

Personalised digital care pathways enable enhanced patient management as perceived by healthcare professionals: a mixed-methods study

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Abstract

Background: Clinical decision support systems (CDSS) are known to improve adherence to clinical practice guidelines and patient outcomes by providing clinicians with timely, accurate, and appropriate knowledge.

Objective: This study investigates the perceived usefulness and practical implementation of UpHill Route v3, a personalized digital care pathway (PDCP) system, in enhancing clinical decision-making and patient management across various clinical settings.

Methods: A mixed-methods retrospective study was conducted involving medical doctors and nurses from four NHS Local Health Units in Portugal. Data was collected from May 2023 to April 2024. The primary data source was an anonymous questionnaire assessing healthcare professionals' perceptions of UpHill Route v3's usefulness (Likert scale from 0 to 10). Secondary analysis involved quantifying decisions across heart failure, multimorbidity, diabetes and colorectal and breast cancer clinical pathways (data were collected from user interactions with UpHill Route v3, as well as from its internal database). Descriptive and bivariate statistics were used to analyse the data.

Results: 22 healthcare professionals (mean age 44.7±10.6, 68% females, 41% physicians) participated. High ratings for adherence to clinical protocols (mean score: 8.06±1.73), clinical decision support (mean score: 8.05±1.73), patient care improvement (mean score: 7.63±2.22), and confidence in patient management (mean score: 8.26±1.56) were reported. Secondary analysis showed that, across 3,574 patients, 25,741 clinical decisions were informed and 9,254 actions were performed with the assistance of the PDCP tool.

Conclusions: The perceived usefulness paired with the underlying volume of decisions informed and/or tasks performed indicates the potential of the tool to enhance clinical efficiency and patient care. The study's findings align with existing literature on the effectiveness of CDSSs in improving clinical practice and patient outcomes. However, the small sample size and potential response bias limit the generalizability of the results. Further research with larger and more diverse populations is needed. UpHill Route v3 PDCP tool is highly valued by healthcare professionals for its ability to support clinical decision-making and operational efficiency across various clinical settings, suggesting it can effectively bridge the gap between clinical guidelines and real-world practice.

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Original Manuscript

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ABSTRACT

Background: Clinical decision support systems (CDSS) are known to improve adherence to clinical practice guidelines and patient outcomes by providing clinicians with timely, accurate, and appropriate knowledge.

Objectives: This study investigates the perceived usefulness and practical implementation of UpHill Route v3, a personalized digital care pathway (PDCP) system, in enhancing clinical decision-making and patient management across various clinical settings.

Methods: A mixed-methods retrospective study was conducted involving medical doctors and nurses from four NHS Local Health Units in Portugal. Data was collected from May 2023 to April 2024. The primary data source was an anonymous questionnaire assessing healthcare professionals' perceptions of UpHill Route v3's usefulness (Likert scale from 0 to 10). Secondary analysis involved quantifying decisions across heart failure, multimorbidity, diabetes and colorectal and breast cancer clinical pathways (data were collected from user interactions with UpHill Route v3, as well as from its internal database). Descriptive and bivariate statistics were used to analyse the data.

Results: 22 healthcare professionals (mean age 44.7 ± 10.6 , 68% females, 41% physicians) participated. High ratings for adherence to clinical protocols (mean score: 8.06 ± 1.73), clinical decision support (mean score: 8.05 ± 1.73), patient care improvement (mean score: 7.63 ± 2.22), and confidence in patient management (mean score: 8.26 ± 1.56) were reported. Secondary analysis showed that, across 3,574 patients, 25,741 clinical decisions were informed and 9,254 actions were performed with the assistance of the PDCP tool.

Conclusion: UpHill Route v3 PDCP tool is highly valued by healthcare professionals for its ability to support clinical decision-making and operational efficiency across various clinical settings, suggesting it can effectively bridge the gap between clinical guidelines and real-world practice.

Number of words (abstract): 262

KEYWORDS

Care integration, clinical pathway, digital, heart failure

INTRODUCTION

Computerised clinical decision support systems (CDSS) are designed to enhance patient care by providing clinicians and patients with timely, accurate, and appropriate knowledge in the context of specific medical interactions or encounters. These systems have gained significant traction for their potential to improve adherence to clinical practice guidelines, thereby bridging the gap between knowledge and its application in diverse clinical contexts[1, 2]. Systematic reviews and studies have been conducted to evaluate the effectiveness of CDSS and showed that CDSS can lead to improvements in process adherence, thus leading to higher diagnosis accuracy and comprehensive disease management[3, 4]. There are multiple types of CDSS. Traditional CDSS primarily offer static recommendations, whereas personalized CDSS integrate patient-specific data from electronic health records (EHR) to tailor recommendations. Personalized Digital Care Pathways (PDCP) represent a further advancement, extending CDSS capabilities beyond single encounters by ensuring continuity of care across multiple medical interactions. PDCP systems facilitate decision-making and action execution across multidisciplinary teams, maintaining compliance with best practice protocols and continuously adapting based on patient-specific data. These systems have demonstrated benefits for patients, healthcare professionals (HCP), and institutions, contributing to improved service quality, workforce efficiency, and patient outcomes. This expands the concept of CDSS to the whole continuum of care, enabling the interaction of multiple multidisciplinary teams through a shared care pathway. These systems have long been advocated for patients, HCP, and institutions demonstrating benefits in service quality, workforce efficiency and improved patient outcomes[4, 5].

PDCP ensure that each HCP delivers tailored care aligned with standard protocols and guidelines, especially relevant for chronic conditions requiring frequent workups and timely therapy adjustments occurring in different contexts[6]. Current management strategies for chronic patient care typically rely on traditional methods such as face-to-face consultations, periodic monitoring, and manual documentation of patient records. Care plans are often manually developed based on clinical guidelines and personal clinical judgment, with minimal decision support integration. Most EHR lack advanced decision support capabilities, decision characterisation, and patient communication. Overall, current management strategies can be time-consuming and prone to variability in care delivery.

For example, CDSS have been shown to improve patient outcomes by enhancing monitoring, management, and optimisation of therapies for heart failure management[7]. As more clinical practice guidelines emphasise the necessity of digital solutions for early disease detection and patient self-care[8], multidisciplinary chronic disease management programs powered by CDSS tools have been shown to yield better quality of life, lower readmission rates, and reduced mortality[3]. Albeit the abovementioned benefits, there is lacking evidence regarding the perceived usefulness by HCP actually using these systems and regarding the quantification and characterisation of this usage — more specifically, the number and types of decisions and actions usually performed by CDSS — in chronic disease management[3, 9].

The hypothesis under study is that HCP consider PDCP (UpHill Route v3) more valuable than their current management strategies for chronic patient management. As PDCP and a subtype of a CDSS, UpHill Route v3 aids medical decision-making, and improves patient management by increasing compliance with locally validated clinical pathways. The software creates personalised care pathways by capturing patient health and demographic data from the hospital EHR, from manual input by HCP or from self-reported patient questionnaires (sent via text messages, web forms or voice interaction capabilities) to further support HCP clinical decisions and tasks throughout that

clinical pathway. Thus, the main aim of this study was to characterise the perceived usefulness of a PDCP in chronic patient management. A secondary aim was to describe the number and type of decisions supported by software, thus quantifying them as a proxy for the system's impact on decision support and patient management efficiency.

METHODS

Study design

This is a mixed-methods retrospective study conducted to evaluate the usefulness of PDCP as a CDSS for HCP. For the primary aim, qualitative data was collected through a questionnaire directed to HCP using UpHill Route v3 assessing perceived usefulness of PDCP and comparing it to current management practices for chronic patient care. For the secondary aim, quantitative data on decisions and tasks performed during care pathways was retrieved from UpHill Route v3. This design allows for a comprehensive understanding of the impact of UpHill Route v3 on clinical decision-making and patient management.

Setting

Medical doctors and nurses from four National Health System (NHS) Local Health Units (LHUs) in Portugal, pilot testing UpHill Route v3, were invited to participate. These professionals were trained in using UpHill Route v3 as part of the software implementation framework as described in the software technical documentation and instructions of use. Also, as part of that implementation process, clinical content running on the software was validated and approved, meaning that clinical leaders from enrolled institutions approved the protocols reflected on the software.

The inclusion of patients in UpHill Route v3 was the exclusive responsibility of HCPs, who were instructed and trained to use the software in accordance with the technical documentation for non-critical patients in non-critical clinical settings.

The study encompassed the central, capital, and southern coastal regions of Portugal and took place from May 2023 to April 2024. These LHUs—Litoral Alentejano, Amadora Sintra, Coimbra, and São José — serve a combined population of over 1.40 million people across 17,660 km². This vast region includes urban and suburban populations, and the clinical journeys in these four LHUs include heart failure, multimorbidity (combined heart failure, chronic obstructive pulmonary disease and diabetes), diabetes, colorectal, and breast cancer, which represent a diverse spectrum of chronic diseases with frequent acute care interventions.

Participants

To be eligible for this study, participants must have been part of the HCP user base of the previously described health units pilot testing UpHill Route v3 in their daily practice and have completed the training session on properly using the software. The instruction to use UpHill Route v3 only in non-critical settings was directly related to the targeted diseases, which were chronic or elective conditions integrated into predefined care pathways. Healthcare professionals were briefed on the appropriate use of the system, and adherence to this criterion was monitored through participant feedback and usage data.

Of relevant notice is that the device itself does not autonomously provide care to patients, and

all the content and behaviour occur according to the locally validated clinical pathway. All participants provided informed consent to be included in each care journey, ensuring their voluntary participation.

Endpoints and Variables

The primary aim was to study the perceived usefulness of this PDCP, captured through a questionnaire applied to HCP piloting UpHill Route v3. This questionnaire was developed so that the constructs under each question contributed to understanding the perceived usefulness of UpHill Route v3. These constructs were: 1) adherence to clinical protocols, as the ability to easily comply with protocols; 2) clinical decision support, as a measure of recommendation relevance; 3) improvement in patient care, as the perceived value of the presented recommendations to the patient; 4) task management, as the benefit of time-savings; and 5) confidence in patient management, as the ability to rely on the tool to support the delivery of exhaustive and proper care. Each question was answered using a Likert scale, from 0 to 10, indicating the participant's level of agreement with the presented component concerning PDCP usefulness. The questionnaire was written in Portuguese and distributed to participants via email. It can be found in the supplemental materials – Supplementary Data – Appendix 3.

Regarding the secondary aim, to describe the number and type of decisions supported by the software, human-computer interactions made on UpHill Route v3 graphical user interface were analysed. Decisions made with support of the software are encapsulated in decision gateways, which are elements within UpHill Route v3 that prompt decision-making based on specific criteria. These criteria may relate to the patient's condition, signs and symptoms, or clinical results. Figure 1 in Supplementary Data – Appendix 2 represents UpHill Route v3 graphical interface for type 2 diabetes mellitus clinical pathway of a test patient. In this case HCPs are presented with patient-specific actions and decisions on the center panel. On the right panel, supportive complementary information related to the selected action or decision in the central panel is presented to the HCP. Data was collected from user interactions with UpHill Route v3, as well as from its internal database. Participants were characterized according to demographic variables (sex, age) and years of clinical experience. Additionally, academic activity as a binary variable, indicating whether participants were involved in academic roles alongside their clinical duties was collected.

Data sources/measurement

Primary objective data was collected through an online questionnaire. The questionnaire, in Portuguese, was delivered through Microsoft Forms[®] and sent to the participants through email and can be found in supplemental materials. The analysis of the data was made using Microsoft Excel[®] and STATA[®] 14.

Secondary objective data was collected through queries to UpHill Route v3 internal database.

Data processing protocol

Data was collected from the software's database to describe the number and type of decisions supported by the software. The database recorded each option the user clicked for each pathway element. Then, the data was aggregated by pathway elements (actions and decisions), each with a unique identification number. To analyse these elements and their selected options, queries on the database were performed, aggregating the same pathway element across all patient records.

Decisions were categorised into one of the ten clinical decision types as defined in the Decision Identification and Classification Taxonomy for Use in Medicine (DICTUM)[10]. These are: gathering additional information, evaluating test results, defining problems, drug-related decisions, therapeutic procedure-related decisions, legal and insurance-related decisions, contact-related decisions, advice and precaution, setting treatment goals, and deferment.

Actions were categorised as clinical if assigned to nurses or physician profiles, or as non-clinical if assigned to administrative profiles. Clinical tasks are the recommendations to request a mandatory diagnostic test, for example. Non-clinical tasks are, for example, appointment scheduling. Data was aggregated by pathway elements, combining all the patient records without any identifiable patient variable.

Study size

Considering the primary objective, at the time of the study recruitment, 48 potentially eligible HCP were actively piloting UpHill Route v3, and all were invited through email to answer the questionnaire.

Considering secondary objectives, Route's internal data was retrieved anonymously for HCP and patient data. So, for this objective, data considering the activities of all 48 professionals was analysed.

Statistical methods

Descriptive statistics were used to summarise the demographic characteristics of the participants. Continuous variables were summarised with central tendency and dispersion measures, namely mean and standard deviation. Categorical variables are reported as relative and absolute frequencies. Bivariate analysis was conducted with a chi-squared test for categorical variables and a t-student test for continuous variables.

To address the primary objective, responses collected from the questionnaire were analyzed by calculating mean scores and measures of dispersion (standard deviation) for each question. Higher mean scores indicate a greater perceived usefulness of UpHill Route v3, while low dispersion reflects strong agreement among participants regarding the software's usefulness.

For the secondary objective, we categorized and counted the types of decisions involving human-computer interaction. These decision types were presented as absolute and relative frequencies. Additionally, we analyzed the tasks suggested by UpHill Route v3 within each care pathway, reporting these tasks as percentages.

RESULTS

There were 22 participants answering the questionnaire (response rate of 46%). The mean age

of the participants was 44.7 ± 10.6 years, while mean years of experience was 20.6 ± 11.0 years. Out of the 22 participants, 15 (68%) were female, 9 (41%) were medical doctors (MDs), and the remaining 13 (59%) were nurses. Additionally, 2 (9%) of participants were involved in academic activities.

Bivariate analysis was conducted to assess the influence of gender on various aspects of the UpHill Route v3. The chi-squared tests for categorical variables showed no significant associations between gender and MD status ($P=0.297$), gender and Nurse status ($P=0.133$), or gender and involvement in academic activities ($P=0.655$). Similarly, t-tests for continuous variables indicated no significant differences in age ($P=0.538$) or years of experience ($P=0.439$) between male and female participants.

Perceived usefulness of UpHill Route v3

Participants rated the statement “UpHill Route v3 makes it easier to manage patients according to the clinical protocols of my institution” with a mean score of 8.06 (SD = 1.73), a statement that aimed to assess the ability to easily comply with protocols. Focusing on clinical decision support, the statement “The UpHill Route v3 provides me with relevant clinical recommendations at the right time” received a mean score of 8.05 (SD = 1.73). For the statement “The UpHill Route v3 helps me to improve my patient care”, which evaluated the sense of patient care improvement, the mean score was 7.63 (SD = 2.22). Finally, for confidence in patient management, “The UpHill Route v3 gives me more confidence that my patients are being properly cared for” had a mean score of 8.26 (SD = 1.56). The results of the questionnaire are presented in Table 1.

There were no significant differences in the perceptions of the UpHill Route v3's effectiveness between physicians and nurses, as well as between genders.

Table 1. Results of questionnaire applied to HCPs to assess the perceived usefulness of the UpHill Route v3.^a	
Question	Mean Score (SD)
UpHill Route v3 makes it easier to manage patients according to the clinical protocols of my institution	8.06 (1.73)
The UpHill Route v3 provides me with relevant clinical recommendations at the right time	8.05 (1.73)
The UpHill Route v3 helps me to improve my patient care	7.63 (2.22)
The UpHill Route v3 gives me more confidence that my patients are being properly cared for	8.26 (1.56)
^a 0 (Do not Agree) to 10 (Totally agree).	

Overall, the analysis did not find significant differences based on gender or professional role (MD vs. Nurse) in relation to the demographic characteristics or the perceived usefulness of the UpHill Route v3.

Decisions supported by the software

The data was collected from heart failure, diabetes, and cancer (colo-rectal and breast) care pathways from the four different institutions (LHUs) previously described.

Forty-eight HCP used UpHill Route for supporting decisions of a total of 3,574 patients with

25,741 decisions captured. HCPs answered 427 decision gateways, performed 9,254 actions, and the system generated 2,429 clinical notes. Overall, there were 37,534 activities (sum of decisions, actions and notes) performed in UpHill Route v3. These results are summarised in Table 2.

Local Health Unit (Care pathway)	Patients, n	Gateways, n	Decisions, n	Actions, n	Clinical notes, n	Total Activities, n (per patient)
Litoral Alentejano (Heart Failure)	609	76	8,249	2,570	0	10,819 (19.5)
Litoral Alentejano (Multimorbidity)	668	207	10,680	2,350	0	13,030 (17.8)
Coimbra (Colorectal Cancer)	355	3	685	1,356	0	2,041 (5.8)
São José (Colorectal Cancer)	202	25	883	856	144	1,883 (9.3)
São José (Breast Cancer)	223	32	878	1,079	107	2,064 (9.3)
Amadora/Sintra (Diabetes)	1,517	84	4,466	1,053	2,178	7,697 (5.1)
Total	3,574	427	25,741	9,254	2,429	37,534 (10.5)

The Litoral Alentejano multimorbidity care pathway presented the highest number of activities per patient, with an average of 19.5 activities. Similarly, Litoral Alentejano heart failure care pathway also exhibited a high level of clinical activity, with 17.8 activities per patient. São José colorectal and breast cancer journeys had an average of 9.3 activities per patient. Coimbra colorectal cancer and Amadora/Sintra diabetes care pathways averaged 5.8 and 5.1 activities per patient, respectively. Overall, there were, on average, 10.5 clinical activities per patient performed in UpHill Route v3 in the four health institutions piloting under study.

As part of the secondary objective, the categorisation of clinical decisions showed that the majority of decisions (9,215 out of 25,841) were related to "Defining problem" (35.7%), followed by "Gathering additional information" (5,759 out of 25,841; 22.3%) and "Treatment goal" (4,845 out of 25,841; 18.7%). The distribution of these decisions varies across different care pathways, with Litoral Alentejano multimorbidity and heart failure accounting for the largest proportions, representing 41% (10,678 out of 25,841) and 32% (8,251 out of 25,841) of the total decisions, respectively. Other decision types, such as "Contact-related" and "Therapeutic procedure-related," accounted for smaller proportions, 7.0% (1,814 out of 25,841) and 5.0% (1,280 out of 25,841), respectively. The distribution highlights the diverse range of decision types supported by UpHill Route v3, tailored to the specific needs of different clinical contexts. The results of the decision categorization presented by clinical journey are summarized in Figure 1 (see also Supplementary Data – Appendix 1).

Concerning decision types, a total of 1,814 out of 25,841 (7.0%) decisions were found contact-related. These decisions involve admitting or discharging patients, scheduling follow-ups, and referring patients to other parts of the healthcare system. There were 460 (1.8%) deferment decisions. These involve actively delaying a decision or rejecting a decision on a problem presented by the patient. The highest number of decisions were defining-problem decisions, totaling 9,215 out of 25,841 (35.7%). These complex, interpretative assessments define what the problem is, including diagnostic conclusions, evaluations of health status, etiological inferences, and prognostic judgments. A total of 1,415 (5.5%) decisions were related to drug therapy. These involve starting, stopping, altering, or maintaining a drug regimen. There were 1,053 (4.1%) decisions related to the evaluation of test results, involving simple, normative assessments of clinical findings and tests. A total of 5,759

(22.3%) decisions were aimed at gathering additional information, which involves obtaining information from sources other than patient interviews, physical examinations, and patient charts. There were 1,280 (5.0%) decisions related to therapeutic procedures. These involve planning, performing, or refraining from therapeutic interventions. A total of 4,845 (18.7%) decisions were related to setting treatment goals, which involve defining specific objectives for patient care. The comprehensive details of each decision type's categorization can be found in supplemental materials –Appendix 5.

DISCUSSION

This study evaluated the perceived usefulness and practical implementation of the UpHill Route v3 as a PDCP in various clinical settings. The primary outcome focused on the perceived usefulness of the system, as assessed by HCP through a structured questionnaire. The results demonstrated high scores across multiple dimensions, including adherence to clinical protocols, clinical decision support, and confidence in patient management. Specifically, participants rated the system highly in the easiness of adhering to clinical protocols by providing relevant clinical recommendations, demonstrating that healthcare professionals perceive UpHill Route v3 as a valuable tool in clinical settings. Our analysis found no significant differences in the perceived usefulness of UpHill Route v3 between genders or professional roles (MDs vs. Nurses). This lack of disparity indicates that UpHill Route v3 is perceived to be equally beneficial across different demographic and professional groups within healthcare settings. Overall, this posits that the software, with its decision support capabilities, proves valuable in adhering to clinical guidelines, providing relevant clinical guidance, enhancing patient care, and instilling confidence in the care provided.

The high scores across multiple dimensions of perceived usefulness indicate that HCP find the UpHill Route v3 system valuable for clinical decision support. The system's ability to integrate clinical protocols and provide timely recommendations appears to enhance both clinical efficiency and the quality of patient care.

Concerning secondary outcomes, the data indicates significant usage of clinical activities being supported by UpHill Route v3, averaging 10.5 activities per patient. There were expectable variations in clinical activities per patient across different care pathways. Litoral Alentejano multimorbidity and heart failure cases required the most activities per patient, suggesting a highly complex pathway with numerous decision points. These care pathways naturally require more complex clinical activity for the management of these conditions. Coimbra Colorectal Cancer and Amadora Sintra Diabetes involved fewer activities per patient, reflecting a more focused and shorter clinical pathway in those use-cases.

The distribution of decisions supported by UpHill Route v3 varied significantly, with defining-problem decisions and gathering additional information being the most common. This finding is consistent with the complex nature of clinical diagnostics and the need for comprehensive information gathering to inform clinical decisions in the follow-up phase of symptomatic chronic diseases such as heart failure or multimorbidity[11]. The system's ability to support these critical decision types highlights its relevance and utility in clinical practice. Overall, the categorisation of decisions and tasks demonstrates the system's versatility in supporting various aspects of patient management, from diagnosis and treatment to follow-up care. These findings suggest that the UpHill Route v3 system can effectively bridge the gap between clinical guidelines and real-world practice,

potentially leading to improved patient management.

The study's findings on UpHill Route v3 align well with existing literature on the effectiveness of CDSS in healthcare[12]. Our findings emphasise the importance of CDSS, and especially PDCP, in providing timely and accurate decision support, through personalization and longitudinal continuity, which is crucial for clinicians in complex and dynamic environments[13]. This aligns with findings from multiple systematic reviews and studies. Indeed, many CDSS enhance practitioner performance, but evidence of their impact on patient outcomes remains limited and inconsistent, indicating a need for further research in this area[14]. A recently published systematic review and meta-analysis focusing on the primary prevention of cardiovascular disease demonstrated that CDSS were found to be effective in improving blood pressure clinical target attainments. However, multi-layered barriers affecting the uptake, longer-term use and active engagement from clinicians and patients may hinder the full potential for achieving other quality-of-care outcomes[15]. While digital care pathways have shown promise to optimize the efficiency of care delivery, effective implementation requires training, resource allocation, support for information management and optimizing alert algorithms to manage information overload[16, 17].

The positive feedback on UpHill Route v3's decision support capabilities reinforces the notion that a PDCP as a CDSS can enhance clinical decision-making and patient management and the subsequent step for PDCPs is likely to be task automation of predictable and mandatory tasks. Previous findings in the literature highlight its benefits. For instance, a systematic review by Jones et al. discusses how task automation through CDSS can streamline workflows, reduce administrative burdens, and minimize human errors, thereby allowing HCPs to focus more on direct patient care[18].

Future research should explore the long-term impacts of task automation on clinical outcomes and examine how the integration of PDCPs with other healthcare technologies can provide efficient orchestration of patient health care.

Several limitations and potential sources of bias need to be acknowledged in this study. Firstly, only 22 HCPs replied to the questionnaire, a small number which may limit the generalisability of the findings, albeit working in multiple healthcare centers. Additionally, the study relied on self-reported data to assess the perceived usefulness of the system, which could be subject to response bias. Despite participant anonymization, participants might have provided favourable responses due to social desirability or perceived expectations from the study organisers. Finally, another strength of the study is the presentation of aggregated data from diverse patient populations (heart failure, diabetes, breast and colorectal cancer) across various clinical settings (primary and secondary care) and contexts (urban and rural).

Although all authors are affiliated with UpHill Health, S.A., the study design, data collection, and analysis were conducted using standardized methodologies to ensure objectivity. The findings were interpreted transparently and align with prior research on clinical decision support systems, reinforcing their validity.

While the study's findings are promising, the small sample size limits the generalisation of the results. Future research should aim to include a larger and more diverse cohort across multiple healthcare settings (various specialties and practice settings) and geographic regions to enhance external validity and applicability to broader clinical contexts. We speculate that variations in healthcare system infrastructure, clinical workflows, cultural factors, and user experience levels may influence the adoption and perceived effectiveness of PDCP.

Additionally, this study primarily focuses on short-term implementation outcomes. Future research should adopt a longitudinal approach to evaluate sustained adherence to protocols, patient outcomes, and cost efficiency, allowing for a more comprehensive assessment of the long-term

impact of the UpHill Route v3 system on clinical outcomes and healthcare efficiency. Despite these limitations, the positive qualitative feedback and the objective quantitative interaction with the software from HCPs suggest that the UpHill Route v3 system is a valuable tool in various clinical settings, supporting decision-making and enhancing patient care.

CONCLUSION

This study demonstrates that HCPs highly value PDCP as CDSS for enhancing adherence to clinical protocols, providing timely recommendations, and improving patient care. The system showed significant activity, with many decisions supported across various clinical journeys and settings.

Despite the study's small sample, the anonymous nature of the questionnaire and objective secondary outcome data provide robust evidence of the system's effectiveness across different clinical scenarios, such as chronic, oncological and surgical conditions. Further research with a larger and more diverse population is needed to confirm these findings and explore the system's long-term impact.

In summary, the PDCP systems support clinical decision-making and operational efficiency and promote the correct execution of wide range of clinical activities in patient management in healthcare settings.

FUNDING

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CONFLICT OF INTEREST STATEMENT

All authors of this study are direct employees of UpHill. This affiliation may represent a potential conflict of interest. Efforts were made to ensure the study's design, data collection, analysis, and interpretation were conducted impartially and without undue influence from the author's employment status. The findings and conclusions presented in this manuscript are based on objective data and aim to contribute to the scientific understanding of clinical decision support systems.

ETHICS

This research project was submitted and approved by NOVA Medical School under the main author PhD research project "Characterizing uncertainty in decision making with complex multimorbidity patients" (No.108/2021/CEFCM) – Supplementary data, Appendix 5.

FIGURES

Figure 1: Decision categorisation presented by care pathway

SUPPLEMENTARY FILES

Appendix 1: Table with detailed information on decision categorization presented by care pathway.

Appendix 2: Health Care Professional Questionnaire

Appendix 3: UpHill Route V3 graphical interface

Appendix 4: Aggregated clinical pathway supported decisions categorized as by DICTUM taxonomy.

Appendix 5: Ethics Committee approval

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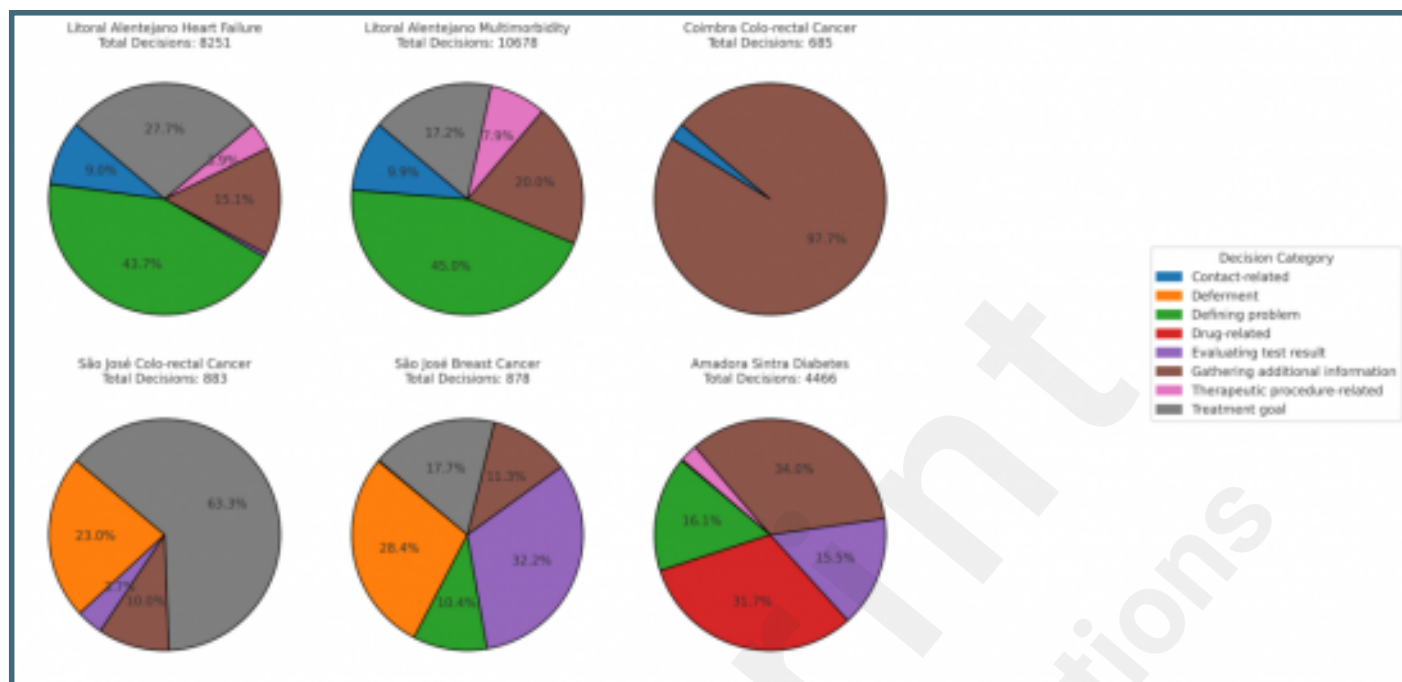
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Supplementary Files

Figures

Decision categorisation presented by care pathway.



Multimedia Appendixes

Table with detailed information on decision categorization presented by care pathway.

URL: <http://asset.jmir.pub/assets/a8df2eb10a45d476b89dad4d72a29865.docx>

Health Care Professionals Questionnaire.

URL: <http://asset.jmir.pub/assets/30fb4887ce223a01a12fbb651d24a19d.docx>

UpHill Route V3 graphical interface.

URL: <http://asset.jmir.pub/assets/a07149372f39c536dc7d99199d069319.docx>

Aggregated clinical pathway supported decisions categorized as by DICTUM taxonomy.

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Ethics Committee approval.

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