium, Spain (2)	1995 (1) 1997 (1) 2004 (2) 2005 (1) 2006 (1) 2012 (1) 2013 (2) 2014 (1) 2016 (2) 2017 (1)	5 × RCT ➔ 38,46 %	COPD	**Complications** Data from 3 studies in a meta-analysis show a statistically significant reduced likelihood of complications. **Readmission overall** Data from 7 studies in a meta-analysis show a reduced likelihood of readmission overall. **Readmission within 30 days** Data from 4 studies in a meta-analysis show a reduced likelihood of readmission (not significant) **Mortality** Data from 6 studies in a meta-analysis show no difference (not significant). **LOS** Data from 6 studies in a meta-analysis show a significant reduction **Quality of life** Data from 3 studies in a meta-analysis show no difference (not significant).	Quality evidence rated mainly as very low or low.	1

Table 5 (continued)

No.	Authors and publication year	Number of includes studies	Study population	Country	Publication years of primary studies	Study designs of primary studies	Condition	Outcomes	Quality assessment of authors	AMSTAR
5	Phillips et al. (2011)	26	9,276	UK (15) Netherlands (4) USA (3) Australia (2) Ireland (1) China (1)	2001 (1) 2002 (1) 2003 (2) 2004 (1) 2005 (5) 2006 (5) 2007 (3) 2008 (2) 2009 (5) 2010 (1)	0 × RCT ➔ 0 %	End of life care	**Use of drugs** 1 out of 1 study shows no difference (not significant) 1 out of 1 study shows no difference (descriptive data) **Satisfaction** 1 out of 1 study shows higher satisfaction (survey) **Quality of documentation** 1 out of 3 studies shows better documentation quality (descriptive data) 1 out of 3 studies shows significantly better documentation quality 1 out of 3 studies shows better documentation (not significant) **Communication among team, family, and patient** 3 out of 3 studies show better communication (descriptive data) **Awareness of spiritual or religious needs** 2 out of 2 studies show better awareness **Perceived symptoms** 2 out of 2 studies show significantly reduced perception of symptoms in the last days of life **Symptom control** 1 out of 2 study shows better control (descriptive data) 1 out of 2 study shows significantly better control	High heterogeneity of data didn't allow meta-analysis, therefore content analysis was conducted.	1

Table 5 (continued)

No.	Authors and publication year	Number of includes studies	Study population	Country	Publication years of primary studies	Study designs of primary studies	Condition	Outcomes	Quality assessment of authors	AMSTAR
6	Storm et al. (2019)	9	1,422	USA (4) Germany (2) Norway (1) UK (1) Japan (1)	2007 (1) 2008 (1) 2011 (2) 2012 (2) 2014 (1) 2016 (1) 2017 (1)	1 × RCT ➔ 11,11 %	Cardiac arrest patients	**Functional outcomes** Data from 6 studies in the meta-analysis show a significantly higher likelihood of better functional outcomes	Methodologic quality rated was good in six studies comparing two groups of patients and poor in the three studies reporting on only one prospective group.	0,8
7	Vogt et al. (2012)	7	1,667	USA (5) Denmark (1) Canada (1)	2008 (2) 2009 (5)	0 × RCT ➔ 0 %	Massive blood transfusion	**Mortality** Data from 6 studies in the meta-analysis show no difference (not significant). **Use of blood products** Data from 4 studies in the meta-analysis show a reduction in the number of blood products used (not significant). **Complications** 1 out of 1 study shows a significantly reduced likelihood of complications like multi-organ-failure or sepsis. 1 out of 1 study shows significantly no difference.	Quality of evidence of included studies is rated as very low.	0,7

Table 5 (continued)

No.	Authors and publication year	Number of includes studies	Study population	Country	Publication years of primary studies	Study designs of primary studies	Condition	Outcomes	Quality assessment of authors	AMS TAR
8	Tyson et al. (2016)	13	1,493	England (4) USA (3) Italy (2) Sweden (2) Germany (1) China (1)	2003 (1) 2007 (1) 2008 (1) 2013 (2) 2014 (4) 2015 (3) 2016 (1)	0 × RCT ➔ 0 %	Cystectomy	**Readmission within 90 days** Data from 13 studies in the meta-analysis show no difference (not significant). **Readmission within 30 days** Data from 13 studies in the meta-analysis show a significant reduction. **Complications** Data from 13 studies in the meta-analysis show a significant reduction. **LOS** Data from 12 studies in the meta-analysis show a significant reduction. **Time-to-bowel function** Data from 7 studies in the meta-analysis show a significant reduction.	Low quality because included studies were observational studies.	0,8
9	Romiti et al. (2022)	8	285,253	Europe (4) Asia (2) North America (1) multinational (1)	2018 (1) 2020 (6) 2016 (1)	3 × RCT ➔ 37,5 %	Atrial Fibrillation	**Mortality** Meta-analysis of the data shows a significant reduction. **Cardiovascular death** Meta-analysis shows a significantly lower risk **Stroke** Meta-analysis shows a significantly lower risk **Major bleeding** Meta-analysis shows a significantly lower risk	Overall high quality of studies, with the exception of one study which was found at high risk of bias for both prevalence and outcomes analysis.	0,9

Table 5 (continued)

No.	Authors and publication year	Number of includes studies	Study population	Country	Publication years of primary studies	Study designs of primary studies	Condition	Outcomes	Quality assessment of authors	AMSTAR
10	Puccetti et al. (2022)	26	3,722	China (8) Japan (2) Italy (1) USA (6) UK (6) Netherlands (1) Spain (1) Canada (1)	1998 (1) 2010 (2) 2012 (1) 2013 (4) 2014 (4) 2015 (5) 2016 (3) 2017 (4) 2018 (2)	5 × RCT ➔ 26,2 %	Esophagectomy	**Overall morbidity** No significant difference. **Postoperative Mortality** No significant difference. **LOS** Out of 26 studies, 24 examined differences in LOS, and on average, it is significantly shorter with pathway management. **Anastomotic leaks** No significant difference. **Pulmonary complications** This was examined in 17 out of 26 studies and is significant less frequent with pathway management. **Readmission** No significant difference.	Overall study quality was moderate.	0,8

surveys in 2019, such as for patients undergoing coronary angiography, stent placement, or balloon dilation of heart vessels (IQTIG 2020). The increasing use of Patient Reported Outcome Measures (PROMs) also shows that the subjective health status is gaining relevance (Manteuffel 2020). Thus, future outcome measurements on the effectiveness of clinical pathways could be more patient-centered and include the satisfaction with treatment quality from the patient's perspective.

Study quality

The quality assessment using AMSTAR indicates that the quality of the included articles is high. The results reveal a median score of 0.85. However, only a quarter (24.3%) of the studies, which are included in the systematic reviews and meta-analysis adopted a study design that corresponds to the gold standard of randomized controlled trials. Furthermore, the results of this study suggest that an investigation of the effects of clinical pathways at the outcome level, as conducted by Rotter et al. (2010), increases the likelihood of obtaining better results because it increases the variation in study interventions. Limiting the analysis to specific pathways or specific interventions restricts the selection from the beginning, reducing the possibility of including a sufficient number of studies. The results of this study can indicate the positive effects of clinical treatment pathways, but they also highlight the need for more research in this area with appropriate research models to obtain valid results.

Limitations

This umbrella study has some limitations. It did not search for unpublished literature. Inclusion and exclusion criteria cannot be totally applied. For example, one inclusion criterion is that studies from industrialized countries are included. However, some of the included studies in the meta-analysis and systematic reviews also involve studies from non-industrialized countries but only to a limited extent. In addition to PubMed, Cochrane Review, and MEDLINE, the EMBASE database could have been searched as well. It has only a small overlap with MEDLINE, which would enhance the overall quality of the search.

Conclusion

This comprehensive umbrella review demonstrates a positive impact of clinical pathways, including a reduced risk of complications, reduced length of stay and a better documentation quality. However, the lack of standardized definitions for clinical pathways, differences in healthcare systems, the long time span between the first and last included primary studies examining outcomes, and especially the frequently used but unsuitable study designs all contribute to this work showing that the effects of clinical pathways cannot be sufficiently proven for direct application in the current healthcare context. Even though the results presented in the studies may overestimate the effectiveness of clinical pathways, they do suggest that pathways offer the potential for added value for patients, healthcare professionals, and families of patients. The introduction of pathways is particularly suitable for medical conditions that are highly prevalent, costly, and require extensive communication among various healthcare professionals.

Furthermore, another important result of this work is that further research with randomized controlled trials is essential to investigate the effects of clinical pathways. To not only evaluate the effects of clinical pathways in the future but also to compare different pathways to determine which is better for the same interventions, it is crucial to establish a common definition of clinical treatment pathways that includes minimum criteria. This will enable the comparison of different pathways in the future to decide which pathway is best for the same intervention. The ongoing digitalization of healthcare, e.g., in terms of implementing process mining tools, will undoubtedly support the management of clinical pathways for all stakeholders (Munoz-Gama et al. 2022). Moreover, this may also enhance the acceptance of using pathways and the possibilities for evaluation.

Authors' contributions AB carried out the systematic research for articles with searching, screening and selecting the articles and rated the quality with AMSTAR. JK conducted the systematic research in the databases as well. Both authors discussed content and structure of results and discussion sections. AB wrote the paper.

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