Finnish Journal of eHealth and eWelfare

SCIENTIFIC PAPERS

VERTAISARVIOITU
KOLLEGIALT GRANSKAD
PEER-REVIEWED
www.tsv.fi/tunnus

Technological maturity model for digital decision support systems in mental healthcare: A scoping review comparing the Finnish Therapy Navigator services to international alternatives

Tino Karolaakso[1,3], Kasperi Mikkonen[2,3], Tiina Tantarimäki[3], Samuli Saarni[3,4,5]

[1] Faculty of Social Sciences, Tampere University, Tampere, Finland; [2] University of Helsinki, Helsinki, Finland; [3] HUS Psychiatry, Helsinki, Finland; [4] Faculty of Medicine and Health Technology, Tampere University, Tampere, Finland; [5] Pirkanmaa Wellbeing services county (Pirha), Tampere, Finland

Tino Karolaakso, PhD, Faculty of Social Sciences, Tampere University, FI-33014 Tampere University, FINLAND. Email: tino.karolaakso@gmail.com

Abstract

Mental disorders are among the leading causes of disability worldwide, creating an increasing demand for timely and effective mental healthcare. Digital decision support systems (DDSS) have emerged as promising tools for enhancing the assessment and treatment navigation of mental disorders. This review examines the international development and maturity levels of DDSS in mental healthcare. The objective is to identify recent systems, analyze their key features, and propose a technological maturity model for these systems, while comparing them to the Finnish Therapy Navigator (FTN) services.

The study used a scoping review methodology to map the existing literature and identify relevant DDSS. The review was conducted in accordance with the PRISMA extension for scoping reviews (PRISMA-ScR) guidelines. A framework for a technological maturity model was developed through a thematic analysis of findings based on the prevalence, complexity, and clinical utility of system features, comparing functional features across systems to identify emerging patterns in technological sophistication.

A total of 35 studies on adult DDSS and 38 studies on adolescent DDSS met the inclusion criteria, of which 10 distinct DDSS were identified for adults and 9 for adolescents, with one system designed for both groups. The most prevalent features included multi-disorder screening (100%), summary report generation (100%), and contextual factor mapping (65%). Less common but potentially more advanced features included automated treatment recommendations (35%), response-based therapeutic content (20%), and AI-driven capabilities such as chatbot with natural language processing and probabilistic reasoning (5%).

Based on the prevalence and perceived clinical utility of these features, we propose a three-tiered technological maturity model to classify DDSS for mental healthcare assessment and treatment navigation: 1) structured data collection, 2) rule-based decision support, and 3) intelligent and adaptive decision support. FTN services fall within the first maturity level, as they primarily facilitate structured assessments without automated treatment recommendations. The proposed model highlights the transition from

passive tools to interactive systems and to intelligent and adaptive platforms. The development of mental healthcare DDSS is still in its early stages, with significant potential for future advancements.

Keywords: mental disorders, digital health technology, clinical decision support systems, self-assessment, access to treatment, AI (artificial intelligence)

Introduction

Mental disorders are among the most prevalent health concerns globally and a leading cause of disability [1]. Although effective treatments for mental disorders are well-researched, access to care remains insufficient globally [2,3]. Key challenges in providing public mental health services (MHS) relate to the functionality of treatment processes: issues such as limited availability of professionals, resource constraints, long waiting times, challenges in identifying and diagnosing disorders, and the suboptimal implementation of evidence-based treatments are primarily systemic rather than purely clinical problems [4,5]. Addressing the increasing demand for MHS solely by expanding resources is not a viable solution in Finland. Instead, optimizing treatment processes to minimize systemic inefficiencies and enhance the effectiveness of timely interventions is essential. This can be achieved through innovative, cost-effective, and scalable process optimization solutions [6].

The success of care pathways depends, in part, on effective initial assessments. If assessing the need for psychological treatment and treatment navigation fails, both the quality and scalability of care suffer. Consequently, there has been significant global progress in adopting digital decision support systems (DDSS) to aid in assessing and guiding the treatment of mental disorders [6–8]. DDSS are computer-based systems that integrate information from multiple sources, facilitating data organization and analysis to support clinical decision making [9]. In practice, they provide patients with online self-assessments prior to healthcare visits while offering healthcare providers structured information and decision-making support to aid in assessing the patient's situation.

DDSS offer several advantages, including improved accuracy in disorder identification, reduced inter-assessor variability, and enhanced efficiency in professional workflows by automating tasks such as questionnaire administration and data transfer between systems [6,10–12]. Self-assessment measures integrated into DDSS have been found to be as acceptable as clinician-administered interviews [13]. Furthermore, digital self-assessment tools appear to facilitate the disclosure of personal concerns, particularly among younger populations [14,15]. In Finland, the First-Line Therapies Initiative, implemented through national collaboration between university hospitals and wellbeing service counties, has developed two DDSS: the Finnish Therapy Navigator (FTN), designed for adults, and the Intervention Navigator for Young People (collectively referred to as the FTN services) [16]. The Children's Intervention Navigator is currently in its pilot phase. Implemented nationwide, the FTN services supported the assessment of approximately 120,000 individuals in 2024. As pre-assessment tools, the FTN services incorporate standardized self-assessment measures recommended by Finnish Current Care Guidelines and other expert bodies. They focus on common mental disorders such as depression, anxiety, and stress-related conditions while also collecting relevant treatment-planning information, including social determinants, prior treatment history, and treatment preferences.

The evolution of digital systems is often described using maturity models, which outline progressive technological advancement [17]. However, no widely accepted models exist for assessing DDSS maturity in mental healthcare. To our knowledge, only one such model has been proposed, focusing on implementation rather than technological maturity [9]. While this model is connected to a broader DDSS framework which covers various aspects of DDSS, the framework still omits certain system features described in the literature. Thus, this study aims to complement previous work by summarizing additional system features and developing a framework for technological maturity levels. Establishing such a framework improves understanding of both the broader trajectory of DDSS development and the potential for improving individual systems.

This scoping review examines international research on DDSS for mental healthcare. The objective is to identify recent systems, analyse their key features, and formulate a technological maturity model to classify these systems based on feature prevalence and perceived clinical utility. We hypothesize that lower-maturity features are more common due to their easier implementation, although systems within the same maturity level may vary in specific functionalities.

The research questions guiding this study are: i) What DDSS for mental healthcare, comparable to the FTN services, have been developed and studied? ii) What features do these systems encompass? iii) Can a simple framework of technological maturity levels be delineated based on these features, iv) How do the FTN services compare?

Material and methods

The design of this study is scoping review, which was conducted following the PRISMA extension for scoping reviews (PRISMA-ScR) guidelines [18]. The study used a scoping review methodology to map the breadth and depth of existing literature to identify relevant contemporary DDSS and the available evidence for their support. Supplementary Material 1 provides the PRISMA-ScR checklist. No review protocol was preregistered. The inclusion criteria for this review were as follows: i) the study was an original research article or a systematic literature review published in a peer-reviewed journal, ii) the publication was in Finnish or English, iii) the described system was designed for adults or adolescents, iv) the system supported healthcare assessment and/or treatment navigation, v) the system assisted in the evaluation and identification of mental disorders. Exclusion criteria included: i) systems that did not assess common mental disorders, including depression, anxiety and stress-related disorders, and ii) systems intended for other purposes than initial assessment for treatment (e.g., systems focusing on physiological measurements or Ecological Momentary Assessment EMA).

Systematic searches were conducted in the Cochrane, Ovid MedLine, PsycINFO, and Scopus databases separately for adult and adolescent DDSS (Supplementary Material 2). The search for adult DDSS was conducted in July 2023, and the search for adolescent DDSS in October 2023, covering publications from 2018 to 2023 to focus on recent research. A system met the inclusion criteria if it had been evaluated in a study or systematic review published during this period. Any duplicate studies extracted via systematic reviews but already identified by the literature search were excluded during the screening phase of the review. Additional manual searches were conducted based on reference lists and recent citations, with updates made in June 2024 to identify newly published articles. Older references (pre-2018) were included if they provided relevant foundational information on a

given system. Systematic reviews were analysed together with the original studies to identify all relevant DDSS and thus were complementarily used to identify any articles missed by the original literature search.

The search for adult DDSS yielded 3,832 articles. After removing duplicates, 2,265 remained, of which 133 were selected for further review based on abstracts. The search for adolescent DDSS resulted in 1,295 articles, leaving 829 after duplicate removal, with 88 selected for further analysis. The study review process is described in Figure 1 flowchart. Author TK screened and reviewed the articles. Any ambiguities were resolved through discussions among the authors.

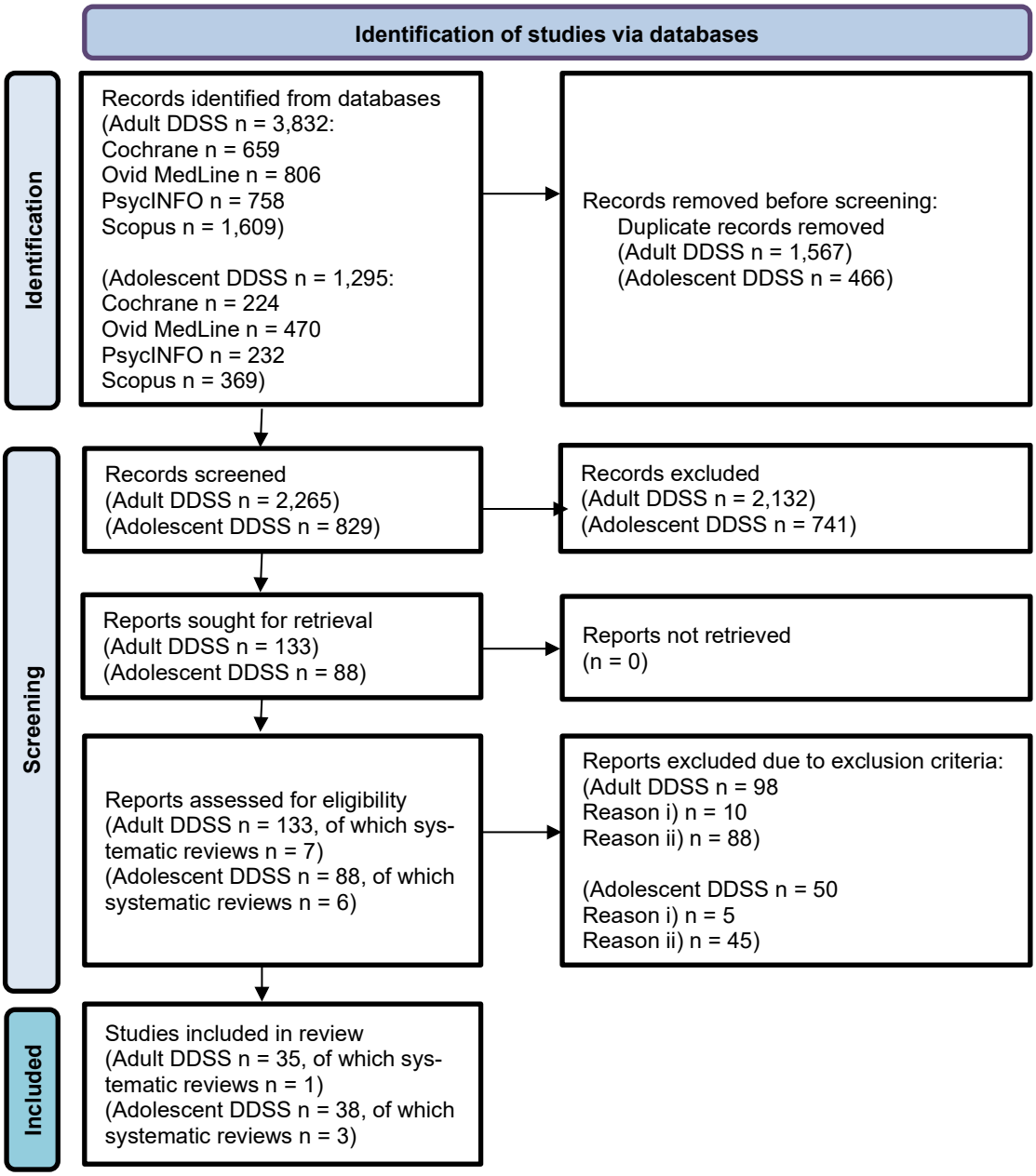

Figure 1. PRISMA flowchart.

No widely used and accepted model exists in the literature for describing the features of DDSS for mental healthcare, although these aspects have been extensively discussed in systematic reviews and user experience analyses [5,6,9,19,20]. From these previous studies, the most common and prominent features related to technology and integration in health care were mapped and selected to evaluate technological maturity in this study, altogether encompassing 15 features: digitalization of standardized symptom measures [6,19], mapping of contextual factors (e.g., life circumstances, social determinants) [6,19], screening for multiple disorders [5,6,19], adaptability (i.e., questions are partially based on previous responses to improve accuracy and time efficiency) [6], customizability for different clinical settings [5], summary reports [5,20], diagnosis recommendations, treatment recommendations, or recommendations for therapeutic content (e.g., self-help programs, psychoeducation), [5,9,19,20], direct digital submission of responses to healthcare providers [20], stepped-care treatment navigation [5,19,20], treatment effectiveness monitoring [5,9,19,20], machine learning with pattern recognition [9] and artificial intelligence (AI)-based capabilities in input and processing: AI-based chatbot with natural language processing and AI-driven probabilistic reasoning [9].

A framework for a technological maturity model was developed through a thematic analysis of findings from the scoping review [20-22]. Each identified study was examined, and the features of each device were documented in a separate table. In cases where the information was unclear or ambiguous, publicly available sources, such as the DDSS websites or publishers' presentations, were consulted. Functional features were compared across systems to identify patterns in technological sophistication. The thematic synthesis was based on the prevalence, complexity, and clinical utility of these features, with the aim of forming a simple framework with a limited number of maturity levels, allowing the model to emerge organically from the data. The number and names of the maturity levels were finalized collaboratively by all authors using the compiled information.

Results

A total of 35 studies on adult DDSS and 38 studies on adolescent DDSS met the inclusion criteria (Supplementary Material 3). From these studies one systematic review was identified for adult DDSS and three for adolescent DDSS [6,15,19,23]. In total, 10 distinct DDSS were identified for adults [4,24–32] and 9 for adolescents 33–41], with one system designed for both groups [29]. Two manufacturers provided separate system versions for adults and adolescents [24,30,33,34]. A summary of the identified systems is presented in Table 1, while Supplementary Material 4 details the mental disorders assessed by each system.

Table 2 describes the features of the identified DDSS and compares the FTN services with the identified DDSS. The most common features included multi-disorder screening (100%), summary report generation (100%), and the mapping of contextual factors alongside symptom measures (65%). In contrast, integrated AI capabilities were the least common features, present in only one system (5%). The number of features per system ranged from three to ten, with a gradual decline in feature prevalence across systems.

Table 1. Digital decision support systems in mental healthcare.

Device	Manufacturer /Publisher	Age Group	Description
Finnish Therapy Navigator (14)	HUS Group	Adults	A digital pre-assessment form, supporting initial mental health evaluations and treatment guidance for healthcare professionals. Uses standardized symptom questionnaires.
Computerized Adaptive Testing-Mental Health (CAT-MH) (20)	Adaptive Testing Technologies	Adults	A computer-adaptive screening and diagnostic support tool with over 1,500 questions. Used in primary care for large-scale screening and monitoring of depression and anxiety.
Electronic Psychological Assessment and Screening System (e-PASS) (21)	Swinburne University of Technology	Adults	A digital assessment platform with 500+ questions. Integrates with Australia's Mental Health Online system, recommending digital interventions based on responses.
Connected Mind Fast Check (CMFC) Electronic Screen (2)	Connected Mind	Adults	A digital screening tool using an initial set of questions followed by disorder-specific modules. Used in U.S. primary care with insurance reimbursement eligibility.
The symptom checker ADA (22)	Ada Health GmbH	Adults	AI-based chatbot that dynamically assesses symptoms using a large medical database. Supports professionals in early screening and diagnostic decisions.
The Trier Treatment Navigator (23)	University of Trier	Adults	A digital assessment tool for the beginning of psychotherapy, providing recommendations on treatment strategies such as problem-solving therapy or motivational enhancement.
Link-Me Decision Support Tool (24)	University of Melbourne	Adults	A 23-item assessment tool (including PHQ-9 and GAD-7) categorizing patients into low, moderate, or high-risk groups with corresponding treatment recommendations.
InnoWell Platform (25)	Innowell	Adults and adolescents	A stepped-care digital support platform that assists professionals in optimizing treatment pathways based on screening and assessment outcomes.
StepCare Service (26)	Black Dog Institute	Adults	A brief screening and assessment tool delivered via QR code in clinical settings. Categorizes individuals based on symptom severity, provides tailored treatment recommendations and assists professionals in stepped care treatment coordination.
Electronic Mental Wellness Tool (E-mwTool) (27)	Columbia University Medical Center	Adults	A 13-item digital screening and assessment tool designed for early identification of mental disorders and intervention planning within a stepped-care model.
My Mood Monitor (M-3) Checklist (28)	M3 Information	Adults	A 27-item online self-assessment tool for primary care, aimed at reducing underdiagnosis and improving access to treatment.
Intervention Navigator for Young People	HUS Group	13–19 years	A digital pre-assessment tool for mental health professionals and school health services. Includes a separate caregiver assessment module.
Kiddie–Computerized Adaptive Tests (K-CATs) (29)	Adaptive Testing Technologies	7–17 years	A child and adolescent mental health screening tool that adapts questions based on age. Combines self-assessments and parental input. Used in primary care, schools, and child welfare.
Youth StepCare (30)	Black Dog Institute	14–17 years	A youth-specific digital screening tool using PHQ-9 and GAD-7 to assess depression and anxiety severity, providing evidence-based treatment recommendations.

The Development and Well-Being Assessment Online (DAWBA) (31)	Youthinmind	5–17 years	A digital diagnostic tool that suggests DSM-5, DSM-IV, or ICD-10 mental disorder diagnoses based on responses from youth, parents, and teachers. Used for the base for clinical assessment and epidemiological research.
The Behavioral Health Screen (BHS) (32)	Children's Hospital of Philadelphia	Adolescents	A multi-domain screening tool assessing demographics, general health, family dynamics, and mental health symptoms using 61 core questions and 46 follow-ups.
DartScreen (33)	Dartmouth-Hitchcock Pediatrics	11–19 years	A pre-visit self-assessment tool aiming improve clinical decision-making. Uses 65 core questions and adaptively 94 questions in total, including e.g., PHQ-9, GAD-2, and a suicide risk assessment module.
YouthCHAT (34)	Kekeno Tech	13–17 years	A digital self-assessment tool for youth mental health screening in New Zealand, integrated with the HEEADSSS model and stepped care.
MyHEARTSMAP (35)	University of British Columbia	10–17 years	A psychosocial assessment tool for youth and their families in healthcare settings. Provides algorithm-based service recommendations.
Computerized Kiddie Schedule for Affective Disorders and Schizophrenia for school-age children (KSADS-COMP) (36)	KSADS-COMP Inc.	Adolescents	A web-based psychiatric diagnostic tool based on KSADS. Includes clinician-administered, self-report, and parent-report versions. Integrates assessment of family and contextual factors.
Screening Wizard (SW) 2.0 (37)	University of Pittsburgh School of Medicine	12–26 years	A screening tool integrating e.g., PHQ-9, GAD-7, and treatment readiness measures. Designed to assist primary care providers in identifying depression and suicide risk.

Table 2. Features of digital assessment and treatment decision support systems.

Maturity Level	Feature	The symptom checker ADA	InnoWell Platform	CAT-MH	KSADS-COMP	K-CAT	Link-Me DST	StepCare Service	Trier Treatment Navigator	The Finnish Therapy Navigator Services	e-PASS	Online DAWBA	Screening Wizard 2.0	Youth StepCare	DartScreen	YouthCHAT	BHS	CMFC Electronic Screen	MyHEARTSMAP	M-3 Checklist	E-mwTool	Total number of DDSS with feature	Percentage of DDSS with feature
1) Structured data collection	Screening for multiple mental disorders	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	100%
	Summary report	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	100%
	Mapping of contextual factors	X	X	X	X		X	X	X	X	X		X		X		X		X			13	65%
	Digitalization of standardized symptom measures		X		X		X	X	X	X			X	X	X	X						10	50%
	Adaptive questioning	X		X	X	X				X	X	X			X		X	X				10	50%
	Digital submission of responses to healthcare providers	X	X	X	X	X	X										X	X		X		9	45%
	Stepped-care treatment navigation		X				X	X		X		X		X		X					X	8	40%
2) Rule-based decision support	Response-based diagnostic recommendations	X		X	X	X					X	X						X				7	35%
	Response-based treatment recommendations	X	X				X	X	X				X	X								7	35%
	Treatment effectiveness monitoring		X	X		X		X	X													5	25%
	Customizability for different clinical settings		X	X	X	X																4	20%
	Response-based therapeutic content		X								X								X	X		4	20%
3) Intelligent and adaptive decision support	Machine learning with pattern recognition	X		X		X			X													4	20%
	AI-driven chatbot with natural language processing	X																				1	5%
	AI-driven probabilistic reasoning	X																				1	5%
	Total number of features in system	10	10	9	8	8	7	7	7	6	6	5	5	5	5	5	5	5	4	4	3		

Based on the prevalence and perceived clinical utility of key features, we propose a three-tiered technological maturity model to classify mental disorder assessment and treatment navigation DDSS: 1) Structured data collection, 2) Rule-based decision support, 3) Intelligent and adaptive decision support. The classification was informed by how frequently each feature appeared across the evaluated systems and how much utility it offered for sophisticated and automated decision-making. Lower-tier systems included functionalities that were commonly found and supported narrower aspects of decision-making, whereas higher-tier systems offered more refined technical implementations and broader, more advanced capabilities. The model is shown in Figure 2.

Technological Maturity Levels

1) Structured data collection

The first maturity level, structured data collection, includes basic DDSS that offer standardized assessments and summary reports with minimal automation. These systems provide fundamental self-assessment measures but lack personalized recommendations with rule-based decision-making.

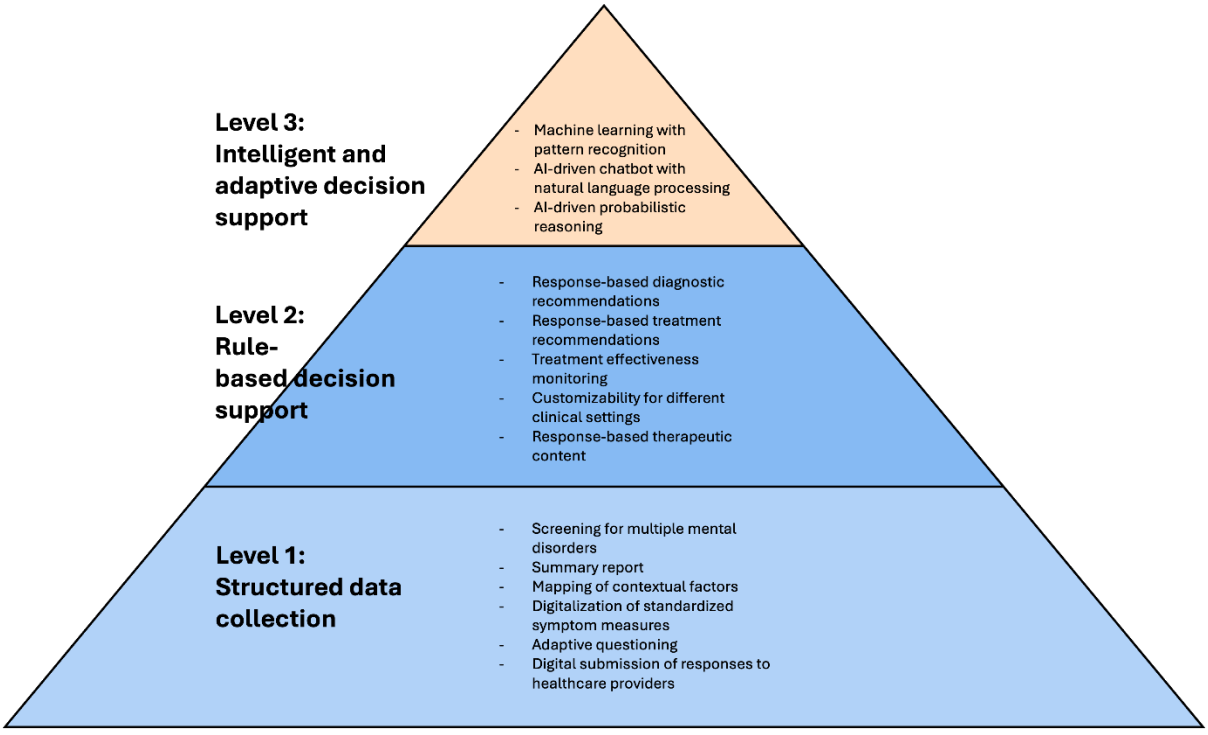

Figure 2. Technological maturity model for digital decision support systems (DDSS) in mental healthcare.

2) Rule-based decision support

The second maturity level, rule-based decision support, consists of systems that incorporate structured algorithms for diagnostic and treatment recommendations, linked to monitoring subsequent treatment effectiveness or recommending therapeutic content in some systems. 20% to 35% of DDSS included these features, which indicates a higher maturity level, as they enable structured decision pathways and provide evidence-based recommendations to both healthcare professionals and patients.

3) Intelligent and adaptive decision support

Third maturity level, intelligent and adaptive decision support, includes AI-enhanced systems that utilize machine learning, natural language processing, or probabilistic reasoning to dynamically personalize recommendations, surpassing rule-based decision support. However, only four DDSS (20%) included machine learning features, and just one system (5%) had cutting-edge built-in AI capabilities.

Discussion

This review identified 19 DDSS for the assessment and treatment navigation of mental disorders in adults and adolescents and compared them to the FTN services. Using these 19 DDSS and 15 device features, this review proposes a novel technological maturity model for DDSS in mental healthcare. The FTN services falls within the first category of structured data collection, incorporating six of the 15 key features as defined from the literature. Notably, these features were the most common among all systems. Each of the six features was found in at least 40% and up to 100% of the DDSS, reinforcing their classification within the first maturity level.

The second maturity level of rule-based decision support might be able improve accelerating treatment initiation, enhancing care personalization, and improving patient engagement compared to the first level. However, while automated recommendations can improve efficiency, clinician oversight in decision-making remains crucial to ensure clinical appropriateness and patient safety.

Third maturity level, intelligent and adaptive decision support, represents thus far the highest maturity for DDSS in this model, as they enable adaptive learning, real-time patient-specific decision-making, and continuous system improvement based on user interactions and feedback. Advances in AI will likely reshape DDSS by introducing bidirectional, natural language-driven data collection and improving recommendation precision through feedback-informed learning [42]. As these technologies evolve, they are expected to become more widely adopted in healthcare. However, this review identified published studies only for one DDSS with state-of-the-art AI capabilities. Furthermore, increasing system complexity will also introduce stricter regulatory requirements [43,44].

To the best of the authors' knowledge, the proposed technological maturity model is the first to systematically classify DDSS for mental healthcare based on their level of technological advancement. Existing digital maturity models have primarily been used to assess organizational readiness to adopt digital tools [17,45,46]. What is novel about this model is that it focuses on the inherent technological capabilities of the systems themselves. As such, previous models have not explicitly defined levels of technological sophistication. Notably, the three-tiered model proposed here shares conceptual similarities with the widely recognized stages in the evolution of the internet: Web 1.0 ("read-only", characterized by static information delivery), Web

2.0 ("read-write", marked by interactivity and user-generated content), and Web 3.0 ("read-write-execute", encompassing AI, automation, and decentralized systems) [47]. This analogy highlights the transition from passive tools to interactive systems and, ultimately, to intelligent and adaptive platforms.

Strengths, limitations, and future research

A key strength of this scoping review is its systematic literature search, which identified a broad range of DDSS for mental healthcare assessment and treatment navigation. By evaluating multiple system features, this review provides insights into the emerging maturity levels of these technologies. Another strength is the novel approach of synthesizing the identified DDSS into a technological maturity model, allowing for direct comparison of different systems.

This study also has several limitations. First, it relies on published literature rather than direct system evaluation, which may lead to incomplete or outdated representations of DDSS features. Ongoing system developments may introduce new functionalities not captured in the reviewed studies. Second, the literature review was performed by only one reviewer who carried out the screening and selection of studies. Third, some DDSS may not have been identified in the literature. Additionally, given the rapid development of AI and DDSS, some contemporary studies might have been published during the writing of this review. The literature search was last updated in June 2024, and due to resource constraints, it was not feasible to conduct an additional update in 2025. Fourth, quality assessment of reviewed studies was not performed due to this scoping review including studies with a wide range of research designs, which would have required the use of several different quality assessment instruments. Fifth, feature prevalence does not necessarily directly relate to technological advancement. Adoption of features may be influenced by regulatory constraints and integration feasibility. Moreover, rarer features could be experimental rather than inherently more mature.

Sixth, the proposed three-level maturity model provides a simplified classification to illustrate development trajectories and areas for improvement in DDSS. Alternative classifications may exist, and other technological advancements—such as passive data collection, psychophysiological measurements, or integration of different systems—could also drive DDSS evolution. Alternate maturity levels might include themes such as integration with existing care workflows, user engagement, and clinical effectiveness. Nonetheless, given the rapid advancements in AI, it is likely to also influence the developments of these other domains.

Future research should evaluate the comparative effectiveness of different maturity levels and features in improving clinical outcomes and patient engagement. The model presented here also serves as an important foundation for examining future developments. It can be utilized to advance new conceptual frameworks in which the AI developments described in the third category of the model constitute a more central focus.

Conclusion

This review highlights the evolving landscape of DDSS and proposes a structured and transparent technological maturity model, offering a clear framework for categorizing system capabilities. Based on the findings, the FTN services fall within the first maturity level, characterized by structured digital data collection as a decision support tool. The FTN services present an interesting comparator technology, as they are — to our knowledge — by far the most widely used of all the systems

identified in this review. A logical next step in its development could involve the integration of advanced features, such as evidence-based recommendations, to enhance both professional decision-making and patient engagement while ensuring that final treatment decisions remain under the clinical judgment of healthcare professionals. Due to regulatory constraints, AI is likely to be adopted more rapidly for data collection and analysis than for individualized treatment recommendations. Nevertheless, the development of mental healthcare DDSS remains in its early stages, with significant potential for future advancements.

Conflict of interest

All authors have been involved in the development of the FTN services at the Department of Psychiatry, Helsinki University Hospital (HUS Group).

Funding

This research was funded by European Union RRP grants for the development of the First-Line Therapies services, including the FTN services.

References

[1] GBD 2019 Mental Disorders Collaborators. Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Psychiatry. 2022 Feb;9(2):137-150. https://doi.org/10.1016/S2215-0366(21)00395-3

[2] Alonso J, Liu Z, Evans-Lacko S, Sadikova E, Sampson N, Chatterji S, Abdulmalik J, Aguilar-Gaxiola S, Al-Hamzawi A, Andrade LH, Bruffaerts R, Cardoso G, Cia A, Florescu S, de Girolamo G, Gureje O, Haro JM, He Y, de Jonge P, Karam EG, Kawakami N, Kovess-Masfety V, Lee S, Levinson D, Medina-Mora ME, Navarro-Mateu F, Pennell BE, Piazza M, Posada-Villa J, Ten Have M, Zarkov Z, Kessler RC, Thornicroft G; WHO World Mental Health Survey Collaborators. Treatment gap for anxiety disorders is global: Results of the World Mental Health Surveys in 21 countries. Depress Anxiety. 2018 Mar;35(3):195-208. https://doi.org/10.1002/da.22711

[3] Santomauro DF, Vos T, Whiteford HA, Chisholm D, Saxena S, Ferrari AJ. Service coverage for major depressive disorder: estimated rates of minimally adequate treatment for 204 countries and territories in 2021. Lancet Psychiatry. 2024 Dec;11(12):1012-1021. https://doi.org/10.1016/S2215-0366(24)00317-1

[4] Rogers R, Hartigan SE, Sanders CE. Identifying Mental Disorders in Primary Care: Diagnostic Accuracy of the Connected Mind Fast Check (CMFC) Electronic Screen. J Clin Psychol Med Settings. 2021 Dec;28(4):882-896. https://doi.org/10.1007/s10880-021-09820-1

[5] Funnell EL, Spadaro B, Martin-Key NA, Benacek J, Bahn S. Perception of Apps for Mental Health Assessment with Recommendations for Future Design: United Kingdom Semistructured Interview Study. JMIR Form Res. 2024 Feb 23;8:e48881. https://doi.org/10.2196/48881

[6] Martin-Key NA, Spadaro B, Funnell E, Barker EJ, Schei TS, Tomasik J, Bahn S. The Current State and Validity of Digital Assessment Tools for Psychiatry: Systematic Review. JMIR Ment Health. 2022 Mar 30;9(3):e32824. https://doi.org/10.2196/32824

[7] Cuijpers P, Boluijt P, van Straten A. Screening of depression in adolescents through the Internet:

sensitivity and specificity of two screening questionnaires. Eur Child Adolesc Psychiatry. 2008 Feb;17(1):32-8. https://doi.org/10.1007/s00787-007-0631-2

[8] Farvolden P, McBride C, Bagby RM, Ravitz P. A Web-based screening instrument for depression and anxiety disorders in primary care. J Med Internet Res. 2003 Jul-Sep;5(3):e23. https://doi.org/10.2196/jmir.5.3.e23

[9] Bertl M, Metsallik J, Ross P. A systematic literature review of AI-based digital decision support systems for post-traumatic stress disorder. Front Psychiatry. 2022 Aug 9;13:923613. https://doi.org/10.3389/fpsyt.2022.923613

[10] Fairburn CG, Patel V. The impact of digital technology on psychological treatments and their dissemination. Behav Res Ther. 2017 Jan;88:19-25. https://doi.org/10.1016/j.brat.2016.08.012

[11] Jeffrey J, Do MT, Hajal N, Lin YH, Linonis R, Grossman MS, Lester PE. Using web-based technology to improve depression screening in primary care settings. BMJ Open Qual. 2021 Feb;10(1):e001028. https://doi.org/10.1136/bmjoq-2020-001028

[12] Whitton AE, Hardy R, Cope K, Gieng C, Gow L, MacKinnon A, Gale N, O'Moore K, Anderson J, Proudfoot J, Cockayne N, O'Dea B, Christensen H, Newby JM. Mental Health Screening in General Practices as a Means for Enhancing Uptake of Digital Mental Health Interventions: Observational Cohort Study. J Med Internet Res. 2021 Sep 16;23(9):e28369. https://doi.org/10.2196/28369

[13] Thabrew H, D'Silva S, Darragh M, Goldfinch M, Meads J, Goodyear-Smith F. Comparison of YouthCHAT, an Electronic Composite Psychosocial Screener, With a Clinician Interview Assessment for Young People: Randomized Controlled Trial. J Med Internet Res. 2019 Dec 3;21(12):e13911. https://doi.org/10.2196/17339

[14] Bradford S, Rickwood D. Psychosocial assessments for young people: a systematic review examining acceptability, disclosure and engagement, and predictive utility. Adolesc Health Med Ther. 2012 Dec 21;3:111-25. https://doi.org/10.2147/AHMT.S38442

[15] Martel R, Shepherd M, Goodyear-Smith F. Implementing the routine use of electronic mental health screening for youth in primary care: Systematic review. JMIR Ment Health. 2021 Nov 19;8(11):e30479. https://doi.org/10.2196/30479

[16] Saarni SI, Nurminen S, Mikkonen K, Service H, Karolaakso T, Stenberg JH, Ekelund J, Saarni S. The Finnish Therapy Navigator - digital support system for introducing stepped care in Finland. Psychiatr Fenn. 2022;53:120-137.

[17] Gomes J, Romão M. Information system maturity models in healthcare. J Med Syst. 2018 Oct 16;42(12):235. https://doi.org/10.1007/s10916-018-1097-0

[18] Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, Moher D, Peters MDJ, Horsley T, Weeks L, Hempel S, Akl EA, Chang C, McGowan J, Stewart L, Hartling L, Aldcroft A, Wilson MG, Garritty C, Lewin S, Godfrey CM, Macdonald MT, Langlois EV, Soares-Weiser K, Moriarty J, Clifford T, Tunçalp Ö, Straus SE. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med. 2018 Oct 2;169(7):467-473. https://doi.org/10.7326/M18-0850

[19] van Venrooij LT, Rusu V, Vermeiren RRJM, Koposov RA, Skokauskas N, Crone MR. Clinical decision support methods for children and youths with mental health disorders in primary care. Fam Pract.

2022 Nov 22;39(6):1135-1143. https://doi.org/10.1093/fampra/cmac051

[20] Funnell EL, Spadaro B, Martin-Key N, Metcalfe T, Bahn S. mHealth solutions for mental health screening and diagnosis: a review of app user perspectives using sentiment and thematic analysis. Front Psychiatry. 2022 Apr 27;13:857304. https://doi.org/10.3389/fpsyt.2022.857304

[21] Thomas J, Harden A. Methods for the thematic synthesis of qualitative research in systematic reviews. BMC Med Res Methodol. 2008 Jul 10;8:45. https://doi.org/10.1186/1471-2288-8-45

[22] Segur-Ferrer J, Moltó-Puigmartí C, Pastells-Peiró R, Vivanco-Hidalgo RM. Methodological frameworks and dimensions to be considered in digital health technology assessment: Scoping review and thematic analysis. J Med Internet Res. 2024 Apr 10;26:e48694. https://doi.org/10.2196/48694

[23] Glasner J, Baltag V, Ambresin AE. Previsit multidomain psychosocial screening tools for adolescents and young adults: A systematic review. J Adolesc Health. 2021 Mar;68(3):449-459. https://doi.org/10.1016/j.jadohealth.2020.10.003

[24] Achtyes ED, Halstead S, Smart L, Moore T, Frank E, Kupfer DJ, Gibbons R. Validation of Computerized Adaptive Testing in an Outpatient Nonacademic Setting: The VOCATIONS Trial. Psychiatr Serv. 2015 Oct;66(10):1091-6. https://doi.org/10.1176/appi.ps.201400390

[25] Nguyen DP, Klein B, Meyer D, Austin DW, Abbott JAM. The diagnostic validity and reliability of an Internet-based clinical assessment program for mental disorders. J Med Internet Res. 2015 Sep 21;17(9):e218. https://doi.org/10.2196/jmir.4195

[26] Hennemann S, Kuhn S, Witthöft M, Jungmann SM. Diagnostic performance of an app-based symptom checker in mental disorders: Comparative study in psychotherapy outpatients. JMIR Ment Health. 2022 Jan 31;9(1):e32832. https://doi.org/10.2196/32832

[27] Lutz W, Rubel JA, Schwartz B, Schilling V, Deisenhofer AK. Towards integrating personalized feedback research into clinical practice: Development of the Trier Treatment Navigator (TTN). Behav Res Ther. 2019 Sep;120:103438. https://doi.org/10.1016/j.brat.2019.103438

[28] Fletcher S, Spittal MJ, Chondros P, Palmer VJ, Chatterton ML, Densley K, Potiriadis M, Harris M, Bassilios B, Burgess P, Mihalopoulos C, Pirkis J, Gunn J. Clinical efficacy of a Decision Support Tool (Link-me) to guide intensity of mental health care in primary practice: a pragmatic stratified randomised controlled trial. Lancet Psychiatry. 2021 Mar;8(3):202-214. https://doi.org/10.1016/S2215-0366(20)30517-4

[29] Davenport TA, LaMonica HM, Rowe S, Sturgess J, Scott EM, Lee G, Cheng VWS, Hickie IB. Innovative preclinic triage system to guide Australians to the right mental health care first time. Aust Health Rev. 2021 Jun;45:578-583. https://doi.org/10.1071/AH20233

[30] Anderson J, O'Moore K, Faraj M, Proudfoot J. Stepped care mental health service in Australian primary care: Co-design and feasibility study. Aust Health Rev. 2020 Dec;44(6):873-879. https://doi.org/10.1071/AH19078

[31] Martinez-Nicolas I, Basaraba C, Delgado-Gomez D, Lopez-Fernandez O, Baca-Garcia E, Wainberg ML. The Electronic Mental Wellness Tool as a self-administered brief screening instrument for mental disorders in the general Spanish population during the post-COVID-19 era. Int J Environ Res Public Health. 2023 Feb 11;20(4):3204. https://doi.org/10.3390/ijerph20043204

[32] Gaynes BN, DeVeaugh-Geiss J, Weir S, Gu H, MacPherson C, Schulberg HC, Culpepper L, Rubinow DR. Feasibility and diagnostic validity of the M-3 checklist: a brief, self-rated screen for depressive, bipolar, anxiety, and post-traumatic stress disorders in primary care. Ann Fam Med. 2010 Mar-Apr;8(2):160-9. https://doi.org/10.1370/afm.1092

[33] Gibbons RD, Kupfer DJ, Frank E, Lahey BB, George-Milford BA, Biernesser CL, Porta G, Moore TL, Kim JB, Brent DA. Computerized Adaptive Tests for Rapid and Accurate Assessment of Psychopathology Dimensions in Youth. J Am Acad Child Adolesc Psychiatry. 2020 Nov;59(11):1264-1273. https://doi.org/10.1016/j.jaac.2019.08.009

[34] Parker BL, Achilles MR, Subotic-Kerry M, O'Dea B. Youth StepCare: A pilot study of an online screening and recommendations service for depression and anxiety among youth patients in general practice. BMC Fam Pract. 2020 Jan 7;21(1):2. https://doi.org/10.1186/s12875-019-1071-z

[35] Goodman R, Ford T, Richards H, Gatward R, Meltzer H. The development and well-being assessment: Description and initial validation of an integrated assessment of child and adolescent psychopathology. J Child Psychol Psychiatry. 2000 Jul;41(5):645-55. https://doi.org/10.1111/j.1469-7610.2000.tb02345.x

[36] Diamond G, Levy S, Bevans KB, Fein JA, Wintersteen MB, Tien A, Creed T. Development, validation, and utility of internet-based, behavioral health screen for adolescents. Pediatrics. 2010 Jul;126(1):e163-70. https://doi.org/10.1542/peds.2009-3272

[37] Gadomski AM, Fothergill KE, Larson S, Wissow LS, Winegrad H, Nagykaldi ZJ, Olson AL, Roter DL. Integrating mental health into adolescent annual visits: impact of previsit comprehensive screening on within-visit processes. J Adolesc Health. 2015 Mar;56(3):267-73. https://doi.org/10.1016/j.jadohealth.2014.11.011

[38] Goodyear-Smith F, Martel R, Darragh M, Warren J, Thabrew H, Clark TC. Screening for risky behaviour and mental health in young people: The YouthCHAT programme. Public Health Rev. 2017 Oct 13;38:20. https://doi.org/10.1186/s40985-017-0068-1

[39] Virk P, Laskin S, Gokiert R, Richardson C, Newton M, Stenstrom R, Wright B, Black T, Doan Q. MyHEARTSMAP: development and evaluation of a psychosocial self-assessment tool, for and by youth. BMJ Paediatr Open. 2019 Jul 24;3(1):e000493. https://doi.org/10.1136/bmjpo-2019-000493

[40] Townsend L, Kobak K, Kearney C, Milham M, Andreotti C, Escalera J, Alexander L, Gill MK, Birmaher B, Sylvester R, Rice D, Deep A, Kaufman J. Development of Three Web-Based Computerized Versions of the Kiddie Schedule for Affective Disorders and Schizophrenia Child Psychiatric Diagnostic Interview: Preliminary Validity Data. J Am Acad Child Adolesc Psychiatry. 2020 Feb;59(2):309-325. https://doi.org/10.1016/j.jaac.2019.05.009

[41] Radovic A, Coren MA, Wecht S, Hazebrook T, Laporte M, George-Milford B, Lindhiem O. Detecting and managing adolescent depression in primary care: A pilot randomized controlled trial. Procedia Comput Sci. 2022 Jan 1;206:81-91. https://doi.org/10.1016/j.procs.2022.09.087

[42] Bickman L. Improving mental health services: A 50-year journey from randomized experiments to artificial intelligence and precision mental health. Adm Policy Ment Health. 2020 Sep;47(5):795-843. https://doi.org/10.1007/s10488-020-01065-8

[43] Niemiec E. Will the EU Medical Device Regulation help to improve the safety and performance of medical AI devices? Digit Health. 2022 Mar

30;8:20552076221089079. https://doi.org/10.1177/20552076221089079

[44] Busch F, Kather JN, Johner C, Moser M, Truhn D, Adams LC, Bressem KK. Navigating the European Union Artificial Intelligence Act for Healthcare. NPJ Digit Med. 2024 Aug 12;7(1):210. https://doi.org/10.1038/s41746-024-01213-6

[45] Jansen-Kosterink S, Broekhuis M, van Velsen L. Time to act mature-Gearing eHealth evaluations towards technology readiness levels. Digit Health. 2022 Jul 11;8:20552076221113396. https://doi.org/10.1177/20552076221113396

[46] Woods L, Eden R, Pearce A, Wong YC, Jayan L, Green D, McNeil K, Sullivan C. Evaluating digital health capability at scale using the digital health indicator. Appl Clin Inform. 2022 Oct;13(5):991-1001. https://doi.org/10.1055/s-0042-1757554

[47] Wan S, Lin H, Gan W, Chen J, Yu PS. Web3: The next internet revolution. IEEE Internet Things J. 2024 Oct 25;11(21):34811-34825. https://doi.org/10.1109/JIOT.2024.3432116