

A Practical Guide to Using Futures Methods in Healthcare: Approaches, Applications, and Case Studies

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Abstract

The paradigm shift of digital health has transformed healthcare delivery, medical practice, the roles of patients and healthcare professionals, as well as the cultural dimensions of care in the 21st century, prompting increased discussions about the future. Unprecedented advancements in technologies, from wearable sensors to artificial intelligence (AI), are directing our attention toward emerging challenges and opportunities. With the accelerating rise of AI and automation, the next paradigm shift of healthcare is imminent: the inclusion of a technological entity as an active participant within the medical team, alongside patients and healthcare professionals. The COVID-19 pandemic, a recent focus on value-based healthcare, and global demographic issues from doctor shortages to aging populations further reinforce that notion.

However, discussions around the future of medicine, specialties, or therapeutic areas have often relied on the subjective opinions or perspectives of key opinion leaders rather than on future strategies, policies, visions, and scenarios being grounded in rigorous and established methods.

Our goal with this paper is to provide a methodological guide that is supported by case studies, demonstrating how futures methods can be systematically applied in healthcare. By offering practical examples, we intend to empower medical professionals, healthcare leaders, researchers, patients and policymakers with the tools to anticipate and navigate future challenges and opportunities more effectively.

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Introduction

The paradigm shift of digital health has transformed healthcare delivery, medical practice, the

roles of patients and healthcare professionals, as well as the cultural dimensions of care in the 21st century, prompting increased discussions about the future. Unprecedented advancements in technologies, from wearable sensors to artificial intelligence (AI), are directing our attention toward emerging challenges and opportunities. With the accelerating rise of AI and automation, the next paradigm shift of healthcare is imminent: the inclusion of a technological entity as an active participant within the medical team, alongside patients and healthcare professionals. The COVID-19 pandemic, a recent focus on value-based healthcare, and global demographic issues from doctor shortages to aging populations further reinforce that notion.

To better understand these challenges and opportunities, researchers and healthcare institutions have increasingly applied structured futures methods—such as the futures wheel, scenario analysis, forecasting, and horizon scanning—to systematically explore, generate, and prepare for multiple possible futures[1]. Such methods have been employed in social sciences, economics, and business management for decades. Therefore, while the integration of such methods in healthcare is not new, it has never been more opportune than today.

However, discussions around the future of medicine, specialties, or therapeutic areas have often relied on the subjective opinions or perspectives of key opinion leaders rather than on future strategies, policies, visions, and scenarios being grounded in rigorous and established methods.

This underscores the need for futures methods to be widely adopted and effectively incorporated into both medical practice and healthcare policymaking. Integrating structured foresight techniques into strategic planning enables clinicians and policymakers to transition from reactive decision-making to proactive, plausible approaches that shape a more resilient and adaptive healthcare system.

Our goal with this paper is to provide a methodological guide that is supported by case studies, demonstrating how futures methods can be systematically applied in healthcare. By offering practical examples, we intend to empower medical professionals, healthcare leaders, researchers, patients and policymakers with the tools to anticipate and navigate future challenges and opportunities more effectively.

Box 1. A brief overview of futures methods with their key principles.

The preferred future cannot be attained only by extrapolating existing tendencies. Futures methods seek to systematically investigate, generate, and evaluate possible, probable, preferred, and plausible futures to enhance informed decision-making. These methods encompass the examination of prospective changes in conditions resulting from the implementation of alternative policies and

measures, together with the anticipated repercussions of specific policies and measures.

It is contended that the results of initiatives employing futures methods significantly rely on the techniques utilized and the competencies of the participants. Futures methods include both qualitative and quantitative components. It is also feasible to differentiate between exploratory and normative approaches.

The application of futures methods substantially enhances the generation and implementation of futures literacy, hence facilitating prompt action for people or organizations to navigate change more adeptly. The capacity for foresight provides more time to comprehend challenges and possibilities, formulate innovative strategies, design new products, and articulate a vision for prospective organizational transformations.

Methods

Futures methods that our benchmark study already identified were chosen as the focus of this paper, and we looked for case studies and papers highlighting their practical use. The methods include the futures wheel, scenario analysis and planning, backcasting, technology assessment, policy analysis, horizon scanning, and the Delphi method.

We performed an exploratory literature search on Pubmed and Crossref with the following search terms derived from the previously selected methods:

"the Futures Wheel" OR "Future Wheel"

"scenario analysis"[Title/Abstract]) AND (future[Title/Abstract]

"scenario planning"[Title/Abstract]) AND (future[Title/Abstract]

"backcasting"[Title/Abstract])

"technology assessment"[Title/Abstract]) AND (future[Title/Abstract]

"policy analysis"[Title/Abstract]) AND (future[Title/Abstract]

"horizon scanning"[Title/Abstract])

"Delphi"[Title/Abstract]) AND (future[Title/Abstract]

We used PubMed to capture health-focused applications of futures methods and Crossref to identify broader interdisciplinary uses across policy, planning, and technology fields, ensuring a

comprehensive view on how these methods might have been applied in the healthcare setting.

Inclusion criteria were 1) original research articles, 2) that used the specified futures methods, 3) that are relevant to medicine or healthcare, and 4) with at least an English abstract available.

Results

The Futures Wheel

The Futures Wheel (FW) method helps explore the direct and indirect consequences of an event, milestone, statement, or trend. It was first used by Jerome C. Glenn in the 1970s[2]. Creating an FW starts with placing a central event in the middle of a diagram, and then mapping out its first-order effects, which will lead to possible second- and third-order consequences. After each primary effect, secondary effects create further circular patterns. To identify secondary impacts, participants are asked to ignore the initial element placed in the center of the FW and instead provide the most likely future outcomes of the primary impacts. Participants can similarly outline third- and fourth-order effects. Several research groups have used this method to map out the consequences of healthcare and medical events.

Similar to structured brainstorming, FW is organized around future-related issues and conceptualized within this framework[3]. The impact mechanism persists until the consequences of the event or trend become apparent. To identify future trends and events, futurists ask participants what next steps they expect, what the essential components of the events and trends are, and what impacts or consequences they expect. This creates a cognitive framework for the future, encouraging novel concepts[4]. (Figure 1.)

FW is an accessible option that demands neither special software nor specialized equipment. A sheet of paper and a pen, or a schematic diagram, are sufficient to apply the method. We provide a sample diagram in Figure 1.

It has been demonstrated to encourage subsequent investigation and comprehension of occurrences and trends. When futurists encounter obstacles in strategic planning, they frequently employ FW to rejuvenate the group's cognitive flow. The outcomes of FW can facilitate concept formation, methodical investigation of futures, structuring of future knowledge, and future experimentation[5].

Nouhi et al applied this method to assess the primary and long-term effects of COVID-19 on

the healthcare system[6]. They focused on key dimensions such as service delivery, workforce, infrastructure, governance, pharmaceutical industries, research, and medical education. The research started with a systematic literature review, then proceeded with expert panel discussions, and finally, concluded with structured brainstorming sessions. This approach enabled the project managers to understand the complexity of COVID-19's impact and offer a systematic foresight into the pandemic's long-term implications.

Eidgaih et al aimed to discover the impact of pandemics on elderly populations in Iran[7]. Considering Iran's demographic shift towards an aging society, comprehending the multifaceted repercussions of pandemics on older individuals is important. The research was conducted in three phases. Initially, a panel of geriatric health experts identified a range of pandemic-related effects through brainstorming and literature review. These impacts were further analyzed using the Social, Technological, Economic, Environmental, and Political (STEEP) framework, classifying them into six dimensions: socio-psychological, technological, economic, environmental, political, and health-related consequences. The final consensus phase involved validating the findings and refining the FW model to depict interrelated implications. The research identified 81 distinct effects of infectious disease outbreaks on the elderly, with 10 categorized as opportunities and 9 categorized as threats. The study concluded the necessity of strengthening digital literacy initiatives, broadening mental health support services, and cultivating resilient healthcare systems tailored to the specific needs of aging populations. The FW provided an essential analytical framework for anticipating future crises.

Scenario analysis and scenario planning

Scenario analysis (SA) and scenario planning (SP) are complementary methods used in foresight. SA helps to discover possible future scenarios based on key driving forces and major uncertainties. SP is a more structured approach, usually used by businesses and governments to prepare the uncertain futures by identifying strategies that can work across different possible circumstances[8]. The primary goal of SP is to find the best combination of strategic actions that might optimize organizational performance amidst diverse uncertainties. Futurists point out that the future is never singular, as there are always multiple possible scenarios. Foresight methods like SA and SP offer organizations valuable tools to better prepare for a range of possible futures. The next section outlines several examples of how these approaches have been applied in practice. (Figure 2.)

Leufkens demonstrated that SA was already used in medicine as early as 1994[9]. The author aimed to explore how SA can serve as a strategic tool for anticipating the changing dynamics of healthcare policy. The research involved several steps. It began with the delineation of the industry, followed by identifying critical uncertainties and key driving forces, such as demographic shifts and scientific advancements. These were then categorized into two groups named market regulation and technological trust. Researchers constructed four narrative-based scenarios, based on quantitative estimations that were obtained from drug consumption databases and demographic forecasts. This mixed-approach study illustrates how qualitative and quantitative methods can be combined.

York et al used SA to examine the future of precision[10]. The study sought to establish a collaborative foresight process that involved both undergraduate students and experts. The methodological framework combined SA with designing fiction, mixing components of storytelling and visual media. Structured workshops adhered to a three-phase process. Initially, experts and students identified the key drivers that are shaping precision medicine. Secondly, SA was used to detect the varying levels of technological adoption and regulatory policies. Ultimately, participants developed visual and narrative depictions of possible futures. The study demonstrated that scenario-based storytelling can foster interdisciplinary dialogue, and it also highlighted the importance of governance in shaping ethical and equitable medical futures.

Bierbooms et al explored the future residential options for individuals with mental health disorders in Eindhoven[11]. They adhered to van der Heijden's deductive scenario method[12]. They began with the deep examination of the external environment using document analysis and stakeholder interviews. Experts from different areas, such as mental health services, housing corporations, municipal authorities, and patient advocacy associations, identified two key uncertainties: the availability of financial resources and the potential for effective social integration of individuals suffering from mental health issues. These uncertainties formed the four scenarios that were evaluated in a stakeholder workshop. They concluded that community-based care with robust social support was the most preferable scenario, regardless of financial circumstances. The results indicated that this method is an effective tool for converting macro-level trends into actionable, real-world local policies. Consistent with earlier research, this study also concluded that stringent collaboration between healthcare providers and policymakers is essential.

In another study, Ludvig et al applied SA in a workshop to examine the future of academic health sciences libraries[13]. Participants identified key drivers of change and developed four possible scenarios for libraries: *Library, Inc.*, wherein libraries operate as profit-oriented

organizations; *Evolution to Reformation*, characterized by their complete integration into clinical, research, and educational frameworks; *If Disney® Ran the Library*, emphasizing user experience and public engagement; and *Go Global*, which prioritizes international collaboration and the public accessibility of important health information. Each scenario brings distinct obstacles and, naturally, opportunities from financial perspectives and open-access policies. Likewise, they assist librarians in identifying their new roles in an increasingly digital landscape. SA empowers the libraries to mitigate risks and consider their realistic opportunities while anticipating possible futures.

Backcasting

Backcasting, often following SA or visioning, is a futures method that starts with the definition of a preferred or a plausible future state and then works backward to the present to identify the necessary steps to achieve this vision. The approach is particularly useful for recognizing potential roadblocks, necessary interventions, and policy changes required to reach the future goal. By focusing on the end goal rather than just extrapolating from actual trends, backcasting allows for the development of a structured and strategic pathway toward the envisioned future.

The process is distinctly normative, since it delineates the necessary policy actions required to attain a specified future endpoint from the present. The method is used in situations where a normative objective exists, although fundamentally uncertain future occurrences influence these objectives[14]. It involves identifying key stakeholders, resources, and decision points, ensuring that all of the relevant factors are considered in the implementation process[15]. An innovation champion is often designated to advance the initiative[16]. Backcasting is particularly useful in complex systems like healthcare, where foresight accuracy is limited and the most likely future may not align with the most desirable one.

The COVID-19 pandemic has underscored the urgent need for proactive strategies to strengthen healthcare systems[17]. A study employed backcasting to identify actionable measures for achieving global health resilience by 2030. The study delineated a preferred future state of health system preparedness and retrogressively formulated 13 strategic plans encompassing policy changes, healthcare system reforms, and international collaboration. By addressing key challenges such as pandemic response, health equality, and sustainable healthcare practices, it provided a roadmap for governments, health organizations, and international institutions to improve pandemic preparedness and global health security. This comprehensive approach demonstrates how systematic foresight might yield plausible solutions to global health challenges in the post-pandemic era.

To facilitate eHealth adoption, researchers conducted focus group interviews with middle managers and staff across different healthcare service settings to identify roadblocks and facilitators of digital healthcare implementation[18]. These insights provide valuable information for understanding management challenges and guide conversations on future-oriented decision-making. The authors highlight the method's potential as an invaluable instrument for structuring future decisions by reverse-engineering from a preferred healthcare scenario to determine necessary steps and policy changes while stepping away from the limitations of present-focused thinking. Backcasting is presented as a framework that can help address uncertainties, establish a rational basis for decision-making, and foster active stakeholder engagement in complex transformations. The research exemplifies how empirical evidence on current challenges can be utilized to formulate a future vision and delineate actionable strategies for its achievement.

Technology Assessment

Health Technology Assessment (HTA) is a multidisciplinary process that systematically investigates the medical, social, ethical and economic implications of a health technology. In a complex, evolving healthcare environment, HTA aids decision-makers in comprehending the implications for all stakeholders (patients, providers, payers, policymakers) while providing an independent appraisal of the benefits and detriments of technology to guide economic decisions. HTA facilitates the integration of diverse evidence assessments to ensure the right utilization of technologies, safeguarding the optimal and ethical allocation of healthcare resources[19].

A study aimed at providing guidance on how the patient's perspective should actively influence decisions in technological development. The authors contended that it is essential to incorporate patient preferences from the outset of the design process, rather than treating their input as an afterthought. The study employed HTA to systematically evaluate the clinical, economic, and societal impacts of health technologies, incorporating direct feedback from the end users, by considering patient-level outcomes, preferences, and values. This patient-centered approach exemplifies inclusive and transparent assessment, as it ensures that real-world perspectives guide policy and practice. It highlights that including patient viewpoints can improve the relevance, adoption, and overall success of health innovations, proving HTA's potential to adjust to the shifting expectations in healthcare[20].

This idea is particularly true in when health systems need to determine the value of new and emerging technologies, such as precision medicine. Love-Koh and their collaborators proposed that

traditional evaluation models are insufficient for assessment due to the integration of highly unique patient data, including genetic, environmental, and lifestyle aspects, necessitating the development of new, adaptive frameworks. They did not offer a single, definitive way of changing the evaluation, but suggested a variety of methodological modifications in economic modelling, evidence standards, and evaluation timing. The study combined a literature review with expert interviews, allowing a comprehensive exploration of possible obstacles. Utilizing HTA principles, the research delineates deficiencies in current HTA models and highlights the need for more flexible, responsive assessments. This article illustrates that HTA needs to continue to adapt its existing ways of working in order to remain functional in a meaningful and useful way in these innovative and rapidly changing healthcare settings[21].

However, HTA must remain systematic and evidence-based, even during rapid public health crises like the COVID-19 pandemic, to support proper decision-making. Cadeddu et al. described a practical example from the first 12 months of the COVID-19 vaccination rollout in Italy that included horizon scanning combined with multi-criteria decision analysis to guide HTA to assess vaccine candidates under a variety of criteria, such as distribution logistics and availability. In this article, HTA demonstrated its strength in providing actionable and relevant advice even in rapidly changing times, showing itself to be a robust, evidence-based tool[22].

This demonstrates HTA's critical role in guiding future research and policy development in the context of personalized medicine.

Policy analysis

Policy analysis is a systematic method applied to public policies to determine their efficacy, implications, and consistency with societal objectives. It entails determining policy problems, analyzing current policies or suggested solutions, and projecting their likely impacts along multiple dimensions, such as social, economic, ethical, and political aspects. By applying methods such as literature reviews, stakeholder analysis, interviews, or comparative analysis, policy analysis attempts to inform decision-makers to make strategically appropriate, plausible choices to solve complex challenges.

A study analyzed the challenges faced by rural healthcare providers and illustrated how policy analysis can be used to form an effective response[23]. The authors employed policy analysis to identify targeted interventions that can enhance sustainability and quality improvements, acknowledging that rural healthcare providers are especially vulnerable to the impacts of public

policy changes due to their constrained size and resources. The research identifies deficiencies in current healthcare policies affecting rural providers by analyzing existing literature and policy contexts, demonstrating that policy analysis offers a systematic approach to comprehending these socio-political dynamics. This methodological approach delineates actionable steps for policymakers, establishing a definitive framework to improving rural healthcare infrastructure.

Another study used policy analysis to anticipate and guide policy change, using the issue of legalizing abortion in Indonesia as a case study[24]. Recognizing the intricacies of policy changes, the researchers applied a well-established policy process theory, the advocacy coalition framework, to analyze stakeholders' beliefs, alliances, and influence. The analysis revealed that policy change was substantially affected by stakeholder coalitions and their foundational ideas through the examination of debates, stakeholder positions, and alliances. This demonstrates the significance of policy analysis in anticipating policy changes and informing strategic approaches to achieve desired outcomes.

Horizon scanning

Horizon scanning (HS) is a systematic, future-oriented method for identifying and analyzing emerging trends, innovations, or weak signals. Its objective is to facilitate policy making, decision-making, and resource allocation in advance by addressing emerging risks, enhancing resilience to future shocks, and mitigating uncertainty[25]. It is based on the collection and analysis of information from a wide range of sources, including online databases, literature, expert panels, stakeholder engagement, and AI-based Generative Pre-trained Transformer (GPT) applications to identify early warning signs of change. The key aim is to inform strategic decision-making, policy formulation, and resource allocation in advance, enabling organizations to anticipate developments and respond accordingly to future challenges or opportunities.

Nonetheless, HS can only effectively contribute to shaping the future if it transcends mere information gathering and strategic intelligence creation as a standalone approach and is instead seamlessly incorporated into the foresight process[26]. Therefore, it is argued that nowadays, HS comprises an essential element for the effective accomplishment of any futures studies or foresight project[27].

The method has demonstrated its usefulness for various strategic purposes in healthcare, including regulatory preparation, policy change, technology prioritization, and anticipating social and ethical effects. The research group of Rodríguez-Gómez used it to analyze how nanotechnology-

enabled products in healthcare would possibly alter existing regulatory frameworks, suggesting that anticipatory methods could reduce delays in decision-making and better align oversight systems with regulation, without hindering innovation[28]. Similarly, Michels and their team analyzed the development of an international HS tool to identify medical devices at an early stage of their life cycle, showing how the tool was shaped by different perspectives, such as regulation, HTA, and resource-sharing among small countries[29]. In both examples, HS was used to support system-level preparedness, rather than prediction in a narrow sense.

Emerging technology identification and prioritization are also areas where HS has proven useful. The authors of the United Kingdom (UK)-based study described a systematic approach involving biomedical engineers to identify remote monitoring tools for national assessment. They informed their judgment using various sources, including literature, expert input, and benchmarks to recommend actions for the UK Department of Health[30]. A more comprehensive picture was provided by Ormstad and their research team, who compared national HS systems for medical devices, looking at differences in scope, timing, and institutional structure. They concluded that even if the practical approaches to the method might be dissimilar, their function as a tool for early awareness remains unchanged[31].

The method can assist in discovering ethical and social issues associated with new Information and Communication Technologies (ICT) in healthcare and aging. Acknowledging the rapid technological development and related ethical uncertainty surrounding this subject, the authors applied a structured HS method using systematic literature reviews, expert interviews, and analysis of online discussions to identify both weak and strong signals. They successfully highlighted important ethical and social concerns, including stereotyping of older persons, privacy and informed consent, autonomy concerns, and apprehension around technology use[32].

In response to the emerging market context, the authors Yeoman et al. evaluated trends that might anticipate how wellness and ageing would shape behaviours and expectations for future consumers and services. In these cases, HS was beneficial for foresight, beyond the scope of technical systems, and helped to direct attention towards changes in society that are closely tied to healthcare needs[33].

The Delphi method

The Delphi method is a structured technique used to achieve expert consensus on complex

topics. It involves a panel of relevant experts who typically participate anonymously in two or more rounds of surveys to gather their opinions on the subject matter. Following each round, the survey responses are summarized by the facilitator and shared with the participants. Based on this collective feedback, the panellists can reassess their previous answers, leading them to converge on a common answer over subsequent survey rounds. This process is repeated until the predefined stopping criterion is reached, such as the achievement of consensus. The Delphi method is a structured conversation process that elucidates the rationale behind extreme viewpoints and facilitates feedback.

To investigate the required skills and attitudes in the digital health curriculum for medical students, the authors conducted a scoping review and Delphi method study[34]. The scoping review, which was based on the research question: “What knowledge, skills and attitudes (KSAs) within digital health are essential for future doctors?”, served as the basis to identify relevant topics for inclusion in the Delphi questionnaire. The participatory expert panel included 18 individuals who professionally worked with digital health research/implementation or were actively involved in developing medical education curricula with knowledge of digital health. After completing two questionnaire rounds, the expert panel identified 40 digital health topics, including a range of knowledge, skills and attitudes, to be taught during medical school. This finding can provide medical educators with adequate insights for developing future digital health curricula.

The method can also be used to obtain a consensus regarding the required competencies for medical graduates to employ AI technologies in practice[35]. A study analyzed this in three rounds via online survey questionnaires. This was completed by an interdisciplinary panel of 60 experts who expressed strong agreement on 23 items. These items served as the basis for the list of competencies that medical graduates require in order to be ready for AI in medical practice. This insight can be used to inform the development of medical curricula to integrate AI competencies.

Another Delphi study was conducted to derive a likely scenario for the use of voice-controlled intelligent personal assistants in healthcare within the next 5 years[36]. It featured an international, interdisciplinary panel of experts. The questionnaires involved four thematic sections (technology, consumer acceptance, potential use cases, and privacy and data protection regulations) and 27 participants completed the second round of questionnaires. There was a high level of consensus for the potential of such technologies to assist the elderly, their widespread use across various healthcare domains, and that the technology is not expected to replace medical staff but rather will act as supportive tools.

A three-round Delphi study in which 33 experts with diverse roles took part helped better understand the perception of Finnish experts regarding future hospital management and leadership in the year 2030[37]. Management and leadership orientation, and future organization were the two main categories that emerged from the expert's perceptions. In relation to management and leadership orientation, the expert perceived patient-centred, clinical dominance, professionally divided and management career options as key factors. Their perceptions relating to future management and leadership organization involved shared, pair, team and individual-centered leadership. The insights derived from these findings can be utilized to plan, develop, and update management and leadership training as well as management practices in healthcare institutions.

Discussion

These case studies demonstrate that the analysis of future directions, scenarios and visions can be grounded in systematic and validated methods that have proven their efficacy in other industries over the last decades. The use of futures methods in medical and healthcare settings, as well as in policy and decision-making, is long overdue.

Given the diverse nature of futures methods, it is important to recognize that each is designed to address different aspects of foresight, from exploring uncertainty to building strategic visions which is crucial for their effective use in healthcare contexts. The FW is used to determine the rippling effects and consequences of future milestones or events. SA and SP facilitate the development of strategies around future visions. Subsequently, backcasting facilitates translating those strategies into actionable steps today. HTA enables the effective adoption of advanced technology, while policy analysis supports policy-makers in enhancing regulation. HS can be used to identify weak signals that might become trends later to anticipate major changes in a given field. The Delphi method highlights the importance of equal opinions about the future of fields of interest. (Figure 3.)

Futurists frequently employ methodological combinations to deepen their research and improve its effectiveness. Methodological combinations can merge the benefits of distinct techniques, yielding more reliable outcomes than when employing the methods separately[38]. The integration of methods is especially advantageous, as reliance on a singular method rarely provides a complete picture of the future. It advocates for the utilization of various methods tailored to certain contexts, facilitating a comprehensive comprehension of their advantages and limitations, along with

their potential applications[39].

Moreover, futures methods inherently encourage interdisciplinary collaboration by creating structured frameworks that require diverse perspectives to envision, analyze, and prepare for multiple possible futures. These approaches shift the focus from siloed expertise to collective intelligence, making them particularly powerful in complex domains like healthcare, where challenges span clinical practice, policy, technology, ethics, and human behaviour.

By design, methods such as SP, the FW, and backcasting invite contributions from professionals with different backgrounds—physicians, technologists, economists, designers, patients, ethicists, and policy-makers. This inclusive engagement ensures that future-oriented strategies are not only scientifically grounded but also socially relevant, ethically sound, and practically feasible.

As medicine increasingly intersects with fields like data science, robotics, environmental studies, and behavioural economics, futures methods offer an essential toolset for coordinating these domains. Their adoption in healthcare can serve as a model for how complex, human-centered industries can evolve through collaborative foresight.

Challenges and pitfalls in using futures methods

Futures methods are useful tools for structured anticipation but using them includes potential pitfalls that require thoughtful navigation. One main issue comes from the future's inherent nature: it is uncertain, and our ability to conceive of alternatives to the present is limited by our paradigms, producing a potential for presentism and narrow thinking[40]. This clearly demonstrates the necessity of remaining reflexive and self-critical when practicing foresight exercises.

Choosing the appropriate method is also not always a straightforward task. There is no normative standard for which tool to employ in one situation or another, and presumably, most practitioners' choice is based on personal preference rather than methodological appropriateness. Additionally, foresight generates prospective future scenarios that cannot be tested in the present; it is difficult to verify the findings. This concern should not diminish the value of futures methods, rather, it should emphasize careful planning, transparent reasoning, and the idea that foresight is a tool to prepare and not to predict.

Therefore, the merit of futures studies lies not in the precision of their forecasts. The

objective of futures studies is not to predict the future, which is unattainable, but to facilitate improved decision-making in the present by prompting the exploration of opportunities and risks and contemplating strategies to address them. Although the future is inherently unpredictable, the judicious application of theoretical and methodological resources from futures studies enables constructive foresight and the potential to influence the future towards favourable outcomes.

Beyond methodological challenges, the practical implementation of futures methods faces additional barriers rooted in human and organizational behaviour. Many of these exercises largely rely upon the judgment of experts or group facilitation; they could be subject to cognitive biases, such as confirmation bias, groupthink, and overt reliance on known assumptions. These subjective lenses can subtly affect method choices, as well as the outcomes that are emphasized. A further pitfall is overconfidence in certain scenario outputs, especially if one becomes too prominent and taken as a projection of what is expected rather than just one possible future. This can result in the limitation of adaptive thinking and be too restrictive in strategy formation. Lastly, even well-designed methods can exhibit barriers to translating insights into action. Institutional barriers, including short-term planning cycles, limited futures literacy, and lack of leadership support can hinder taking futures sensing into policies or practices. Avoiding some of these barriers requires not only methodological awareness but organizational preparedness to address uncertainty in genuine and sustained ways.

Call to action: encouraging healthcare institutions to apply futures thinking

The rapid pace of evolution of the healthcare landscape in the 21st century, from technological progress to climate change, presents unpredictable challenges that necessitate more than hindsight. As we emphasized in our benchmark study, there is an imperative need to integrate futures methods within this landscape, ideally through a distinctive “medical futures studies” subdiscipline, to better equip healthcare stakeholders to address forthcoming challenges in the digital health era.

Despite the clear benefits of such methods, adoption in the healthcare field remains low; as such, we encourage healthcare institutions to adopt and apply futures thinking within their routine practices. To that end, we issue a call to action for widespread adoption of medical futures methods and propose the following key actions: (Table 1.)

- **Dedicated medical futures team:** formally appoint a team of futurists, or at least future-oriented people, who oversee the integration of futures thinking within the institution.

- **Futures literacy:** incorporate the fundamentals of medical futures methods into staff training and upskilling to develop an anticipatory and proactive mindset.
- **Policy integration:** embed futures thinking in the institution's major projects and decision-making.
- **Research networks:** build on the knowledge base by conducting academic research involving medical futures methods within the institution and with collaborators and share the findings to help develop field-specific frameworks and best practices.
- **Practice futures methods:** exercise simpler futures methods such as SA or the FW in brainstorming sessions without the need to have a practical outcome.

Table 1. Calls to action.

	Action item	Overview
Call to action	Dedicated medical futures team	Oversee integration of futures thinking
	Futures literacy	Training and upskilling in medical futures methods and mindset
	Policy integration	Futures thinking embedded within key project and decision-making
	Research networks	Build on and contribute to the knowledge base
	Practice futures methods	Exercise simpler futures methods in brainstorming sessions

Through such actions, healthcare and medical institutions can effectively adopt a proactive mindset that is crucial in the digital health era. By embracing futures thinking at every level, organizations can guide innovative practices and prepare for unforeseen obstacles, leading to a resilient and future-ready healthcare landscape.

It is important to point out that one of the underappreciated advantages of futures methods is their accessibility and adaptability for low-resource settings. Many techniques, such as the FW, backcasting, or basic SA, require minimal technological infrastructure and can be facilitated with just a pen and paper or simple digital tools. Because these methods prioritize structured thinking, collaborative dialogue, and creative ideation rather than costly data or proprietary software, they can empower local stakeholders, from clinicians, and community health workers to patients to co-create

context-sensitive strategies. In low- and middle-income regions, where health systems face chronic shortages of staff, infrastructure, and funding, futures thinking offers a cost-effective and scalable approach to anticipate emerging challenges and identify innovative, locally grounded solutions.

AI, especially generative AI in the form of large language models (LLMs) also acts as a facilitator in the process. LLMs can support HS by sifting through vast volumes of data to identify weak signals or emerging patterns that human analysts might overlook. Those can also summarize stakeholder interviews or generate possible future narratives based on diverse inputs. In general, LLMs can help democratize foresight by lowering the technical barriers for non-experts to engage in futures exercises. However, this potential must be balanced with ethical oversight to ensure transparency, avoid algorithmic bias, and maintain human agency in shaping desirable futures.

Conclusions

In an era defined by rapid technological disruption, shifting demographics, and unpredictable global events, the ability to anticipate and prepare for change is essential. Futures methods provide healthcare organizations with the structured tools and collaborative frameworks needed to move from reactive crisis management to proactive, strategic thinking.

By embracing these methods, every healthcare organization—regardless of size, geography, or resources—can build resilience, drive innovation, and ensure that decisions made today are aligned with the needs of tomorrow.

The integration of futures thinking should become a core competency in healthcare leadership, planning, and education, not just as a means of survival, but as a foundation for shaping a more equitable, adaptable, and future-ready health system.

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Figure 1. A sample futures wheel with a central statement or trend and primary, then secondary consequences in categories such as legal, technological or social impact.

Figure 2. A sample scenario analysis with a key driving force, a key uncertainty and four possible scenarios based on the combinations of the two factors.

Figure 3. A summary of futures methods and for what purposes each method could be a good fit.



References

- [1] B. Meskó, T. Kristóf, P. Dhunnoo, N. Árvai, and G. Katonai, “Exploring the Need for Medical Futures Studies: Insights From a Scoping Review of Health Care Foresight,” *J Med Internet Res*, vol. 26, p. e57148, 2024, doi: 10.2196/57148.
- [2] T. J. Glenn, J. C. & Gordon, “The futures wheel,” in *Futures Research Methodology, Version 3.0. The Millennium Project*, 2009, p. Chapter 6, 1-17.
- [3] D. Bengston, “The Futures Wheel: A Method for Exploring the Implications of Social–Ecological Change,” *Soc. Nat. Resour.*, vol. 29, pp. 1–6, Aug. 2015, doi: 10.1080/08941920.2015.1054980.
- [4] “Evolution of framework foresight,” *Foresight - J. Futur. Stud. Strateg. Think. policy*, vol. 22, no. 5–6, 2020.
- [5] P. Daffara, “Applying the Futures Wheel and Macrohistory to the Covid19 Global Pandemic,” *J. Futur. Stud.*, vol. 25(2), 35–, 2020, [Online]. Available: [https://doi.org/10.6531/JFS.202012_25\(2\).0006](https://doi.org/10.6531/JFS.202012_25(2).0006).
- [6] M. Nouhi, M. Heydari, Z. Goudarzi, R. S. Shahtaheri, A. Ahmadzaeh, and A. Olyaeemanesh, “The Future Effects of COVID-19 on the Health System: Applying the Futures Wheel Method.,” *Med. J. Islam. Repub. Iran*, vol. 36, p. 164, 2022, doi: 10.47176/mjiri.36.164.
- [7] Z. Nejat-zadehgan Eidgahi, R. Dehnavieh, V. Borhaninejad, A. Alikhani, and V. Rouhi, “The Future Wheel Model of the Effects of the Emerging Infectious Diseases Pandemics on the Elderly in Iran,” *Salmand Iran. J. Ageing*, vol. 18, no. 4, 2024, doi: 10.32598/sija.2023.3641.1.
- [8] P. Schwartz, *The art of the long view: Planning for the future in an uncertain world*. Doubleday., 1996.
- [9] H. Leufkens, F. Haaijer-Ruskamp, A. Bakker, and G. Dukes, “Scenario analysis of the future of medicines.,” *BMJ*, vol. 309, no. 6962, pp. 1137–1140, Oct. 1994, doi: 10.1136/bmj.309.6962.1137.
- [10] E. York *et al.*, “Co-Imagining the Futures of Implementation Precision Medicine Using Scenario Analysis and Design Fiction.,” *OMICS*, vol. 23, no. 7, pp. 340–349, Jul. 2019, doi: 10.1089/omi.2019.0083.
- [11] J. J. P. A. Bierbooms, I. M. B. Bongers, and H. A. M. van Oers, “A scenario analysis of the future residential requirements for people with mental health problems in Eindhoven,” *BMC Med. Inform. Decis. Mak.*, vol. 11, no. 1, p. 1, 2011, doi: 10.1186/1472-6947-11-1.
- [12] K. van der Heijden, *Scenarios: The art of strategic conversation*. John Wiley & Sons., 2005.

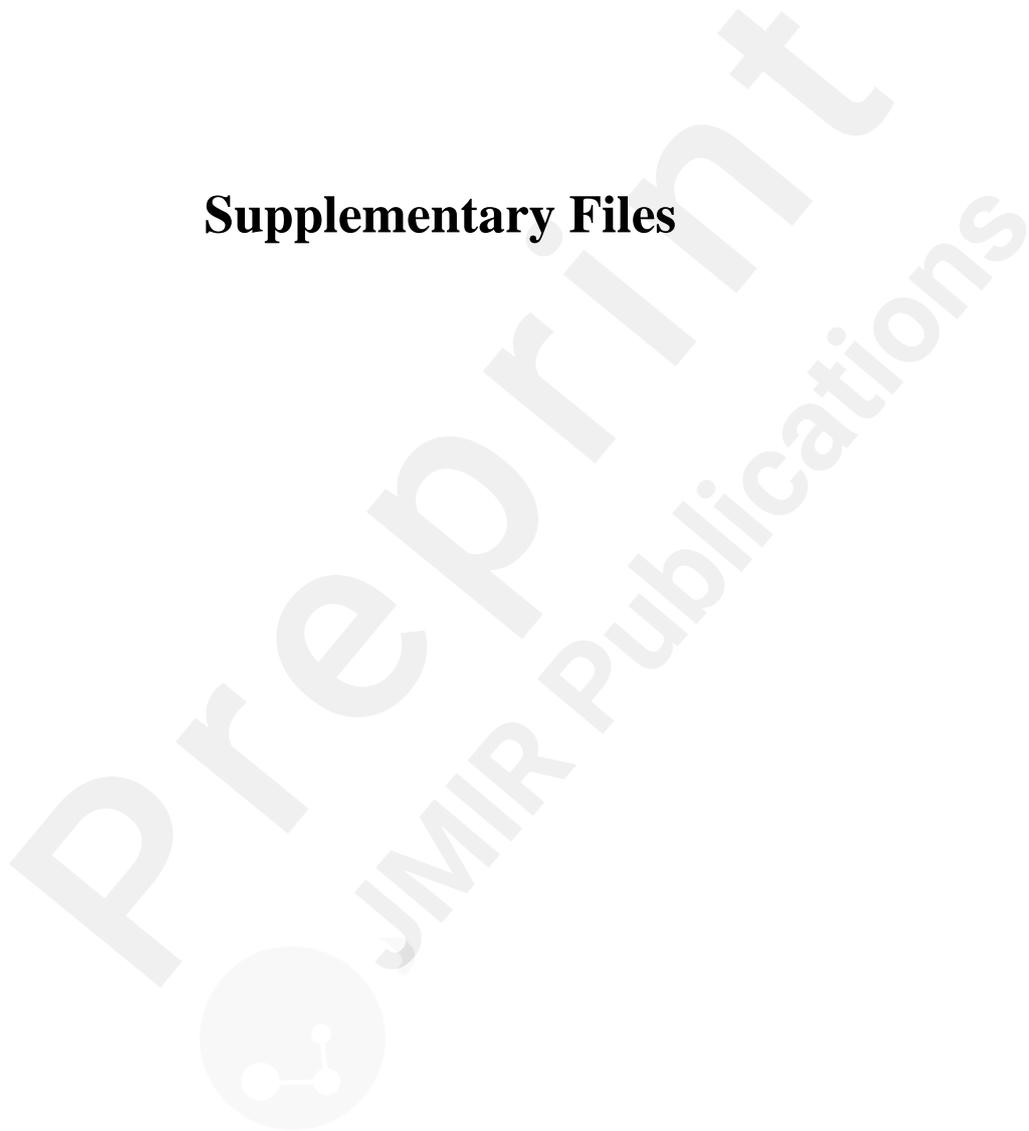
- [13] L. Ludwig, J. Giesecke, and L. Walton, "Scenario planning: a tool for academic health sciences libraries," *Heal. Inf. & Libr. J.*, vol. 27, no. 1, pp. 28–36, 2010, doi: <https://doi.org/10.1111/j.1471-1842.2009.00853.x>.
- [14] J. B. Robinson, "Unlearning and backcasting: Rethinking some of the questions we ask about the future.," *Technol. Forecast. Soc. Change*, vol. 33(4), 325, 1988, [Online]. Available: [https://doi.org/10.1016/0040-1625\(88\)90029-7](https://doi.org/10.1016/0040-1625(88)90029-7).
- [15] J. Quist and P. Vergragt, "Past and future of backcasting: The shift to stakeholder participation and a proposal for a methodological framework," *Futures*, vol. 38, no. 9, pp. 1027–1045, 2006, doi: <https://doi.org/10.1016/j.futures.2006.02.010>.
- [16] J. Quist, W. Thissen, and P. J. Vergragt, "The impact and spin-off of participatory backcasting: From vision to niche," *Technol. Forecast. Soc. Change*, vol. 78, no. 5, pp. 883–897, 2011, doi: <https://doi.org/10.1016/j.techfore.2011.01.011>.
- [17] M. I. Gariboldi, V. Lin, J. Bland, M. Auplish, and A. Cawthorne, "Foresight in the time of COVID-19.," *Lancet Reg. Heal. West. Pacific*, vol. 6, p. 100049, Jan. 2021, doi: [10.1016/j.lanwpc.2020.100049](https://doi.org/10.1016/j.lanwpc.2020.100049).
- [18] C. Gjellebæk, A. Svensson, C. Bjørkquist, N. Fladeby, and K. Grundén, "Management challenges for future digitalization of healthcare services," *Futures*, vol. 124, p. 102636, 2020, doi: <https://doi.org/10.1016/j.futures.2020.102636>.
- [19] B. O'Rourke, W. Oortwijn, and T. Schuller, "The new definition of health technology assessment: A milestone in international collaboration.," *Int. J. Technol. Assess. Health Care*, vol. 36, no. 3, pp. 187–190, Jun. 2020, doi: [10.1017/S0266462320000215](https://doi.org/10.1017/S0266462320000215).
- [20] J. F. P. Bridges and C. Jones, "Patient-based health technology assessment: a vision of the future.," *Int. J. Technol. Assess. Health Care*, vol. 23, no. 1, pp. 30–35, 2007, doi: [10.1017/S0266462307051549](https://doi.org/10.1017/S0266462307051549).
- [21] J. Love-Koh *et al.*, "The Future of Precision Medicine: Potential Impacts for Health Technology Assessment.," *Pharmacoeconomics*, vol. 36, no. 12, pp. 1439–1451, Dec. 2018, doi: [10.1007/s40273-018-0686-6](https://doi.org/10.1007/s40273-018-0686-6).
- [22] C. Cadeddu, M. Ruggeri, P. Roazzi, D. Mandolini, M. Grigioni, and M. Marchetti, "Health Technology Assessment for COVID19: an approach for the Horizon Scanning of health innovations.," *The European Journal of Public Health*, vol. 31, no. Suppl 3, Oct. 2021, doi: [10.1093/eurpub/ckab165.301](https://doi.org/10.1093/eurpub/ckab165.301).
- [23] I. Moscovice and J. Stensland, "Rural Hospitals: Trends, Challenges, and a Future Research and Policy Analysis Agenda," *J. Rural Heal.*, vol. 18, no. S1, pp. 197–210, Jan. 2002, doi: [https://doi.org/10.1016/S0197-2789\(02\)00011-1](https://doi.org/10.1016/S0197-2789(02)00011-1).

<https://doi.org/10.1111/j.1748-0361.2002.tb00931.x>.

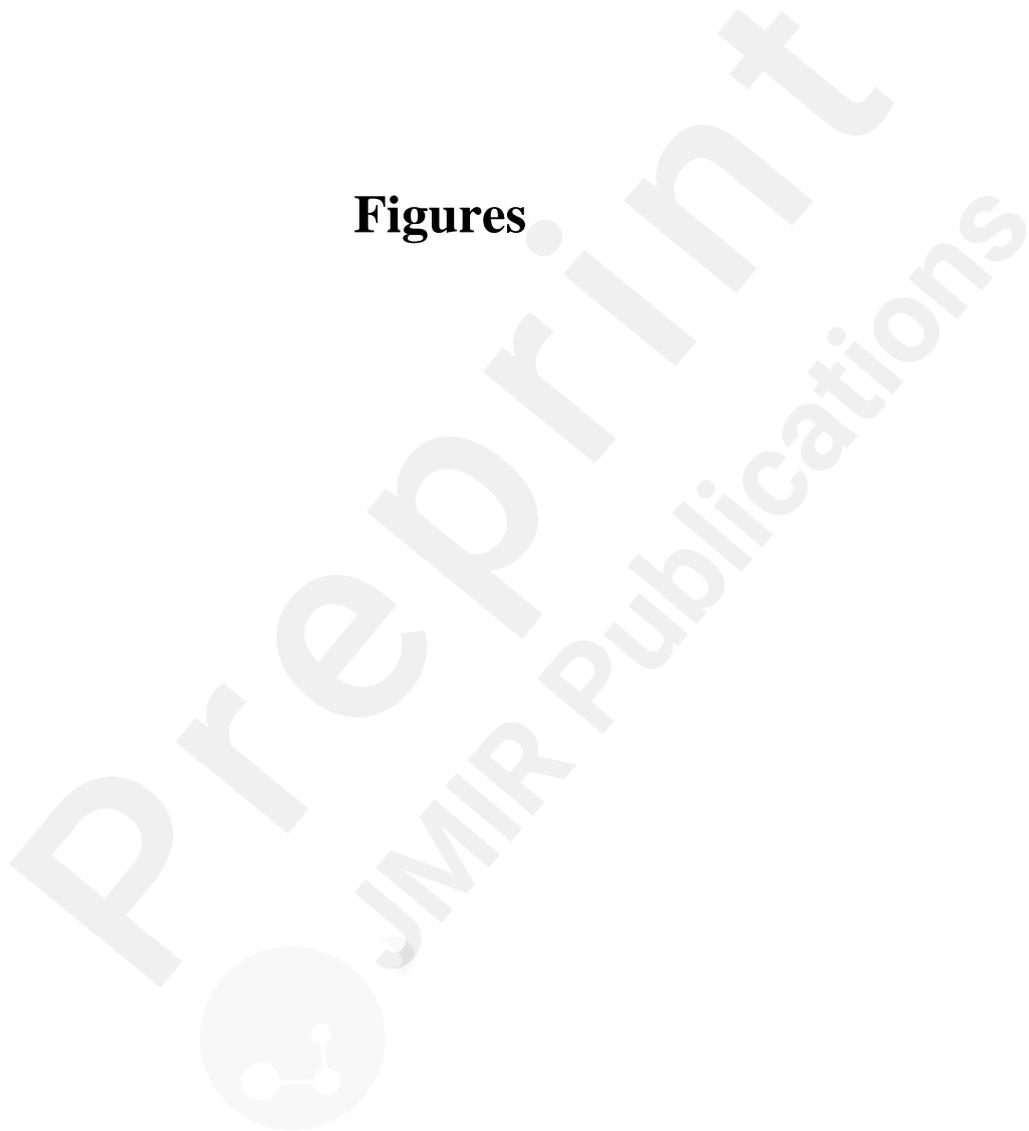
- [24] C. Surjadaja and S. H. Mayhew, “Can policy analysis theories predict and inform policy change? Reflections on the battle for legal abortion in Indonesia.,” *Health Policy Plan.*, vol. 26, no. 5, pp. 373–384, Sep. 2011, doi: 10.1093/heapol/czq079.
- [25] K. E. Cuhls, “Horizon Scanning in Foresight – Why Horizon Scanning is only a part of the game,” *Futur. FORESIGHT Sci.*, vol. 2, no. 1, p. e23, Mar. 2020, doi: <https://doi.org/10.1002/ffo2.23>.
- [26] E. A. Akartuna, S. D. Johnson, and A. Thornton, “Enhancing the horizon scanning utility of futures-oriented systematic and scoping reviews,” *Futures*, vol. 158, p. 103340, 2024, doi: <https://doi.org/10.1016/j.futures.2024.103340>.
- [27] E. Störmer, L. Bontoux, M. Krzysztofowicz, E. Florescu, A.-K. Bock, and F. Scapolo, “Foresight – Using Science and Evidence to Anticipate and Shape the Future,” 2020, pp. 128–142.
- [28] F. D. Rodríguez-Gómez, D. Monferrer, O. Penon, and P. Rivera-Gil, “Implementing Horizon Scanning as a tool for the strategic development of regulatory guidelines for nanotechnology-enabled health products,” *Front. Med.*, vol. Volume 10, 2024, doi: 10.3389/fmed.2023.1308047.
- [29] R. E. Michels, M. B. de Graaff, P. Abrishami, and D. M. J. Delnoij, “Anticipating emerging medical technologies: The start of an international horizon scanning tool for medical devices,” *Futures*, vol. 156, p. 103326, 2024, doi: <https://doi.org/10.1016/j.futures.2024.103326>.
- [30] I. T. Brown, A. Smale, A. Verma, and S. Momandwall, “Medical technology horizon scanning,” *Australas. Phys. Eng. Sci. Med.*, vol. 28, no. 3, p. 200, 2005, doi: 10.1007/BF03178717.
- [31] S. S. Ormstad, C. Wild, J. Erdös, and K. Moulton, “Mapping horizon scanning systems for medical devices: similarities, differences, and lessons learned,” *Int. J. Technol. Assess. Health Care*, vol. 39, no. 1, p. e69, 2023, doi: DOI: 10.1017/S0266462323002684.
- [32] C. Flick, E. D. Zamani, B. C. Stahl, and A. Brem, “The future of ICT for health and ageing: Unveiling ethical and social issues through horizon scanning foresight,” *Technol. Forecast. Soc. Change*, vol. 155, p. 119995, 2020, doi: <https://doi.org/10.1016/j.techfore.2020.119995>.
- [33] I. Yeoman, U. McMahan-Beattie, and K. Findlay, “The Future of Urban Spas: A Trend Analysis of the UK Market,” *Tour. Recreat. Res.*, vol. 39, no. 3, pp. 397–413, Jan. 2014, doi: 10.1080/02508281.2014.11087008.
- [34] M. P. Khurana, D. E. Raaschou-Pedersen, J. Kurtzhals, J. E. Bardram, S. R. Ostrowski, and J.

- S. Bundgaard, “Digital health competencies in medical school education: a scoping review and Delphi method study,” *BMC Med. Educ.*, vol. 22, no. 1, p. 129, 2022, doi: 10.1186/s12909-022-03163-7.
- [35] S. A. Çalışkan, K. Demir, and O. Karaca, “Artificial intelligence in medical education curriculum: An e-Delphi study for competencies,” *PLoS One*, vol. 17, no. 7, p. e0271872, Jul. 2022, [Online]. Available: <https://doi.org/10.1371/journal.pone.0271872>.
- [36] A. Ermolina and V. Tiberius, “Voice-Controlled Intelligent Personal Assistants in Health Care: International Delphi Study.,” *J. Med. Internet Res.*, vol. 23, no. 4, p. e25312, Apr. 2021, doi: 10.2196/25312.
- [37] V. Pihlainen, T. Kivinen, and J. Lammintakanen, “Perceptions of future hospital management in Finland,” *J. Health Organ. Manag.*, vol. 33, no. 5, pp. 530–546, Jan. 2019, doi: 10.1108/JHOM-02-2018-0045.
- [38] A. Hines and P. C. Bishop, “Framework foresight: Exploring futures the Houston way,” *Futures*, vol. 51, pp. 31–49, 2013, doi: <https://doi.org/10.1016/j.futures.2013.05.002>.
- [39] A. Hines, *Thinking About the Future: Guidelines for Strategic Foresight*. Washington,: Social Technologies, 2006.
- [40] V. Virmajoki, “Limits of conceivability in the study of the future. Lessons from philosophy of science,” *Futures*, vol. 142, p. 102993, 2022, doi: <https://doi.org/10.1016/j.futures.2022.102993>.

Supplementary Files



Figures



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A summary of futures methods and for what purposes each method could be a good fit.

