Scoping Review Article
http://mjiri.iums.ac.ir
Medical Journal of the Islamic Republic of Iran (MJIRI)

Med J Islam Repub Iran. 2023 (18 Dec);37.137. https://doi.org/10.47176/mjiri.37.137

The Importance of Uncertainty in Health Scenarios: A Scoping Review on COVID-19 Scenarios

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Received: 10 Mar 2022 Published: 18 Dec 2023

Abstract

Background: Scenarios are the most efficient methods to explore our uncertainty about the future. Even with increasing utilization, the majority of scenarios still fall short of meeting the future "uncertainties" in health. This article examines one of the most sensitive encounters of the health system with uncertainties—COVID-19 pandemic—and the type of uncertainty analysis in health scenarios to discuss the importance and determine the existing gaps while providing a better mechanism for scenario planning in the health system.

Methods: To examine the extent, range, and nature of scenario research, a preliminary mapping of the existing literature, summarizing research findings, and identifying research gaps, we have taken help from the Arksey and O'Malley (2005) model and to improve the quality of the results, we have also used the PRISMA framework. To identify the studies relevant to the issue, the PubMed and Embase databases were searched for peer-reviewed published articles. All peer reviewed articles from January 01, 2020, to December 31, 2020, were included in this review. The search strategy was mainly the systematic use of English keywords such as "coronavirus," "covid-19," "SARS-CoV-2," "2019-ncov," and scenario. To improve the search sensitivity, subject searching based on MeSh and Emtree keywords was used.

Results: It is crucial to identify the health domains where the scenarios can be used. The major ideas that were covered and their variations would also be identified using these different scenarios. Based on the selected articles, we can answer some critical questions. First, in which health fields is the scenario method used? Second, what are the key concepts in these studies, and third, what is the difference between them? Policy, epidemiology, and economics use futures studies scenarios more than other social science disciplines in health. Furthermore, we have looked at the fact that selecting the appropriate kind, utilizing new methodologies, and emphasizing uncertainty analysis are the core difficulties associated with health case scenarios.

Conclusion: Based on examining the existing indicators in the health scenarios, establishing the "uncertainty analysis" as the basis can improve scenario planning in this field. Also, if scenario planning is done as a process based on uncertainty analysis, it is more accurate and helps make better decisions in the field of health.

Keywords: Futures Studies, Uncertainty, Health Scenarios, Policy, Epidemiologic Methods, SARS-CoV-2

Conflicts of Interest: *None declared*
Funding: *None*

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Cite this article as: Hosseini Golkar M, Mowlaei MM, Behzadi A, Keshavarz-turk M, Zolfagharnasab A, Hosseini Golkar M. The Importance of Uncertainty in Health Scenarios: A Scoping Review on COVID-19 Scenarios. *Med J Islam Repub Iran.* 2023 (18 Dec);37:137. https://doi.org/10.47176/mjiri.37.137

Introduction

The scenario is one of the best and most widely used tools to provide decision-making environment understanding in conditions of uncertainty (1-3). Several definitions are provided for the scenario which overlapped (4). A

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↑What is "already known" in this topic:
More than other health domains, policymaking, epidemiology, and economics use scenarios; nonetheless, their methodologies rely less on "uncertainty analysis" as the fundamental component of scenario design.

→What this article adds:
The main challenges of health scenarios are selecting the appropriate type, using new approaches, and focusing on uncertainty analysis. We suggest that it is better to use futures studies approaches with advanced methodologies in this field as a process in health scenarios.

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[DOI: 10.47176/mjiri.37.137]

scenario is a set of plausible narratives about a certain period of time in the future that are internally compatible and the sum of them, as much as possible, provide a comprehensive picture of all potential and critical future situations for stakeholders (for example, compare with Glenn's definition) (2011). Different approaches, each with a variety of scenario methods, are used continuously (5-7). Despite its prevalence, many mistakes are made (8, 9)—some of these mistakes are made by using old approaches instead of new ones. The scenario in the early and the first generation, around the 1950s, was straightforward and only analyzed the consequences of the actions—for example, Herman Kahn told the consequences of thermonuclear war in the form of a story. Although the first generation of scenarios (analysis of the consequences of a specific future) is still used in the health sector (for example see: (10, 11), but in later generations and decades scenario has become a sophisticated tool for analyzing uncertainty (7, 4).

"Uncertainty" is a specialized term in fields of Physics, Statistics, Information Science, Epidemiology and Futures Studies that has a different application and concept in each though. Therefore, the researchers need to distinguish between them carefully. Here, we discussed the meaning of uncertainty only in futures studies, which is very close to social sciences (1).

In futures studies, uncertainty refers to circumstances where it is impossible to predict or forecast the future with the necessary accuracy because of ignorance, ambiguity, lack of information, complexity of circumstances, rapid changes, unexpected events, and the like. These situations are frequently those in which two or more different statuses are probable. Thus, scenarios are used to improve the decision-making process in such ambiguous situations (1, 9, 12).

At least, there are 2 types of uncertainty in futures studies. Type 1 derives from a lack of information or from a lack of analysis. In these cases, we should increase our information about the subject and the plan to reach a good analysis. We can make credible forecasts and possibly do away with scenarios if we collect enough data and obtain appropriate analysis. However, in type 2 or "either–or" scenarios more information and analysis do not help us, and we need scenarios. Uncertainty type 2 "is the case of dichotomous or discrete uncertainties" (13).

Researchers have shown that choosing the appropriate scenario types and using new methods with improved standards and greater transparency are the main challenges of health case scenario planning (7, 8). In the field of health, trend-based, intuitive logic, and la-prospective are 3 typical scenarios (7). The focus of intuitive logic and la-prospective scenarios is on the discovery and analysis of uncertainty. In addition, trend-based scenarios based on imagined uncertainties try to present probable deviations from the official future in the form of possible scenarios. Therefore, as it is clear, in these three common types in the field of health, the uncertainty is the axis of any scenario. However, the uncertainty analysis as a necessary condition for entering the scenario is sometimes forgotten. It also seems that part of the lack of transparency and low standards in health scenarios is due to the lack of considering the uncertainty analysis. In short, the question is whether uncertainty is fully considered in health scenario research?

Here, we have limited the scope of the case studies to COVID-19 scenarios. Because these researches are the most up-to-date, and there is obviously uncertainty in them. The COVID-19 pandemic has placed the health system in a unique and difficult situation for which further forecasting is required. It has produced an atmosphere of ambiguity and brought attention to the need to analyze and reduce uncertainties. However, the reviewed research do not seem to focus enough on the concept and position of uncertainty. In addition to a detailed analysis of the scenarios written for COVID-19, this article explains the uncertainty-based scenario process. Therefore, the primary goal of this study was to investigate the following question: What are the characteristics of uncertainty-based scenarios? Have the COVID-19 scenarios—which serve as an example of health scenarios—considered the implications of uncertainty analysis, or have they carried out a thorough and suitable scoping? At the same time, identifying the elements of drivers and uncertainties is also important, thus additionally the study was aimed to discover whether any suitable environmental scanning model was used or any appropriate scenario approach was chosen. Furthermore, the question of whether the scenarios effectively addressed the health system's future through sound reasoning remained (as secondary aims).

Methods

To better understand the amount, scope, and nature of scenario research, initial mapping of the existing literature, summarizing the findings, and identifying research gaps, we have taken help from Arksey and O'Malley's (2005) model. As these two researchers have mentioned, to improve stages 2, 3, and 4, we need auxiliary tools. In this study, the utilization of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklists and the provision of a scenario planning process framework have been beneficial.

We provided a framework for the steps of the scenario process. Then, based on a scoping review, we selected the articles that examined the COVID-19 problem using the scenario method. The systematic literature review was guided using the PRISMA extension for Scoping Reviews (PRISMA-ScR) Checklist. To identify the studies relevant to the issue, the PubMed and Embase databases were searched for peer-reviewed published articles. All peer-reviewed articles from January 01, 2020, to December 31, 2020, were included in this review.

The search strategy was mainly the systematic use of English keywords such as "coronavirus," "covid-19," "SARS-CoV-2," "2019-ncov," and scenario. Subject searching based on MeSh and Emtree keywords was used to improve the search sensitivity.

The inclusion and exclusion criteria were determined (Table 1). The investigation of the findings to identify and eliminate repetitive research was conducted. Two reviewers (M.H. and M.M.) independently assessed the quality of the included literature.

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Table 1. Article Selection Criteria (Quality Assessments)

R	Criteria	Explanation
1	Language	Articles were reviewed without language restrictions.
2	Source	Journal articles were selected.
3	Access	Articles were selected whose full text is available.
4	Keywords	Articles were selected whose keywords included scenario* concepts.
5	Method	Articles were selected whose main method is scenario and specified in the methodology section.
6	Output	Articles were selected whose main output is a scenario.
7	Discussion	Articles were selected that comparing scenarios are part of their discussion.
8	Consensus	Articles were selected that were agreed upon by the majority of authors.

* According to the definition provided in the introduction for the scenario or Glenn's definition [9] (see: References)

Finally, each of the selected studies was meticulously read to analyze whether the steps of the scenario process have been followed according to the mentioned framework.

The inclusion and exclusion criteria are presented in Table 1.

All the articles were also examined for quality. Only papers that have been peer-reviewed and published in indexed journals were considered. The details of the search strategy (Table 4), the number of retrieved sources (Figure 2), and the forest plot of the selected sources (Figure 3) are presented in Appendix A.

We provided a framework for the steps of the scenario process. Then, based on a scoping review, we selected the articles that examined the COVID-19 problem using the scenario method. In the next step, we analyzed whether the steps of the scenario process have been followed according to the framework in these articles. Also, to further clarify, one of the articles as a sample has been reviewed in detail.

The study population included all the research published in PubMed in 2020 on the subject of COVID-19 scenarios to ensure that these resources are sufficient, comparisons have also been made with those published in Embase.

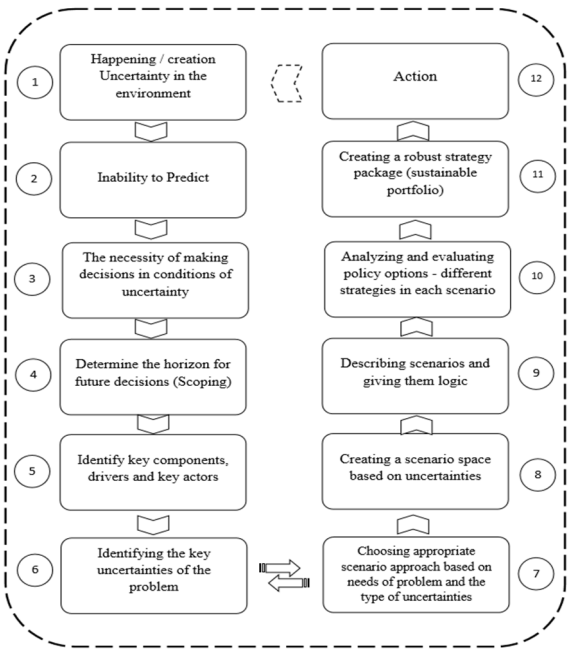

Figure 1. Scenario planning process—Source: Authors

Inclusion Criteria

Studies were included in the review if they met the following criteria:

✓ Articles that were in indexed journals and had peer-review.

✓ Articles in which the scenario was intended to provide narrative(s) of the future under COVID19.

✓ Articles from which at least more than one scenario about the future could be inferred.

Exclusion Criteria

Studies with the following criteria were excluded from this review:

X Studies without full text.

X Articles that had no futures scenario-related keywords.

X Articles whose research method was not based on scenario.

X Articles in which the scenario meant only a specific case study—not a set of futures.

Selection Strategy

Two authors (A1 & A5) performed the literature search, entered the retrieved studies into EndNote X8 bibliographic software, and removed duplicate studies. Two other authors (A1 & A2) reviewed the titles and abstracts of the studies independently. Eventually, after reading the full text, the final papers were rechecked precisely according to the study inclusion and exclusion criteria. Disagreements at any stage of the study were solved by the expert focus group discussion (by A1, A2 & A4).

Data Extraction

Data were independently extracted from final studies by 2 evaluators and entered into a checklist containing author(s), affiliation, disciplines, horizon, scanning model, scope, method, number of uncertainties, and number of scenarios.

Framework

In this study, the observance of the necessary steps for scenario planning based on uncertainty has been examined according to the checklist extracted from the literature review (Table 2). In each case, it is examined that there is evidence in selected articles that the authors have met the criteria for paying attention to uncertainty.

Scenario-making is one of the features of the human mind (2). Scenario is a solution to the unpredictability of

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Table 2. Scenario Process Steps Checklist

Step	Questions
Step 4: Scoping	Is there a specific time horizon for developing scenarios? – Has the choice of time horizon based on the needs of the issue and stakeholders? – Has the logic of choosing a time horizon been explained?
Step 5: Identifying drivers, etc.	Are key components influencing the future determined by the definition of the problem? - Have key actors and drivers extracted based on the time horizon? - Has the relationship between different factors been analyzed?
Step 6: Identifying Uncertainties	Have the key uncertainties of the problem extracted? - Has the criterion for selecting key uncertainties been introduced? - Is it clear how these uncertainties shape different futures?
Step 7: Choosing Approach	Is the choice of scenario method based on the needs of the problem justified? - Is the chosen scenario method appropriate for the type of uncertainties?
Step 8: Creating Space	Are uncertainties covered in the future space completely? - Are there enough scenarios to understand the scope of the future?
Step 9: Describing Scenarios	Are each of the scenarios described with appropriate indicators? - Do each scenario have internal compatibility and a specific relationship with the other scenarios?

* Vollmar et al (2015) [8] proposed key methodological criteria to report in health scenario projects in the form of aim, framework, methodology, and impact based on the GRAMMS-like guideline, which is used for mixed methods studies and recommended by the equator network. These are aligned with steps 4, 5, 7, and 9 in our checklist.

the environment and, at the same time, its necessity. Scenario is a method for summarizing the achievements of futures studies that gives a methodological unity to all these efforts: Scenarios are based on uncertainties (2, 6, 7, 9). To draw a good scenario, first of all, it is necessary to examine the environment thoroughly, analyze the desired time horizon, and identify problem/subject uncertainties in the time horizon and the environment. Basically, scenarios are tools to reduce uncertainties and help make decisions in uncertain situations. Because there is uncertainty that cannot be reduced by other means, a scenario is used. With more rate/amount of uncertainty, using scenarios will be more helpful (9). Summarizing the above considerations, in Figure 1, we have given our framework of the steps of the scenario-based planning process.

There are 12 consecutive steps in the framework that must be followed to complete the process of planning/drawing the required scenario correctly. We presume that stages 1 through 3 have been completed because the examples in this article represent COVID-19 scenarios where uncertainty has happened, prediction is no longer possible, and we must make decisions in the face of uncertainty. The final 3 steps (10 to 12) are also outside the scope of article analysis (ie, uncertainty analysis) and are the next steps; hence, in reviewing our articles, we will look at whether steps 4 to 9 have been completed. Table 2 displays the analysis's findings. Based on the scenario literature from futures studies, we also created checklist-style questions for each phase to determine whether it has been accomplished (Table 2).

Results

In this section, we summarize the results based on Arksey and O'Malley's (2005) 5-stages model of scoping review (29).

Stage 1. Identifying the research question

Based on the explanation of the background and the gap analysis of the existing research, the main question was defined as follows, and supplementary secondary questions were extracted according to the field of study (COVID-19 research) (see the end of the introduction).

What are the characteristics of uncertainty-based scenarios?

Stage 2. Identifying Relevant Studies

As explained in the methodology section, in order to find relevant studies, we first established a framework for identifying relevant keywords and developed a search strategy based on it. Next, we followed the PRISMA checklist's steps and searched the PubMed and Embase databases to compile our list, which was completed in 2020.

This approach primarily aligns with the work and proposal of Arksey and O'Malley (ibid: pg. 14-15).

Stage 3. Study Selection

We selected articles that used the scenario method to investigate the COVID-19 problem. Following the application of the search filters, we were able to find 55 articles in PubMed. The research team then examined these articles (using the "Quality Assessment" criteria; Table 1), and 11 articles (20%) were selected as having the highest appropriateness after carefully going over the abstract, keywords, method section, and conclusion of each article.

Stage 4. Charting the Data

We compared how each of the selected articles derived their scenarios with the framework presented above. Table 3 shows to what extent each step has been completed. By these steps, data related to an affiliation (author's continent), horizon, specified scanning model (such as PEST, STEEP, DEGEST, etc, if exist), scope of scenarios (national, regional, global, etc), method, number of uncertainties, and number of scenarios have been extracted from the articles. Items that were implicitly implied but not explicitly stated in the article were also enclosed in [brackets]. Additionally, a social science category was introduced among the disciplines of anthropology, economics, epidemiology, geography, policy, psychology, and sociology based on the affiliation of authors, keywords, article content, and type of journal for each article. After discussing the instances in focus groups, the team used a Likert scale to score each case's level of realization. This spectrum includes an average expert score as well as values 1 and 5, which represent the smallest connection

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Table 3. Scenario Steps in Articles - In alphabetical order of the authors

R	Article (& Type)	Date	Affiliation	Disciplines	Horizon	Scanning model	Scope of scenarios	Method	Number of uncertainties	Number of scenarios	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9
1	Abbott et al. (Original) (14)	Apr. 2020	Europe	Epidemiology	(short-term]	----	(Global]	Simulation	(1)	3	3	3.5	3	3.5	3.5	3
2	Barbuddhe et al. (Review) (15)	Aug. 2020	Asia	Epidemiology		----	Global	[Trend-based]	----	----	3	3	2.5	2	2.5	2.5
3	Bekkers & Koopman (Original) (16)	Nov. 2020	Europe	Economics	3 – 12 month	----	Global	Simulation and modelling	(3)	3	3	3	3	2.5	3.5	4.5
4	Carli et al. (Orig.) (17)	Oct. 2020	Europe	Policy	1 year	----	National		----	3	3	3.5	3	3.5	3.5	4.5
5	Dasgupta et al. (Letter) (18)	Jul. 2020	America	Sociology	short-term	----	Global	Trend-based	----	1	3	4	3.5	3.5	3	4
6	Decock et al. (Orig.) (19)	Jul. 2020	Europe	Epidemiology	a few weeks	----	National	Trend-based	----	upper and lower limits	3	2	3	4	4	4
7	Kim et al. (Lett.) (20)	Jun. 2020	Asia	Policy	[short-term]	----	National	[Inductive approach]	----	4	3	4	3.5	3.5	3.5	4
8	Rahman et al. (Orig.) (21)	Aug. 2020	Europe	Economics	1 - 5 year	----	Global - Regional	Trend-based	----	4	3.5	3.5	3	3	4	4.5
9	Shammi et al. (Orig.) (22)	Jul. 2020	Asia	Policy	Article(s) claim: Long-term	----	National	[Inductive approach]	----	3	2.5	2	2	2	3.5	4
10	Wallentin et al. (Orig.) (23)	Jul. 2020	Europe	Policy	[Our inference: short-term]	----	Regional	A.B. Modeling	----	4	2.5	3.5	2	3	2	4
11	Zhang et al. (Orig.) (24)	May. 2020	Asia	Epidemiology	1 year	----	National	[Trend-based]	----	5	3	4	3	3	3	3.5
Total percentage of step completion (%)											59	65.5	57	61	65.5	77

and maximum realization of situations, respectively.

Stage 5. Collating, Summarizing, and Reporting the Results

Some important questions can be addressed based on the chosen articles. First, which health domains apply the scenario method? Second, which notions are central to these studies, and third, how do they differ from one another?

Based on the maximum score that all articles can obtain for each step (11*5 = 55), that step's realization percentage was calculated (Table 3). From 55 gathered studies, 11 articles were entered into this research. Policy, epidemiology, and economics use futures studies scenarios more than any other social science disciplines in health, and at least 20% of all scenarios in the health sector can be examined and analyzed using this methodology. Among the uncertainty analysis steps, health scenarios receive the highest score in describing the scenarios (narrations, etc) and the lowest score in determining the uncertainties.

Results at a Glance

More than 90% of researches are published in English.

Also, 55% of scenario research has been done in Europe, 35% in Asia, and <10% in North America.

Furthermore, 36% of the research was in the field of epidemiology, 36% in the area of policy, and 18% in the field of economics.

More than 90% of the research's time horizon was short-term (<1 year).

None of the studies used a specific scanning model.

Moreover, 45% of the research was in the national scope, about 40% was in the global scope, and the rest was in the regional scope.

Also, 45% of the researchers have used trend analysis methods, about 30% have used simulation and modeling methods, and the rest have used other methods.

Almost half of the studies presented only 3 scenarios or fewer.

None of the research has specifically discussed the issue of uncertainty and has not explicitly identified their scenario uncertainties.

The question now becomes: what errors could occur if we disregard the uncertainty analysis procedure, which is

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the most crucial step in scenario writing? To reach the answer, we carefully examine one of the above articles as a case study in Appendix B.

Discussion

Based on our scoping review and selection of appropriate articles, it can be claimed that at least 20% of the total scenarios in the health sector can be reviewed and analyzed with Futures Studies methodology. Moreover, it seems that among the common disciplines of social sciences in health, fields like policy, epidemiology, and economics make the most use of futures studies scenarios.

It seems that despite the prevalence of scenario planning and the development of its literature, especially in future studies, there are still many ambiguities in its application (25-27). This result is consistent with previous research by Glenn (2011) (9); Vollmar et al (2015) (8) and Golkar et al. (2017) (7).

Because of the short-term horizon of COVID-19 scenarios, the use of trend-based approaches is predictable and is consistent with the results of Golkar et al (2017) (7). However, complementary methods can be used to develop scenarios (see Glenn & Gordon, 2003) (9).

It is unclear to us why during COVID-19 pandemic in the United States much fewer articles have been published by scenario method than in Europe or Asia.

Using futures studies approaches can help strengthen the description in epidemiological scenarios.

Unfortunately, in the articles, it is impossible to correctly identify the uncertainties considered by the authors, and sometimes even several uncertainties can be considered as one (for example, the research team disagrees about the number of uncertainties in the third article in Table 3).

Given that uncertainties are not apparent in the articles and there is no scanning model, it can be concluded that most researchers are unaware of the importance of uncertainty analysis.

Scenario research seems to neglect the use of appropriate scanning models. Using a specific scanning model can systematize and structure the scenario (compare with Vollmar et al results) and help better understand and detect uncertainties.

The number of scenarios should be proportionate with the number of uncertainties and also to fully cover the future space (a sufficient number of plausible scenarios should be provided). Therefore, presenting one scenario in no way highlights the research results and does not help to improve decision-making.

Scenarios in the first generation merely told the story of the consequences of actions, but in later generations, they developed as a tool for helping make decisions in uncertain situations. Health researchers should also consider uncertainty analysis as the focus of the scenario. The process of producing a scenario starts with the occurrence of uncertainty in the environment and the inability to predict. It then identifies important components, drivers, and key actors while studying the problem and broadening its perspective. Finally, it identifies key uncertainties. Then, after creating a scenario space based on uncertainties and describing them and their rationale, various policy options-strategies are analyzed and evaluated in each scenario, and finally, appropriate actions are planned. To have good health scenarios, this process must be completed.

Health scenarios receive the best score for defining the scenarios and the lowest score for identifying the uncertainties, with an average performance rate of 60%, according to Table 3's data about the uncertainty analysis procedures.

Previous research has shown that choosing an appropriate scenario approach and using new methods are some of the challenges of health scenario planning. In this article, we have demonstrated to some extent that paying attention to uncertainty analysis as the focus of scenarios is another challenge in the health system studies, and paying attention to the analysis of uncertainty can also address the concerns of previous researchers about improved standards and greater transparency.

Limitations

Selection Bias: Authors of articles in the health field do not necessarily consider their scenarios to be futuristic and must follow futures studies' principles.

Information Bias: It appeared that there was nothing noteworthy to report.

Report Bias/ Wish Bias: Discussions by the focus group of researchers were used to rate the articles. In other studies, more experts can be surveyed independently, and statistical analysis can be done. There was disagreement among researchers in determining the number of uncertainties in each article due to the lack of clarification by the authors.

Biases in Interviewers/Observers and Evaluation: Although the dominant approach of this article is futures studies, the presence of non futurist coauthors (about half of the team) with areas of expertise related to the research (health) has minimized these biases. Additionally, a medical librarian's and information specialist's assistance has been used in accordance with the guidelines provided by the PRISMA (28), the Institute of Medicine, and Cochrane. Also, at least 2 researchers were present at each research phase.

Conclusion

In this study, we have shown how scenario planning as a process helps make decisions in situations of uncertainty. By accepting the principle that scenarios are tools to reduce uncertainties, we have analyzed how scenario writing should be based on the analysis of uncertainties. Based on our results, policy, epidemiology, and economics use future studies scenarios more than any other social science disciplines in health. We have discussed that the main challenges of health scenarios are selecting the appropriate type, using new approaches, and focusing on uncertainty analysis. We suggest that it is better to use futures studies approaches with advanced methodologies in this field as a process in health scenarios.

Abbreviations

Orig.: Original/Research Article; Rev.: Review Article; Lett.: Letter to editor

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[DOI: 10.47176/mjiri.37.137]

Acknowledgments

Special thanks to Prof. Ali-Akbar Haghdoost, Dr. Kambiz Bahaadinbeigy, and Dr. Akram Khayatzadeh-Mahani (Institute for Futures Studies in Health), Prof. Sepehr Ghazinoory (Tarbiat Modares University), Prof. Saeed Khazaee (Iran Future Association), Dr. Salime Goharinezhad (Iran University of Medical Sciences), Dr. Seyed Mohsen Hashemi (Tehran University of Art), Dr. Najmeh Nazeri (Kerman University of Medical Sciences), and reviewers of the MJIRI for their insightful comments.

Ethical Approval

Ethical approval for this type of study is not required by our institute.

Consent for Publication

Not applicable.

Availability of Data and Material

The reviewed articles are all available at PubMed. The detailed reviewed article has been selected from open access articles.

Authors' Contributions

All authors have read and approved the manuscript. Concept and design: M.H. and M.G. Drafting of the manuscript: M.H., M.G., and M.M.M. Critical revision of the manuscript for important intellectual content: M.H., M.M.M., A.B., M.K.T., and A.Z. Analysis: M.H., M.M.M., and A.Z. Administrative, technical, or material support: M.H., M.G., and A.B. Supervision: M.H., M.M.M., A.B., and M.G. Reviewing the PRISMA checklist: M.H. and A.Z. Reviewing the second version: M.H., A.Z., and A.B. The authors read and approved the final manuscript.

Also, M.H., A.B., A.Z., M.G., and M.M.M. revised the third and final version and Dr Salime Goharinezhad (IUMS) and Najmeh Nazeri (UT) (as an external consultant) cooperated and noted some points.

Conflict of Interests

The authors declare that they have no competing interests.

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[DOI: 10.47176/mjiri.37.137]

Appendix A. Scoping review details

Table 4. PubMed Search Strategy and Results - Search Date: 12 2020

Search	Query	Results
#7	Search: ("scenario"[Title]) AND ((((("Coronavirus"[Majr]) OR ("COVID-19"[Majr])) OR ("SARS-CoV-2"[Majr])) OR ((((((("coronavirus"[Title/Abstract]) OR ("covid-19"[Title/Abstract])) OR ("covid 19"[Title/Abstract])) OR ("SARS-CoV-2"[Title/Abstract])) OR ("2019-ncov "[Title/Abstract])) OR ("2019 ncov"[Title/Abstract]))))	118
#6	Search: ((("Coronavirus"[Majr]) OR ("COVID-19"[Majr])) OR ("SARS-CoV-2"[Majr])) OR ((((((("coronavirus"[Title/Abstract]) OR ("covid-19"[Title/Abstract])) OR ("covid 19"[Title/Abstract])) OR ("SARS-CoV-2"[Title/Abstract])) OR ("2019-ncov "[Title/Abstract])) OR ("2019 ncov"[Title/Abstract]))	99,139
#5	Search: (((((("coronavirus"[Title/Abstract]) OR ("covid-19"[Title/Abstract])) OR ("covid 19"[Title/Abstract])) OR ("SARS-CoV-2"[Title/Abstract])) OR ("2019-ncov "[Title/Abstract])) OR ("2019 ncov"[Title/Abstract])	94,670
#4	Search: "SARS-CoV-2"[Majr]	2,255
#3	Search: "COVID-19"[Majr]	7,660
#2	Search: "Coronavirus"[Majr]	31,127
#1	Search: "scenario"[Title]	4,005

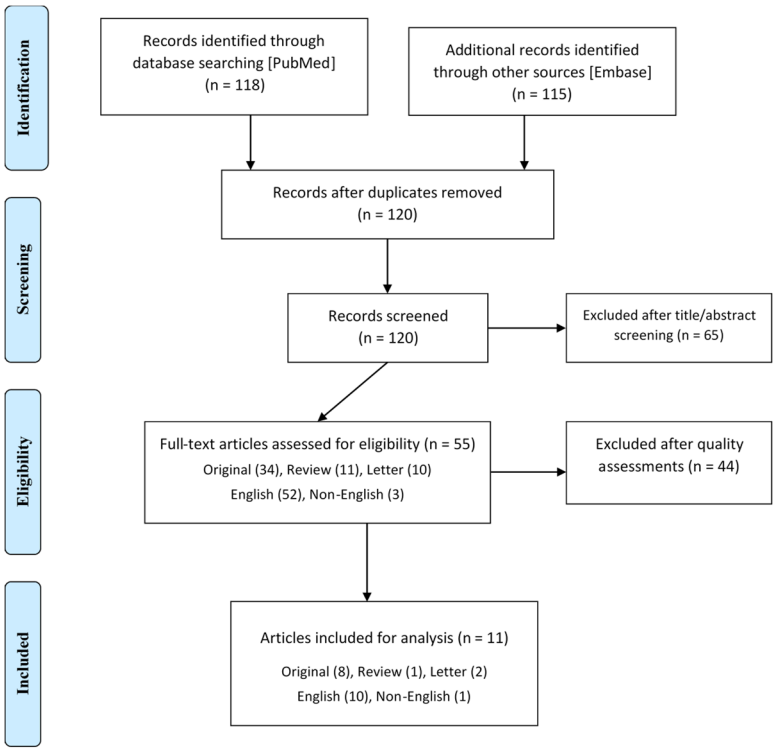

Figure 2. Flow chart of the review process (according to the PRISMA 2009 Flow Diagram)

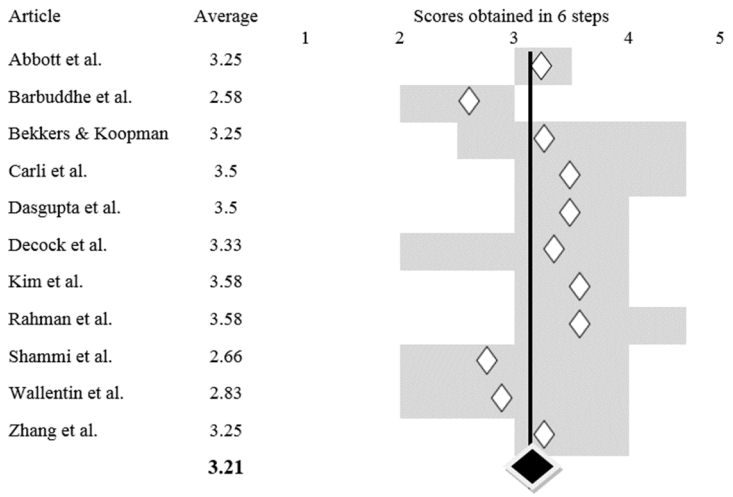

Figure 3. Forest Plot - Scores that Articles obtained in 6 steps

Note: Although scoping reviews does not seek to assess quality of evidence (29), but this assessment here has helped to fit the selected studies with the proposed process framework.

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Appendix B. Case analysis

As stated in the results section, we tried to analyze a new example carefully. A good article entitled "Intervention Scenarios for a Long-term Disease Management" published in IJHPM special issue of COVID-19 (23). This article examined four perceived decisions in a corona epidemic using agent-based modeling: Continued lockdown (1), Stepwise relaxation of the lockdown (2), Relaxation of the lockdown paralleled with contact tracing (3) and Stepwise relaxation with monitoring and adaptive response (4). This article has been able to model the general behavior of the actors and examine consequences of each decision in the future. Nevertheless, considering all these benefits, where is the problem exactly?

According to the objectives of article we will not get involved deeply with the results and analysis of the article; rather, we focus on the methodological assumptions and consider what the later scenario does (not the first generation). From this point of view, there are two main drawbacks:

First, the confusion between the scenario and the strategy.

Second, not paying attention to the key components of the scenario.

Of course, two mentioned issues related to each other, but above distinction helps to provide examples.

In the first step, we must realize that the scenario is different from the strategy. To put it simply, the scenario is a description of the future space of the subject matter, whereas Strategy is a solution or action to achieve a goal. But what is the relationship between them? When the future space is well drawn (scenario); then the best action can be taken to get the most profit and the least loss in the conditions drawn for the future (strategy). Accordingly, strategies are defined or analyzed within scenarios and not vice versa (25). Therefore, if we equate strategies with scenarios, in addition to confusing the subject, we have also reduced the scenario and ignored its key components.

These ambiguities can be divided into several parts; including ambiguity in choosing the time horizon, ambiguity in drawing the problem environment, and determining uncertainties, confusion of strategy with scenario, etc.

The first point comes from the title of the article and determining the time horizon. The question from the beginning to the end of the article is, according to what logic the authors consider the interval of interventions to be "long-term*?*" This ambiguity becomes even greater when we see "mid-term" used in the text many times (e.g. pg. 4, b. & pg. 8, Conclusion). Therefore, it seems that the article does not have a specific criterion for dividing the future time into mid/long-term.

Also, we do not see any analysis related to drawing the problem environment. Commonly, knowing the environment and its elements done through analyzes such as STEEP-V, PESTLE, etc. (2, 9). Following the previous ambiguity, because the problem's environment is not well drawn, there is no discussion about identifying uncertainties. Apparently, we are facing only one uncertainty, which is about the strategy that politicians choose (In other words, the entire STEEP-V environment has been reduced to P!).

It is more correct to know the four scenarios presented in the article, instead of considering four independent scenarios, four answers in possible situations (i.e. the same scenarios that have not been drawn). If we assume the article is a scenario with first generation pattern and if our uncertainty assumed "Spread", then this modeling can tell us in which cases according to which pattern, the "Spread" increases or decreases.

Generally, with each increase of uncertainty, one dimension is added to the scenario space: Linear image of the problem; 2D image; Multidimensional image; etc. (often in a morphological space).

Normally we need at least two uncertainties for creating a scenario. The most important weakness of expressing states associated with a variable in a linear spectrum instead of plotting the scenario spaces are:

First, psychologically decision-makers tend to intermediate mode; and even the researchers themselves often make the middle state bolder and better, so a desirable state is created and other possible states are neglected. As the four modes explained in the article, intermediate mode of "slow and stepwise relaxation (pg. 5, b.) - Added Value of Contact Tracing (pg. 6, a.)" has created some desirability; or other, analyzes are not considered, so despite explaining the general behavior in the fourth case "Good Thresholds for Adaptive Response" (pg. 7), politicians will continue to be relax and tighten their policies intermittently.

Secondly, the key variables and the general space of the problem are no longer seen; excessive simplification takes place; and decisions will be made at high risk level. Therefore, the amount of surprise will increase (For example, compare the results of the article with the results of its own sixth source: Gros et al, 2020 (26)).

Thirdly, the results of analysis will not differ much from the intuitions of experts and specialists and will have little innovation and reperceiving (12). For example, the three insights mentioned in the conclusion can probably be found in interviews with experts. But why are low-variable analyzes not so different from expert opinion? Mainly because the efficiency of the human mind decreases significantly with increasing number of variables, and on the contrary for problems with low variables, experts and specialists are well able to analyze and depict. Therefore, the power of scenario writing increases with increasing variables and the need for scenario thinking arises with increasing uncertainties.

Closing Remark

Scenario writing should be based on the analysis of uncertainties. But in the article, the uncertainties of the problem in a specific time horizon is not identified and the usages of the concept are somehow confused between the various perceptions of uncertainty in Statistics, Information Science, and Futures Studies (e.g. see: pg. 2, b; pg. 4, b. & pg. 5, b.).

It is important to describe the scenarios and their key and constructive factors; however, the article has not paid

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much attention to description of the scenarios. Different scenarios should be both value and weight and cover the whole future space of the subject completely. But the four modes of the article are not like that, and are analysis of policy options for desirable purposes. Based on the uncertainty criterion and key components, the last three scenarios (2, 3 and 4) can hardly be considered independent.

Finally, it seems that the main purpose of the article is not to evaluate scenarios but to make a "Robust Decision Analysis" (as it is clear in referring to the source number 30: Regan et al., 2005 (27) (pg. 4, b). So briefly, looking at Figure 1, it seems that instead of going through the steps and the complete scenario planning process, the article only is bridging between steps 2 and 10.

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