Need Analysis of Clinician-Oriented Integrated Precision Oncology Decision Support Tools: A Mixed-Method Qualitative Descriptive Study

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Abstract

Background: With the advancement of next generation sequencing, healthcare professionals face challenges in keeping pace with increasingly extensive body of knowledge and information in prediction medicine. In oncology area, current functionalities of precision oncology decision support (PODS) tools only partially address clinicians' needs, leaving certain clinical requirements within PODS inadequately defined. Lack of need analysis may result in unaddressed clinician requirements.

Objective: We aimed to explore clinicians' needs and expectations of functions in integrated PODS tools.

Methods: Qualitative investigation was held in Peking University Cancer Hospital (PUCH). Data were derived from structured participant observation records (n=143) from multidisciplinary team (MDT) and in-depth interviews (n=17). Participants included physicians, surgeons, molecular biologists, radiotherapists, radiologists, and pathologists.

Results: Three main themes of functions arose from our data: better access to oncological knowledge; feasibility support; and support abilities demands in decision-making process. Oncological knowledge themes included support in therapies (guidelines, conferences, and consensuses; clinical trials; information of drugs and treatments; and knowledge of complex cases), diagnosis and prognosis. Feasibility support themes included accessibility of clinical trials, accessibility of drugs, and prediction models. Decision-making process support themes included flexible biological knowledge and phenotypes, automatic integration of patient information, better visualization of information, and optimization in retrieval, recommendation and question answering. Several example quotes describing these themes were provided. A functional framework of needs for integrated PODS tools was proposed.

Conclusions: PODS is complex, multi-level decision support. Clear elucidation of the actual clinical needs may impact the improvement of PODS. This study presents unique perspectives directly from clinicians in this new arena of precision oncology.

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Keywords: precision oncology decision support; need analysis; structured participant observation; in-depth interview; functional framework

Introduction

Advancements in next generation sequencing have paralleled the rise of precision oncology, leading to the discovery of numerous cancer diagnostic biomarkers and the approval of many targeted drugs by regulatory authorities such as the FDA, EMA, and NMPA, as well as recommendations by prestigious organizations like NCCN, ESMO, and CSCO (e.g., tepotinib [1] and sunvozertinib [2]). Despite this progress, healthcare professionals face challenges in keeping pace with these advancements and determining the most effective treatment strategies, as well as handling complex genomic information, such as timely renewing information, understanding the clinical significance of genomic alteration.

Nowadays, clinicians mainly rely on genetic testing reports to acquire genomic profile of cancer patients and to understand clinical significance of certain genetic variants. With rapidly growing knowledge of precision oncology, the content of genetic testing reports has greatly expanded, but also brings the problem of inconvenience in reading and searching. Beyond that, the heavy load of clinical work strongly limits the time of reading full contents of genetic testing reports. [3] A fast and effective way of display comprehensive genomic information may help clinician locate the needed information easily. [4]

Under the circumstance, computer-based interactive Precision Oncology Decision Support (PODS) tools have emerged. In oncology area, tools with high interactivity and interoperability, such as knowledge and clinical trial databases, [5-7] therapy recommendation engines, [8] literature search tools, [9] and predictive algorithm-based models, [10] have been developed, and anticipated as valuable resources for facilitating timely update and informed interpretation of genomic data from bioinformatics research to clinical statistical analysis. [11-15] Literature have described the properties, opportunities, and future effects of these tools. [16,17]

However, it should be noted that although these tools may bring broad prospects in the field of oncology research, they may not fully meet the need of practical clinical application. There are already systems integrating part of these function of PODS tools for clinicians, [18,19] but two key issues of current clinician-oriented PODS tools remain unclear.

The first issue is the clinician-oriented PODS functions are currently scattered in different tools. When somatic mutations and germline variants were detected in cancer patients, in order to make a more appropriate and individualized treatment plan based on patients' genomic profile, some functions such as (1) whether these variants are pathogenic or oncogenic, [20] (2) how do they involve in tumorigenesis and cancer progression, [21,22] (3) what are their biological functions and clinical significance, [23,24] (4) in what extent do they potentially affect patients' diagnosis and treatment [25] and (5) whether they are going to influence the choice of certain therapeutic strategy or clinical management may be clinicians' interests [26-30]. However, currently, single available knowledgebase could only meet one or two aspects of the above-mentioned clinical requirements. To answer all these questions, clinicians have to search in multiple knowledgebases using various search engines to achieve one goal, since different evidences may scatter in diverse databases. Such process of switching tools normally cost large amount of time with limit achievement.

The second issue is some of needs in PODS of clinicians are unclarified. Clinicians in different area may have different needs of PODS functions, which may have commonalities in some respects could be found by need analysis. However, current lack of need analysis results in the fact that current PODS tools have not yet met all practical requirements from clinicians. This fact restrains the clinical implementation of PODS tools and underestimate the clinical value of genomic data from cancer patients. Also, the lack of need analysis exposes the problem that there is not currently an appropriate evaluation metric for the measurement of quality of developing such metrics of PODS tools.

Hence this paper aims to explore clinicians' perceptions of the needs of functions in PODS tools. It also seeks to identify the existing urgent needs not met by current tools, and outline a functional need framework of PODS tools.

Methods

Study Design and Theoretical Framework

This qualitative descriptive study, informed by a naturalistic perspective and grounded theory, [31] investigates how clinicians utilize PODS tools in Multidisciplinary Teams (MDTs) and routine clinical practice. Comprising experts like molecular biologists, physicians, surgeons, radiotherapists, radiologists, pathologists, and other departments (Table 1), MDT plays a crucial role in integrating clinical data and molecular profiling to tailor targeted therapies. [32-34] In routine clinical practice such as out-patient service, clinicians receive a lot of patients with simple to complex medical status. When the course of disease and treatments is either no clinical guideline to be followed or lack of evidence to support standard treatments, the case would be raised for discussion in MDT. Therefore, structured observation of MDT discussion was selected to investigate the needs of PODS tools for clinicians, so as to propose elements for framework of PODS tools. These elements were then validated and further verified by in-depth interviews.

Table 1 Characteristics of MDT Records. MDC, molecular biologists and geneticists from Molecular

Diagnostic Center. ○The molecular biologists and geneticists are present, but due to the genetic test information from the patients, they seldom speak in MDT. TCM, Traditional Chinese Medicine Department.

Site	Thoracic Oncology Center	Gastrointestinal Oncology Center
Number of Observations	26	20
Number of Records	86	57
Number of Participants	15-40	10-20
Number of Patients with Genetic Testing (%)	39 (45%)	12 (21%)
Frequency	Once a week	Once a week
Duration (min)	10-120	20-40
Discussion Duration per Patient (min)	10-20	10-15
Number of Speakers per Discussion	4-10	3-6
Participating Departments		
Surgeon	√	√
Physician	√	√
Radiotherapist	√	√
Radiologist	√	√
Pathologist	√	√
MDC	√	○
Nursing	√	
TCM	√	

The study was adhered to the Consolidated Criteria for Reporting Qualitative Research. [35] Conducted from June 2023 to June 2024, the study used a mixed-method approach, combining structured participant observation and in-depth interviews to comprehensively assess the use and integration requirements of PODS tools. [36]

Setting and Data Collection

Structure participant observation and in-depth interview in this study were both carried out in Peking University Cancer Hospital (PUCH). Data for participant observation was collected at MDT held by Thoracic Oncology Center and Gastrointestinal Oncology Center respectively, which were both held regularly (every week) and had large scale discussion group.

The study received ethical approval from the committee of PUCH (code: 2023KT35). The process of the research could be divided into three parts: qualitative observation, in-depth interview, and data analysis (Figure 1). MDT principals and interviewees all signed informed consent.

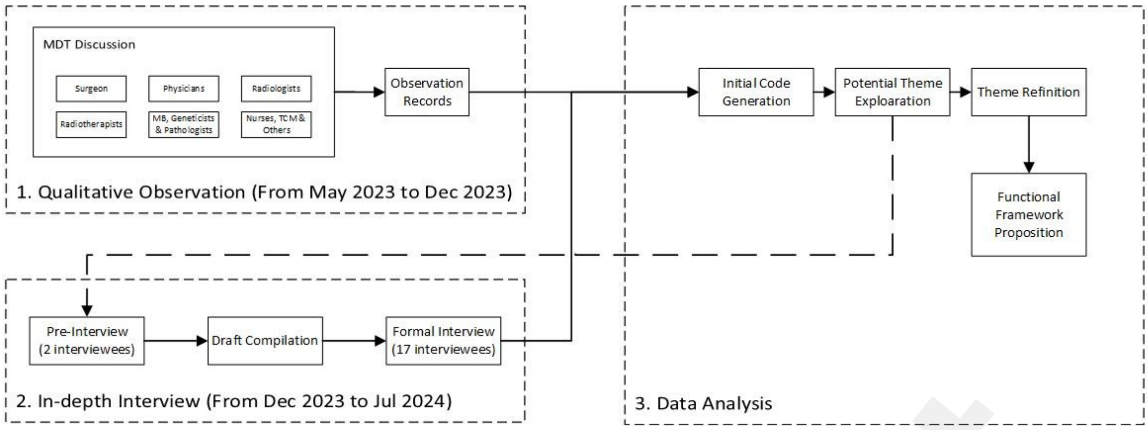

Figure 1 The process of the research. MDT, multidisciplinary team. MB, Molecular Biologists. TCM, Traditional Chinese Medicine Department.

Qualitative Structured Participant Observation

From May to December 2023, two team members, ZS and FY, observed MDTs at the Thoracic Oncology Center and Gastrointestinal Oncology Center. FY participated fully in MDT discussions as a member of the MDC and a participant-as-observer, while ZS is a doctoral candidate from the discipline of medical informatics, trained in qualitative research, and observed as an observer-as-participant. The combination of the two observers balanced the angle of both the clinical and informatics. ZS made preliminary records of the observations (Supplementary Material 1), and these records were subsequently refined with the cooperation of FY. The MDT in PUCH can be divided into three parts: (1) patient information preparation before MDT (*Preparation*), (2) patient information briefing during MDT (*Briefing*), and (3) multidisciplinary discussion (*Discussion*). The observation of this research mainly focused on Discussion, recorded in detail to identify PODS needs related to genomic interpretation, diagnosis, therapeutic recommendation, and possible requirements of PODS functions emerged in the process of Discussion (The other observation of the process of MDTs, and detailed observation of two other parts are described in Supplementary Material 2). The slides in MDTs were obtained post-meeting to refine the records. The team observed 26 Thoracic Oncology Center MDTs (86 records) and 20 Gastrointestinal Oncology Center MDTs (57 records), with each session lasting about 35 minutes on average.

In-depth Interview

Semi-structured, in-depth qualitative interviews were conducted from December 2023 to July 2024 by ZS and FY, with ZS playing the role of main interviewer, having no prior interaction with the participants. FY was one of the colleagues of the interviewees, assisting ZS in refining and complementing questions. Before the formal interview, two interviewees were invited to the pre-interview, in which the draft were compiled based on the initial coding of qualitative observation records. The formal interviews draft was standardized afterward (Supplementary Material 3). Participants were selected using sampling theory and snowball sampling,[37] meeting criteria such as (1) holding a medical certificate, (2) working in tumor-related clinical practice, (3) participating in MDTs, and (4) having the experience of using PODS tools, or having heard or observed the operating of PODS tools. Demographic details are summarized in Table 2. The interviews were conducted in Chinese, audiotaped with a digital recorder, and transcribed verbatim and edited by ZS. Twelve hours of individual interviews were transcribed into approximately 48,000 words. The interviews lasted around 40 min (range: 26-70 min).

Data Analysis

Observation and interview data were thematically analyzed following Braun and Clark's reflexive thematic analysis, [38] which includes familiarizing with data, generating initial codes, exploring potential themes, reviewing themes, defining and refining themes, and finalizing findings. The data analysis was divided into two steps. Between the observation and interview, the observation record data were initially coded, and the potential themes emerged were the basis of interview. After the interview, the theme explored in interview was compared with the initial potential themes as a validation. The validation was deemed as the review process. Afterwards the two classes of themes were combined and refined. The functional framework of PODS tools was extracted through the themes, and concluded by team discussion. NVivo 14 software was used for analysis, with coding performed by ZS and reviewed by FY. Discrepancies were resolved through team discussions.

Results

Qualitative Observation and Interviewee Characteristics

A total of 46 MDT discussions were qualitatively observed, involving treatment decisions for 143 patients (Table 1). After six months' observation, the research team began the first round of exploring potential themes. Potential needs of PODS tools emerged from our observations (Figure 2, Table S2-6). The Thoracic Oncology Center's MDT had significantly more detailed information and longer discussion times for genetic testing and personalized targeted therapy compared to the MDT in the Gastrointestinal Oncology Center. Additionally, the use of PODS tools was more prevalent in the Thoracic Oncology Center.

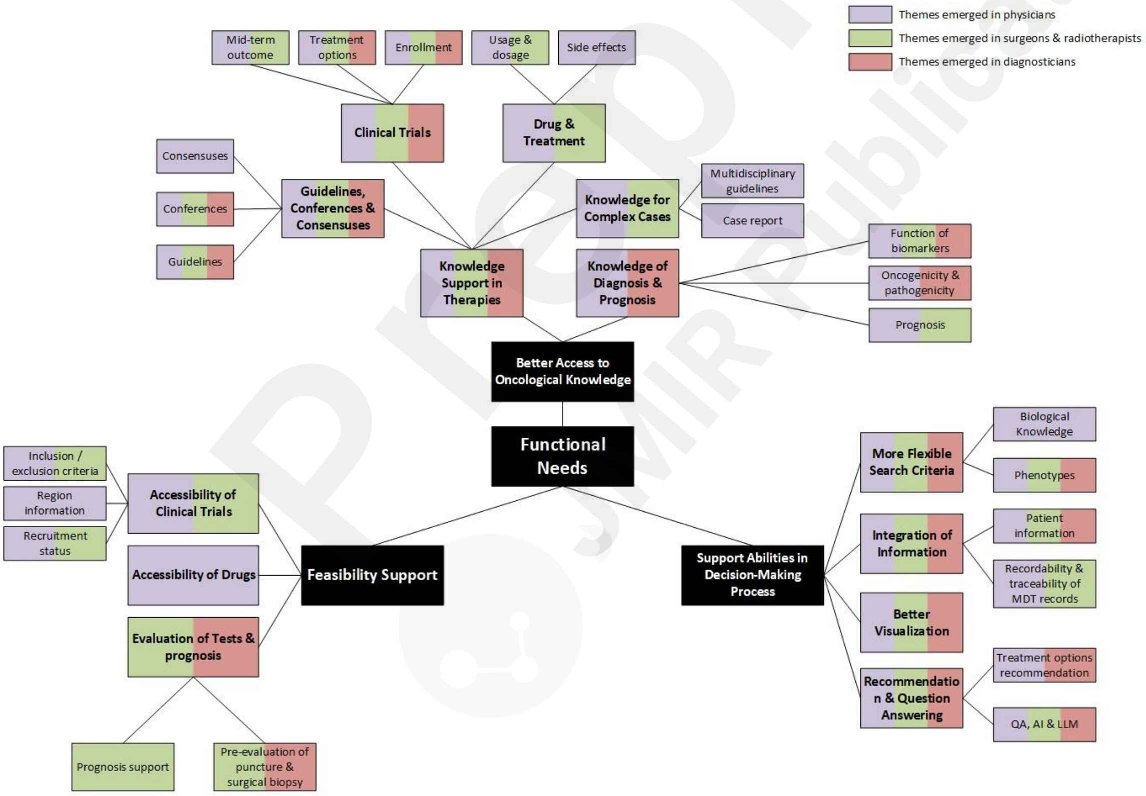

Figure 2 Themes constructed from qualitative observation and interviews. QA, question-answering. AI, artificial intelligence. LLM, large language models

Based on these findings, we focused our interviews with clinicians in the Thoracic Oncology Center on their use of the PODS tools. We also conducted interviews with clinicians from the Radiotherapy Department and MDC.

A total of 17 clinicians participated in in-depth interviews (Table 2). All 17 clinicians had experience using genetic testing reports, while 59% had personal experience using at least one of interactive

PODS tools. However, all 17 clinicians have heard or observed the use of PODS tools. The potential needs were screened and confirmed in the interview. After data analysis, three major themes emerged from our observations and interviews (Figure 2-3, Table S2-6). Themes that emerged from the interview data and organized by knowledge, feasibility and support ability levels are described below and provided in Table 3. Quotes below are from Table 3. Quotes below are from Table 3. From these three themes, the function framework of integrated PODS tools is fully described below. The percentage in brackets in the titles represents the percentage of interviewees holding the corresponding functional requirements among all interviewees.

Table 2 Characteristics of interviewees (n=17). The characteristic “Preparer” is a role in MDT, undertaking the job of collecting information of patients, making MDT briefing slide and present the information. Further description of Preparer is described in Supplementary Material 2.

Characteristics (N=XX)	**n (%)**
Gender	
Male	10 (59%)
Female	7 (42%)
Years of working	
<10	6 (35%)
10-20	8 (47%)
>20	3 (18%)
Clinical Duty	
Physician	9 (53%)
Surgeon	5 (29%)
Molecular biologists	2 (12%)
Radiotherapist	1 (6%)
Professional Title	
Chief	2 (12%)
Associate Chief (Deputy Chief)	7 (41%)
Attending Chief (Supervising)	5 (29%)
Attending	3 (18%)
Preparer	6 (41%)
Had used at least one of PODS tools	10 (59%)

Table 3 Themes’ sources from key informants, translated into English. *: The literature described by the interviewee was [39].

Major Theme and subtheme	**Illustrative quote**	**Quote Number**
Better Access to Oncological Knowledge		
1. Knowledge support in therapies		
Guidelines, conferences, and consensuses	*"Before the MDT, Dr. [name] would like to share recent progress of [progress in treatment of specific disease] ..." (Observation 008, 028, 079)*	1
	“The way I get access to the oncological knowledge are usually from WeChat official accounts, going to	2

	conferences, and newly updated information shared by peer expertise. Sometimes I also search for literatures or reviews in my spare time … What I'm most interested in is the change of the latest version update guideline, from which I could learn a lot … would be great if there is a notification of the changes …" (005, associate chief physician)	
	"We usually discuss the latest progress of conferences before the MDT starts. If PODS tools could notify us this information in our spare time, it would help a lot in summarizing this information for discussion…" (006, associate chief physician)	3
Clinical trials	*"About 25-50% of patients in our hospital would require enrollment in CTs … develop a real-time updating CT recommendation tool is the best …" (004, attending physician)*	4
	"… The information in the website of CTs updates frequently … requires us to retrieve and summarize the latest eligibility criteria and enrollment every half month to one month … so time-consuming …" (009, associate chief surgeon)	5
	"… latest progresses are often discussed in MDT … not so convenient to check … we want future PODS tools could capture these in real time …" (005, associate chief physician)	6
	"Before the MDT, Dr. [name] would like to share the mid-term result of [progress of specific CT] for us ..." (Observation 033, 082)	7
Drugs and treatment options	*"Genetic test reports that vormetinib is effective in LUAD patients with EGFR exon 20 insertion mutation … the descriptions are not particularly clear … we sometimes want to understand the mechanism of drugs …" (003, chief surgeon)*	8
	"Osimertinib, vormetinib and almonertinib are commonly used among the third generation of EGFR-TKIs … there are differences in their use, which requires years of clinical experience … We hope PODS tool will support us in this regard …" (010, attending physician)	9
	"… Some drugs are needed for four cycles, but some patients' health condition is poor … We want to know whether can I reduce the dosage … sometimes drug suppliers would tell us some information, but that's not enough …" (005, associate chief physician)	10
	"… The two most common and risky side effects are vomiting and leukopenia … need prompt intervention … if PODS tools could have a alert or reminder function of these side effects, it would help us reduce unnecessary prescriptions to alleviate these side	11

	effects …" (001, associate chief physician)	
Knowledge for complex cases	*"… when the patient has other cancers … we would invite colleagues from the corresponding departments for MDT discussion, but it is brief … If we can learn easily from other disciplines, we can make treatment decisions more quickly …" (006, associate chief physician)*	12
	"Today's discussion is about the patient with malignant pleural mesothelioma for whom conventional chemotherapy drugs did not respond … if any doctors have seen relevant case reports?" (Observation 046)	13
2. Knowledge support in diagnosis and prognosis	*"… some colleagues asked me the differences between germline variants and somatic mutations … PODS tools could be a useful way to help my colleagues understand the biological knowledge like this …" (014, supervising molecular biologist)*	14
	"… we sometimes want to know the biological function of molecular alterations, understanding why the alteration happens could better guide us to understand the mechanism of the disease …" (013, associate chief surgeon)	15
	"… previously encountered a LUAD patient with co-mutations in TP53, RB1, and EGFR … no appropriate standard treatment or diagnosis options but continued observation at the time … an article said that the concurrence of three variants may be induced to small cell cancer transformation, which is an important reference basis to do puncture for diagnosis … hope to have a better mechanism to search evidences …" (011, attending physician)	16*
	"… we often evaluate the prognosis between different therapies, like radiotherapies and targeted therapies … the knowledge of which could help us make decision better…" (017, attending chief radiotherapist)	17
Feasibility Support		
Accessibility of CTs	*"When there is a patient needs to be enrolled, we will look at the inclusion and exclusion criteria in the CTs we have printed (take out some hardcopy of CTs) and compare the patient's medical status with the criteria item by item … it is very time consuming … Our CT screening usually follow this sequence: 'First, CTs held in our ward; Second, CTs held in our hospital; Third, CTs held in Beijing's Hospital; Fourth, different places other than Beijing in China; Lastly, we consider overseas'… CT enrollment is usually based on the screening order of inside the department,*	18

	hospital, Beijing, China and foreign countries … We need to manually screen it ourselves … want an automatically sort …" (002, attending surgeon)	
	"Sometimes we know there is an enrollment of CT, but we don't know the up-to-date recruitment status. Future PODS tools or CT website should update the status more frequently." (006, associate chief physician)	19
Accessibility of Drugs	*"… Osimertinib is covered in Drug Catalog, but vormetinib and almonertinib need to be paid at patients' own expense …" (001, associate chief physician)*	20
	"Clear mark of drug catalog and price information of drugs can make us discuss the most suitable treatment option for with patient him/herself." (012, associate chief physician)	21
Prediction models: the necessity of ordering diagnostic tests and prediction of prognosis	*"… some genetic tests are expensive … I have known that there are some radiology technologies to auxiliary identify whether there is a certain risk of mutations …" (012, associate chief physician)*	22
	"… examinations like puncture examinations are invasive … we want to use PODS tools to help estimate the necessity of such invasive examinations …" (013, associate chief surgeon)	23
	"… common mutations like TP53 have a poor prognosis … We want to combine the molecular alteration with prognostic prediction …" (002, attending surgeon)	24
Support Abilities Demands in Decision-Making Process		
Using more flexible biological knowledge and phenotypes as search criteria	*"… we once had a patient with MEK mutation and ERK wild type … there were not many drugs targeting MEK … wanted to find some CTs targeting ERK … had to reset the search criteria which was inconvenient … would like to have a flexible retrieval mechanism …" (008, associate chief physician)*	25
	"… would be great if PODS tools could automatically match the inclusion criteria with patient's information and tell us directly whether this patient is a qualified candidate … helps us reduce a lot of comparison work …" (007, chief physician)	26
Automatic integration of patient information	*"… would be great if we just input the ID of patient and click a button … all the information scattered in HIS, PACS … is organized …" (011, attending physician)*	27
	"Acquiring the radiology information is inconvenient currently. We have patients all over the country, and	28

	they have a variety of formats and types of image information. We hope that the future of PODS tools could help us to reduce the burden of identification and input of these data." (010, attending physician)	
	"Suppose there is a timeline of patient in MDT, and all the events of this patient are on the line. Click one button and the details of the event will be shown. That's amazing …" (002, attending physician)	29
	"Some patients will be discussed for several times. We want the PODS tools to record our discussion evey time." (004, attending physician)	30
	"This patient was discussed [time] ago. Last time we decided to use [treatment option], but the disease progressed now …" (Observation 033)	31
Better Visualization of information	*"… Switching slides back and forth to watch the texts is inconvenient … hard to sort out the therapeutic relationships …" (010, attending physician)*	32
	"… automatically generated timeline of history is more logical and visualizable …" (002, attending surgeon)	33
	"… when there is a patient with rare mutation … may want to find previous patients who have the same or similar mutation … may be helpful for diagnosis and treatment … some simple automated generated statistical distribution plots are intuitive to see and discuss …" (014, supervising molecular biologist)	34
Optimization in retrieval, recommendation and question answering	*"… would be great if PODS tools could automatically match the inclusion criteria with the patient information …" (005, associate chief physician)*	35
	"… don't have enough time to read and search the evidences … we may just input some key search information to AI, and ask what latest information it finds …" (015, associate chief physician)	36
	"I wonder if there's a day if AI could be a real assistant for me. Nowadays there is chatGPT, I believe in future there will be a chatbot in oncology area, knows everything, tells us what is the best treatment option ... future PODS tools may be like this ..." (002, attending surgeon)	37

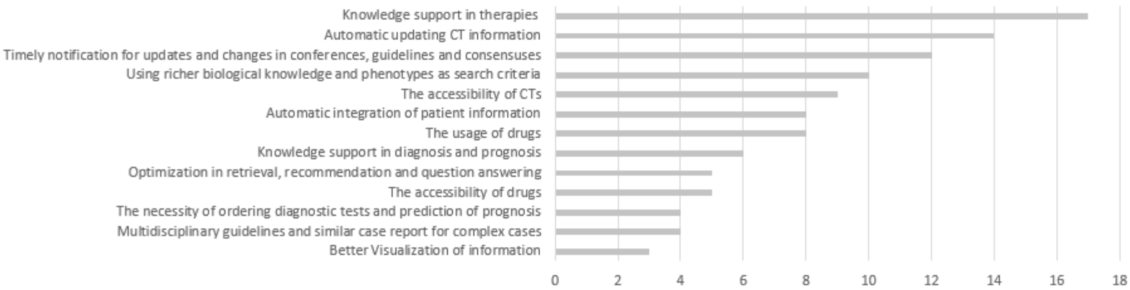

Figure 3 The themes and the number of interviewees who mentioned the topic. CT, clinical trial.

Theme 1: Better Access to Oncological Knowledge

Oncological Knowledge plays an important role in PODS, and the most frequently mentioned need for PODS was faster and better access to the latest oncological information. Precisely, comprehensively, and timely integrating the knowledge of diagnosis, treatment, and prognosis from various sources such as knowledge bases, academic conferences, and guidelines is the most value function of PODS tools.

Knowledge support in therapies (100%)

All interviewees emphasized the importance of the function of knowledge acquisition of therapies in support of clinical practice in oncology.

Guidelines, conferences, and consensuses (71%)
Clinicians paid much attention to latest progresses of oncology area and updates released in guidelines, conferences, and consensuses. However, the current access of these information was mainly from manual search and information share from colleagues (Quote 1). In order to meet these requirements, there is a news update session before MDT discussion in Thoracic Oncology Center to review and interpret latest updates released on academic conferences or by professional associations. However, once a week knowledge updates by attending MDT may not meet the urgent needs during daily clinical practices. They hoped this latest information could be renewed in PODS tools in time (Quote 2-3).

Clinical trials (82%)
All physicians referred to this need. Physicians had a greater need in this aspect, as most of the patients in the thoracic oncology department present with advanced stages and require systemic treatment. After the failure of guideline-recommended therapies, appropriate CTs had to be taken into consideration. Approximately 25-50% of patients would require enrollment in CTs (Quote 4), necessitating physicians to have a comprehensive understanding of available options. The two major channels to access up-to-date CT information were manual search from CT registration websites and information share from physicians who take in charge of CT recruitment and data collection. However, frequent retrieval of this information imposed a burden on their workload. Timely and automatic updates of CT information could help alleviate this burden (Quote 4-5). Mid-term outcome of CTs were also given more attention (Quote 6-7).

Drugs and treatments (47%)
Surgeons and radiotherapists hoped to access the latest knowledge on targeted therapy, immunotherapy, and chemotherapy drugs through PODS tools (Quote 8). Physicians had greater demands for drug information, including their usage and dosage (Quote 9-10). Also, clinicians paid much attention to the side effects of the treatment regimens. It was important to be aware and informed of the potential side effects of certain treatment options for every single patient. At present, the prediction of side effects of certain therapeutic strategy still relied on clinicians' experience, while current PODS tools had limited support (Quote 11).

Knowledge for complex cases (24%)
In some complex cases, physicians expressed a need for acquiring more evidence such as multidisciplinary guidelines and case reports. When encountering patients with a history of multiple primary cancers, convenient access to multidisciplinary guidelines was identified as an important need (Quote 12). Furthermore, clinicians hoped to find similar case reports when dealing with patients having rare tumor types (Quote 13).

Knowledge support in diagnosis and prognosis (35%)

In addition, diagnostic and prognostic evidence was sometimes mentioned by interviewees, which were also important for selection of treatment options. Especially in the area of diagnosis, experts from MDC and Pathology Department were often asked to explain functions, oncogenicity and pathogenicity of specific biomarkers and molecular alterations so as to interpret the potential clinical significance (Quote 14). PODS tools could help collect and filter related evidence from various knowledgebase and assist the explanation and interpretation more comprehensively (Quote 15). Moreover, current PODS tools lack reliable search functions for these purposes (Quote 16-17).

Theme 2: Feasibility Support

When a treatment option was acknowledged or proposed, its feasibility in practice needed to be evaluated. Much of this work was repetitive and could be automated by the PODS tool.

The accessibility of CTs (53%)

Whether patients had the channel to access appropriate CTs was as important as meeting the inclusion/exclusion criteria (Quote 18). Geographic barrier seemed to be a significant influencing factor that might directly affect CTs accessibility (Quote 18). Furthermore, up-to-date recruitment status was another essential factor which might help clinicians filter the available CTs and improve the effectiveness of patients' enrollment (Quote 19).

The accessibility of drugs (29%)

The patient's affordability was one of the biggest factors after medical condition when considering treatment options (mentioned by all interview participants). The drugs mentioned in knowledge bases or clinical guidelines might not be practically accessible regarding cost. In this case, clinicians would like to know whether the cost of certain therapeutic drugs could be covered by Chinese medical insurance policy or by commercial insurance, and took patients affordability into consideration on decision-making of a reasonable therapeutic regime (Quote 20-21).

Prediction models: the necessity of ordering diagnostic tests and prediction of prognosis (24%)

Nowadays, genomic information could be acquired by genetic testing on peripheral blood sample. However, in order to pursue the test results more precisely, sometimes tissues are needed to be obtained. The ways of obtaining tissue are usually invasive such as puncture, bronchoscopy, or surgery, which often cause pain to patients. Also, clinicians were cautious about ordering invasive and unaffordable tests and would prefer a less expensive way to assess the need for these tests (Quote 22-23). In addition, some surgeons would like to use prognostic prediction models to help estimate the risk of surgery (Quote 24).

Theme 3: Support Abilities Demands in Decision-Making Process

During MDTs, there was also clear needs for support in the decision-making process.

Using more flexible biological knowledge and phenotypes as search criteria (59%)

Clinicians expressed a demand to incorporate biological knowledge such as the function of variants or signaling pathways into their searches for information (Quote 25). They would also like to combine phenotypes in the process of finding better treatment options. The most focused phenotypes were stage, number of treatment lines (treatment course), location of lesion, whether multiple primary cancer, and physical conditions such as ECOG, complications, etc. Automatic matching of patients based on phenotype and inclusion/exclusion criteria was also a frequently mentioned need (Quote 26).

Automatic integration of information (47%)

The summarization work in preparation was repetitive and time-consuming. All preparers mentioned that it would be beneficial to have an automatic patient information integration function (Quote 27-29). The ability to record the discussions in MDT was also a valued function, since some patients would be discussed for several times, it was of great help to track not only the patient's diagnostic and treatment history, but also the previous MDT discussion conclusion (Quote 30-31).

Better Visualization of information (18%)

Some clinicians complained about the inconvenience of information presented in slides, especially when the patient's history was long and had to be spread across several pages. They preferred a better visualization of patient information (Quote 32-33). Some clinicians were willingly to see an auto chart display function to be added on PODS tools, in order to show statistical results on previous real-world genomic data more straightforward. This improved data display function could potentially assist clinician to view cancer mutation profile, and their relationship between clinical phenotype, therapeutic effectiveness, and prognosis more directly. Furthermore, such function may not only help clinicians optimize clinical decision based on previous in-house clinical evidence, but also support scientists to design clinical study according to objective analysis. (Quote 34).

Optimization in retrieval, recommendation and question answering (29%)

In addition to search optimization (mentioned in 3.4.1), clinicians wanted PODS tools to intelligently rank treatment options and CTs, and to adjust recommendations as search conditions change (Quote 35).

The popularity of language models has led clinicians to hope that artificial intelligence could help interpret clinical evidence in literature through question answering (Quote 36-37).

Discussion

The Functional Framework of Needs for Integrated PODS Tools

After the theme extracted and confirmed, a functional framework of needs for integrated PODS tools was proposed. In the framework, the needs for PODS tools could be basically divided into three dimensions: (1) provide clinicians with up-to-date and straightforward oncology knowledge; (2) offer suggestions on reasonable diagnosis and feasible clinical management; (3) comprehensive and efficient support for decision-making process (Table 3).

Table 3 Functional Framework of Needs for Integrated PODS Tools.

Dimension	Subcomponents	Recommendation
Up-to-date and straightforward oncology knowledge	High level evidence	High level evidences such as guidelines, conferences and consensuses are always be a priority for clinicians when making decisions about any patient. Clear labelling of evidence level is also conducive to help clinicians determine the credibility of the evidence.[39]
	Clinical trials	After failure of guideline-recommended therapies, appropriate CTs will require to be considered.

	Biological knowledge in diagnosis, treatment, and prognosis	Better explanation of biological knowledge will help clinicians understand the pathological mechanism. The integration will also improve the interpretation of clinical significance of genomic testing results.[40]
	Drug and therapy information	The usage, dosage and side effects information of drugs and therapy options help clinicians accurately implement the treatment.
	Case reports and pre-clinical evidence	Case reports and pre-clinical evidences are important references for complex or rare cases.
	Multidisciplinary guidelines	Although the proportion of patients with multiple primary cancer is small, the discussion of these patients are gradually increasing. These guidelines can be used to keep physicians updated on other cancer types outside of MDTs.
Feasibility Support	Accessibility of clinical trials	For patients, the enrollment criteria of CT are as important as the therapy itself. Letting clinician know whether a certain CT could be accessed also matters.
	Accessibility of drugs and treatment options	A function that helps clinician know about the drug accessibility could save time in screening available CTs and doctor-patient communicating.
	Application of prediction models	There are lots of prediction models in oncology area, such as operative risk assessment, risk for recurrence, etc. However, current PODS tools have not integrated these models yet. Integrating and applicating these models could be a assistance in decision-making.
Support Abilities	Individualized search criteria	Optimization in search criteria like biological knowledge and phenotypes could help clinicians search treatment options more precisely.
	Automatic integration of patient information	Automatic summarization of patient information helps reduce the *Preparation* time.
	Recordability and traceability	Timely record MDT discussion function could help clinicians trace back and summarize and analyze previous data easily.
	Better visualization	Auto-generated timeline help clinician read patients with long history and complex treatment course straightforward, whereas graphs and tables could help clinicians understand data better and interpret clinical significance easily.

	Treatment option recommendation	Treatment recommendation function with evidence classification, data matching and sorting algorithm could provide extra comprehensive support to clinician on decision-making.
	Question answering and dialogue	The development of artificial intelligence and large language models may implement the function of multi-turn question answering and dialogue, and provide information precisely.

Providing timely and updated oncology information is the most frequently mentioned need by clinicians. Currently, most clinicians still obtain the latest cancer knowledge through literature review, data released and presented in academic activities/conferences, or information shared by fellow expertise and drug suppliers, etc. and an integrative PODS tool which properly meet the clinical requirements for up-to-date knowledge summarization and presentation is not yet available. However, clinicians are not satisfied with currently available tools. The main issues include delayed updates, poor retrieval conditions, and insufficient integration with molecular biological evidences. PODS tools supposed to incorporate interpretation of available molecular testing results to meet the requirements of precision medicine concept and to aid molecular tumor board. [18,41]

Our framework suggest that integrated PODS tools related to oncology knowledge should include a timely updated comprehensive knowledgebase,[42] incorporating drug approval information from official administrative authorities, clinical guidelines, and consensus from well-recognized organizations, released CTs results from academic conferences, pre-clincial evidences from literature review, and open CTs updates through official channels. This knowledgebase should be highly structured and user-friendly to meet the advanced retrieval needs of clinicians, focusing on information regarding genetic variants information, molecular functional significance, evidences on therapies and prognosis, multidisciplinary guidelines, and case reports. Genomic profile of cancer patients was normally presented on genetic testing reports, which comprised informative information on potential actionable targets with variants classification according to well-recognized guidelines and recommendations. However, such variant classification critera, four and five classes for somatic mutation [43] and germline variant [44] respectively, and their clinical significance were not familiar to clinicians. Therefore, using a straightforward and clinical-oriented way of display genetic results may help the effectiveness of decision-making process. Furthermore, each clinical evidence of certain genomic variant was shown separately on genetic testing reports, whereas clinician may hope to see more integrative and comprehensive conclusion incorporating multiple related evidences, even on those with discrepancy.

In addition, most clinicians hope to obtain support for feasibility in the diagnosis and treatment process. Although current drug insurance and CT information query systems are well-developed, their integration with patient information is insufficient. Future feasibility-support PODS tools should integrate patient information from local or in-house HIS data with medication usage, making it easier for clinicians to access relevant data. Additionally, diagnostic, and prognostic algorithms or models have broad potential applications in clinical practice, helping clinicians optimize the decision-making process in various situations. [45,46]

Support in the decision-making process is a less developed yet widely demanded aspect of existing PODS tools. Clinicians are willing to see improvements in integrating patient information, optimizing information visualization, and enhancing search and recommendation methods [47] for more efficient decision-making process. Especially, oncology knowledge-related PODS tools should feature an optimized recommendation function[48] and matching algorithm based on the level of evidence and CTs to enhance clinicians' confidence in using these tools.[49] With the development of language models, knowledge acquisition through question answering or dialogue is also expected to become a future direction for knowledge-related PODS tools.[50] Currently, the integration of patient information in PODS tools is limited and often requires manual input.[51] Automatic integration of patient information and improved visualization will offer significant assistance in MDT meetings and routine clinical practice.[7,52]

Limitation and Advantages

To the best of the authors' knowledge, this is the first study to assess the function needs of integrated PODS tools. The results align with recent research and propose statements,[15] indicating that oncological clinicians increasingly rely on the automatic interpretation of genetic test results, which may significantly improve the practice of precision oncology.

The needs analysis should be considered considering some study limitations. First, the rapid development of precision oncology means that additional needs may arise in the future. Second, this study was conducted in only one hospital in China, highlighting the need for broader investigations across more regions and clinical units. Third, the observation and interview processes were based on the subjective perspectives of researchers and interviewees, which may introduce some bias.

Although the development of PODS tools is rapid, traditional genetic testing report will still be an irreplaceable support in genomic interpretation in the future for a long time. The combination of genetic testing report and PODS tools may take both advantages, providing new paradigms in decision-making in oncology, which could be a further study. New technology in artificial intelligence, such as generalist models [53] or LLM agents, may provide a better optimization and interaction for clinicians and PODS tool developers.

Conclusions

With the development of precision oncology, the need for support tools in decision-making has emerged. Our findings clarified and categorized the needs and usage of current PODS tools, providing a framework for future integrated PODS tool development.

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Conflicts of Interest

None declared.

Abbreviations

CT: Clinical Trial
LLM: Large Language Model
MB: Molecular biologists
MDC: Molecular Diagnostic Center
MDT: Multidisciplinary Team
PODS: Precision Oncology Decision Support
PUCH: Peking University Cancer Hospital
TCM: Traditional Chinese Medicine Department

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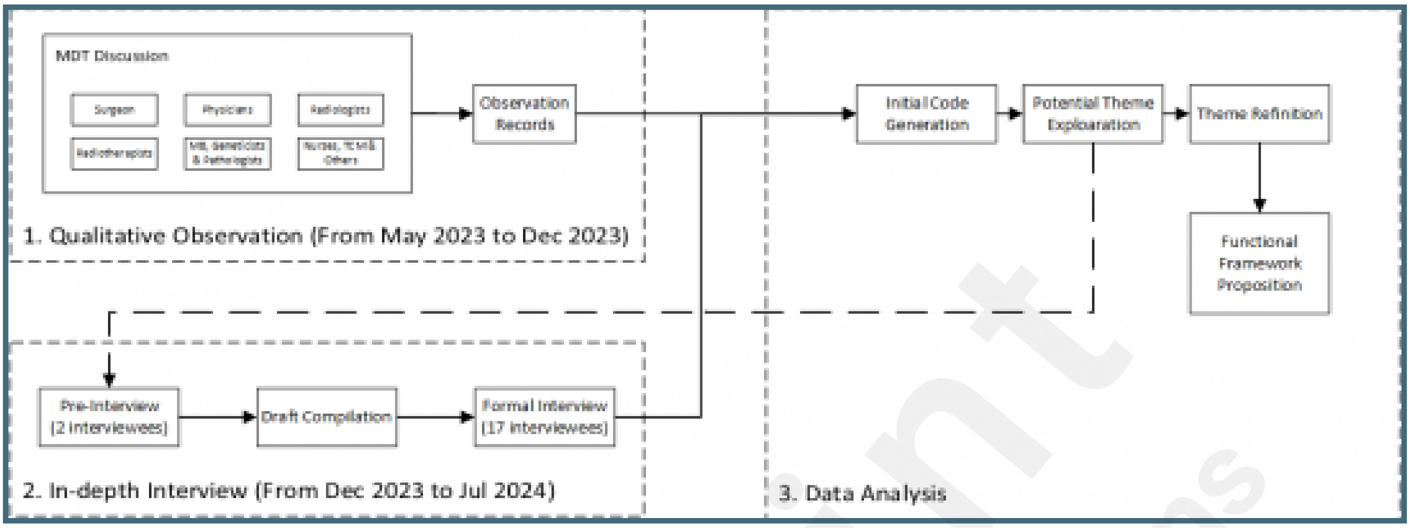
Supplementary Files

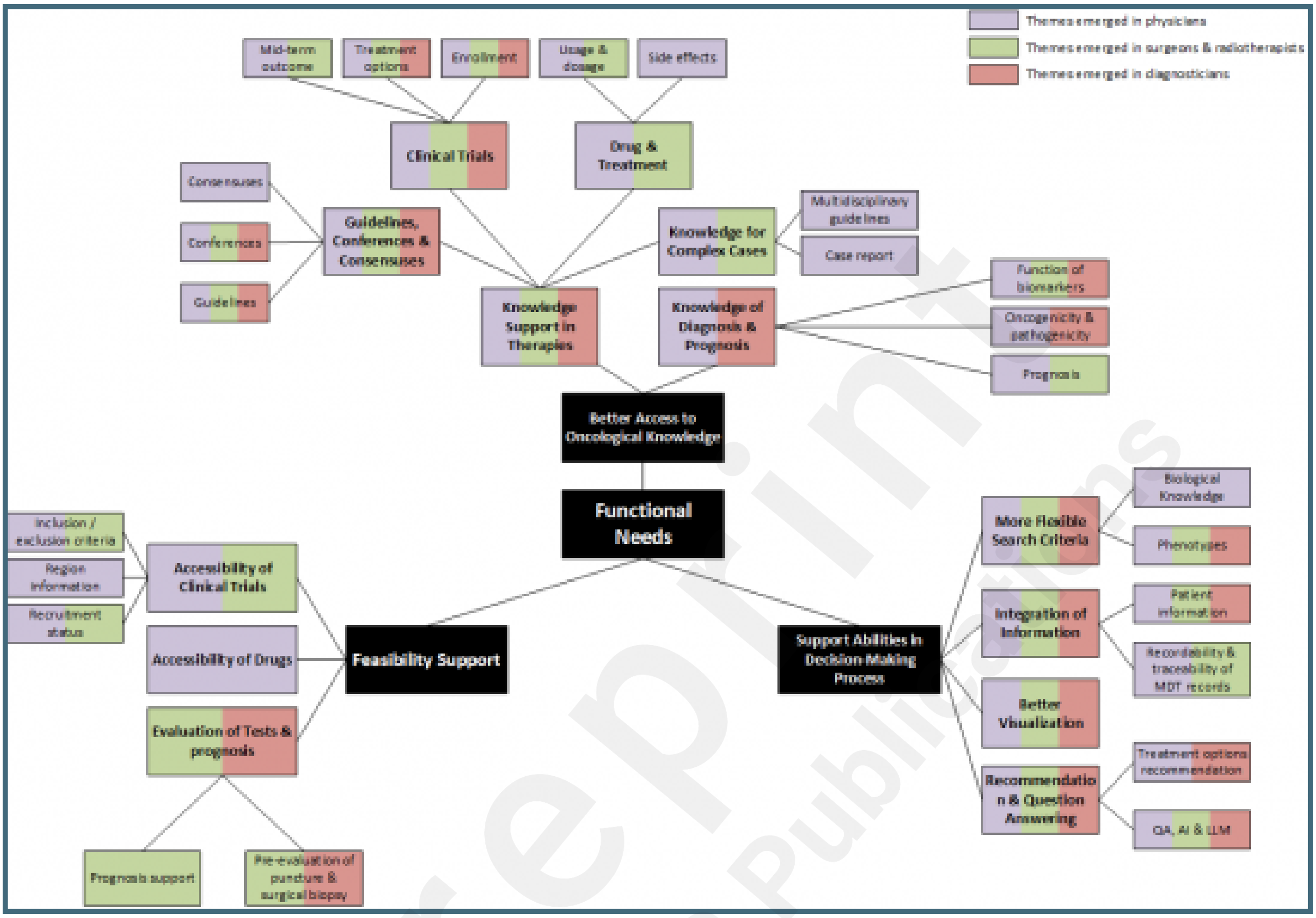
These materials are part of the research data that are open to readers.
URL: http://asset.jmir.pub/assets/8dfbb57c6d3b4b27d539aabff16a9866.docx

Figures

The process of the research. MDT, multidisciplinary team. MB, Molecular Biologists. TCM, Traditional Chinese Medicine Department.



Themes constructed from qualitative observation and interviews. QA, question-answering. AI, artificial intelligence. LLM, large language models.



The themes and the number of interviewees who mentioned the topic. CT, clinical trial.