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# Systemic Modeling of Care Pathways by Identifying Invariant Determinants: A Qualitative Study Protocol

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## Abstract

**Background:** Care pathways are useful for optimizing patient or disease management. However, in practice, the implementation of this concept remains below its potential. Probably because it is a complex intervention in complex systems. In such cases, modeling is beneficial. Thus, facilitating the representation of care pathways can go through the formalization of a standardizable part. Indeed, certain structural elements of care pathways are systematically present, whatever the area of healthcare. The objective of the present study will be to identify and develop a list of these key factors, called “invariant determinants of care pathways”. **Methods:** This qualitative study will adopt a descriptive design. Semi-structured interviews will be conducted with different types of health experts: practitioners, academics, and institutional representatives. An interview guide was designed in 3 research sections: identifying the main key elements of the care pathway concept, defining the main determinants considered as pathway invariants, projecting the interviewee into a broader perspective of systemic pathway description. Once collected, data will be anonymized, transcribed and analyzed according to a thematic approach. The analysis report will follow the COREQ checklist. This research project has been validated by the ethics committee of Lyon (n°2022-05-19-003). **Discussion:** The results of our research will enable us to use a systems approach to gain a better understanding of the concept of care pathways and, in the longer term, to model these pathways. This study will make it possible to identify and characterize the invariant determinants of care pathways. However, although these factors are systematically present, their influence on the care pathway varies. Methods for calculating the power of impact will be used to assess this variability. Then, for a more exhaustive approach, specific factors known as variant determinants will be identified. Determining the invariant and variant determinants will enable each care pathway to be modelled.

## Keywords

care pathway, invariant determinants, modeling, study protocol, qualitative study

## Background and Study Justification

Worldwide, non-communicable diseases (NCD) are the leading cause of disability and death. Of the 55 million deaths worldwide in 2019, around 71% (almost 41 million) were due to NCDs (World Health Organization, 2023). This burden of NCDs has led to a reorientation of the organizational approach of the healthcare system. Specific policies for the management of these diseases have been implemented (Haro et al., 2014). Care pathways represent an effective and efficient way of standardizing treatment progress, reducing the pressure on the healthcare system and

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problems associated with the areas that decision-makers need to address (Aspland et al., 2019). They have some advantages: (i) shortening the duration of the care production process, (ii) increasing the consistency of care, (iii) reducing the risk of errors, (iv) lowering the cost of the care production process, (v) increasing the satisfaction of professionals and patients (Hall et al., 2006; Schrijvers et al., 2012).

However, in practice, the implementation of the concept of care pathways in public health remains below its potential, both qualitatively and quantitatively (Jabbour et al., 2018). Probably because it is a tricky concept to grasp. Indeed, establishing a consensual definition proves difficult (De Bleser et al., 2006). It brings together many different ways of formulating and approaching (Aspland et al., 2019), and it requires a holistic consideration (Gartner et al., 2022). This is a field calling for systemic perspectives (Beleffi et al., 2021): care pathways are complex interventions (Seys et al., 2019) in complex systems (Kuziemsky, 2016). Faced with a complex system, modeling helps to understand its structure and operation. The modeling highlights the relationships between its components and also makes it possible to simulate different parameter configurations and predict system behavior (Salleh et al., 2017). By clarifying the situation, models facilitate informed choices and support clinical decision making (Elbattah & Molloy, 2015). However, there are many issues surrounding the application of modeling that can contribute to its misuse, such as the selection and adoption of inappropriate models (Teerawattananon et al., 2022). This is why a standard formalization for the representation of care pathways in general could be useful (Elbattah & Molloy, 2015). A common baseline, as a first step towards modeling care pathways, could facilitate initiatives to understand complex situations.

At the basic modeling level, a straightforward manner to represent pathways is using sequences of events, as a step-by-step representation of common medical practices. This approach makes it possible to analyze the different pathways (Trajano et al., 2021), and thus to identify the variant features (Rosa et al., 2022). Nevertheless, before looking for variations between care pathways, it is essential to characterize the typical fixed structure as precisely as possible, that is to define the elements common to all care pathways.

Some factors influence a patient's journey through the healthcare ecosystem (Nestrigue et al., 2019), and may impact the quality of care (Anderson et al., 2013; Elmusharaf et al., 2017). These key factors can be called "determinants of care pathways" (DCP) by comparison with the concepts of health determinants (Dyar et al., 2022) or determinants of the quality and safety of care in healthcare institutions (Haute Autorité de Santé, 2022). DCP can refer to guiding principles for healthcare delivery that focus on key elements of the pathway process. They could hence be indicators of the risk of a breakdown in care, or on the contrary levers for positive changes in health (Zelka et al., 2022). Among these DCP,

certain structural factors of care pathways are systematically present, whatever the area of healthcare, such as organizational characteristics (Beaussier et al., 2015). They can be called "invariant determinants of care pathways" (IDPC), and can be seen as one of the first building blocks in the search for a balance between standardization and customization (Benzer et al., 2015) of care. Mastering IDCP (Sloman, 2005) may be a way of reducing undesirable flexibility, to encourage the desired variation (Melin & Axelsson, 2005). Thus, specifying IDCP can be seen as a fundamental step towards a better understanding and greater appropriation of a complex situation. This approach can find a broad echo in any type of health system and field of care.

The objective of the present study will be to identify and develop a list of IDCP based on a qualitative analysis of semi-structured interviews with health professionals.

## Materials and Methods

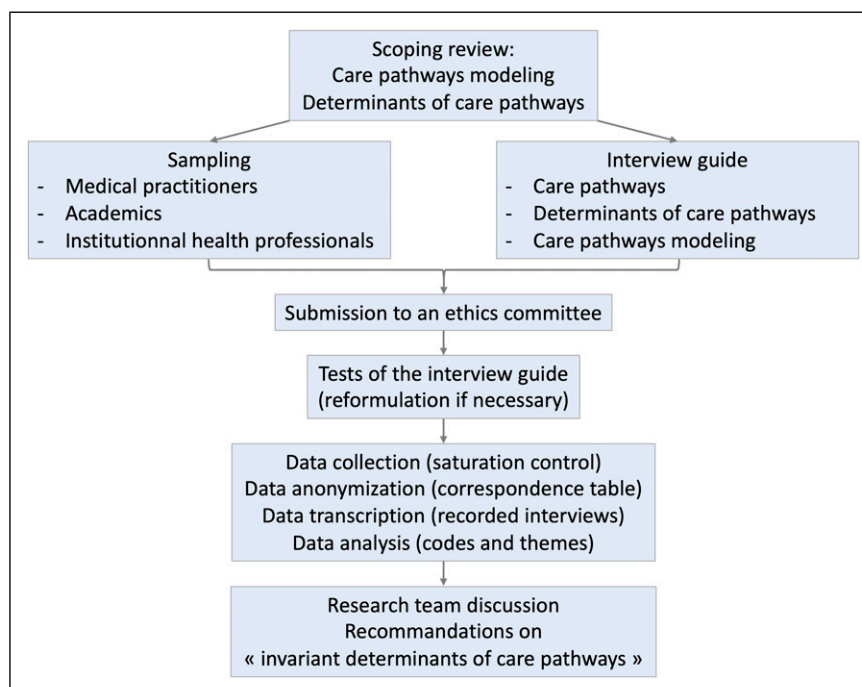
### *Justification of the Method*

The choice of a qualitative study via interviews is justified because this methodological approach allows « to understand the world from the subjects » point of view, to discover their lived world before the scientific explanations (Sayrs, 1998). In addition, qualitative research interviews will gather subjective information about a particular subject or experience. The focus is generally on the experiences of interviewees and how they perceive the world (DeJonckheere & Vaughn, 2019). Thus, semi-structured interviews allow the analysis and the comparison of the participants responses (McIntosh & Morse, 2015). This qualitative methodology permit specific areas to be addressed while giving interviewees the opportunity to reflect on their experiences and perspectives in defining, identifying and presenting the research gaps that concern them and that may not have been analyzed or anticipated by the researchers (Britten, 1995). Semi-structured interviews will allow to obtain new exploratory data in relation to IDCP, triangulate other data sources or validate findings through member verification (comments of participants about the results of the research).

### *Study Design*

This qualitative study will adopt a descriptive design focusing on different health pathway approaches. Data will be collected through semi-structured interviews that will be organized in France from May to July 2024.

The report of this qualitative analysis will follow the consolidated criteria for reporting qualitative research (COREQ) guidelines as recommended by the Enhancing the QUALity and Transparency Of health Research (EQUATOR) network for qualitative research (Tong et al., 2007). The results will also be compared to the literature (Figure 1).



**Figure 1.** The flow chart of the study design.

### Study Sample

To work widely on the subject, to be equally precise in research, and to tend towards consensus, it is expected that all participants will be professionals directly involved in health pathways and representative of the various approaches to them. Purposive sampling will be used to ensure that the insights of all identified groups are considered. This methodology is extensively used in qualitative research to identify and select information-rich cases (Setia, 2016).

Three groups of experts will be interviewed:

- 1) Health professionals in the field from the health, medico-social and social sectors: practitioners of the pathways, confronted in their daily practice with the priority notion of performance (ability to achieve set objectives), in direct contact with individuals, in the various dimensions in health, in a territorial ecosystem.
- 2) Academic health professionals: researchers, analysts, designers, ideologists and educators, confronted with the notion of relevance (link(s) between set objectives and identified needs (added value and service rendered), in a global way in supra-territorial health ecosystems (region, country, international).
- 3) Institutional health professionals: regulators, whether funders or decision-makers, confronted with the notion of efficiency (relationship between allocated resources and results: performance at the lowest cost).

To be included, participants must: (i) be professionals in the field from the health, medico-social and social sectors or Academic health professionals or Institutional health professionals; (ii) be over 18 years old, (iii) have professional experience in the field of pathways; (iv) have knowledges or competences in the health pathway; and (v) have understood, accepted and given written agreement to participate in the study.

Exclusion criteria for the study will be: (i) lack of consent form or; (ii) inability to participate in the interviews.

### Sampling

Recruitment will be carried out via contacts or by sending an email to (i) the secretariats of health care structures (hospitals, nursing homes, ...), representatives of professionals (Regional Unions of Health Professionals, ...), health supervisory agencies (Regional health agencies, ...), educational institutions (University of advanced studies in public health, ...), (ii) to people recommended by peers (snowball method) and, (iii) to people identified on the LinkedIn professional network. This message will include a recruitment announcement, a study information sheet, and a consent document. Individuals interested in participating will be asked to indicate their intention by sending an e-mail to the person in charge of this research. In the email response, the participant will be asked to specify: the professional status (active or retired); the position related to the theme of the pathways held and; the duration of his/her experience related to the theme of the pathways. This will ensure that the sample is representative of the workers in

the field. This will also make it possible to generate an anonymous identification code (which will be sent to the participant by return e-mail, along with the interview appointment information). This will enable anonymization of the content. A correspondence table will be created.

### Sample Size

In qualitative research, the number of interviewees is not a determining factor in the significance of the results. Data saturation through redundancy will be the main indicator. Thus, an initial sample size is estimated but the final sample size will be determined by data saturation (Hennink et al., 2019).

Given that it is recognized that, in the case of a homogeneous sample, (i) the first five–six participants produce the majority of new information in the dataset, while little information is obtained from subsequent participants, and (ii) that data from the first 10 participants identify 80%–92% of the information (Guest et al., 2020), and that when the sample size is around 20 interviews then little new information will be collected (Baker & Edwards, 2012), Thus, about 6–7 experts per group of health professionals should make it possible to achieve data saturation, that is the point at which the new data does not lead to a more complete understanding of the phenomenon studied but replicates previous findings (Saunders et al., 2018) and also to achieve a range of answers from each stakeholder group. Throughout the study, several parameters will be analyzed: study objective, sampling strategy, population, data quality, code type, and saturation. Semi structured interviews will be discontinued when data saturation is reached, according to the parameters defined by Hennink et al. (Hennink et al., 2017).

### Development of the Interview Guide

The guide could not be developed on models pre-used or validated in previous studies because an analysis of the literature did not reveal any. Therefore, it was designed by the research team on the basis of consensus. The consensus

methods are defined as a way to synthesize information and compare contradictory opinions, with the aim to define the degree of agreement within a group of selected individuals. The Delphi method is used to obtain a final, unique, convergent opinion of the group (Romero-Collado, 2021; Waliski et al., 2017). In this research team, the group was composed of specialists in public health and healthcare pathways. Each member established a list of questions that seemed relevant to determine the IDCP. Then, the members pooled all their proposals and they organized a first round of rating to determine if the questions should be included in the guide of interview. Each question was rated from 1 (totally disagree) to 9 (totally agree) with 5 to express indecision. The ratings were analyzed according to Table 1. When a question was deemed appropriate, then it was included in the guide of interview. When a question was deemed inappropriate, then it was excluded. When a question was considered to be uncertain or when a value missed, the group of experts discussed and rated it for a second round. If an agreement was still not reached, then the question was rejected.

This guide will be tested during three individual interviews, by telephone, with professionals working in healthcare pathways who will not participate in our study. These interviews will allow us to collect suggestions on the questions and adapt the guide. The questions included in the interview guide are described in Table 2.

The interview guide is structured in three sections (Table 2). The first section deals with the important elements of health care pathways. The objectives will be to identify the main key elements of the concept of care pathway for all the professionals, to obtain a classification of the elements of this concept according to their importance and to compare this classification according to the professionals. The second part deals with the determinants of care pathways. The objectives will be to identify the main determinants considered as invariants of the pathway by all types of professionals and to define them as precisely as possible. The third part deals with the modeling of care pathways. The objective will be to project the professional in a broader perspective of systemic description of the pathways.

**Table 1.** Conditions for Obtaining an Agreement Between Experts According to Median Value and Distribution of the Quotations.

Proposal estimated	Degree of agreement	Median	Minimum; maximum
Appropriate	Strong	$\geq 7$	7; 9
	Relative	$\geq 7$	5; 9
Inappropriate	Strong	$\leq 3$	1; 3
	Relative	$\leq 3.5$	1; 5
Uncertain	Indecision	$4 \leq \text{median} \leq 6.5$	1; 9
	No consensus	All other situations	All other situations

**Table 2.** Semi-Structured Interview Guide.

Topics	Objectives	Questions
Care pathways	Identify: <ul style="list-style-type: none"> <li>- The main key elements of this concept for any type of professional,</li> <li>- The order in which the elements related to the subject of the study appear, if any,</li> <li>- The characteristics of the comparison of responses between the different professional statuses of the participants.</li> </ul>	<ul style="list-style-type: none"> <li>- What does the notion of a “care pathway” mean to you?</li> <li>- How can this concept be useful for our health care system?</li> <li>- What do you think are the main keywords frequently associated with the concept of care pathways?               <ul style="list-style-type: none"> <li>• Barrier to the pathway</li> <li>• Break in the pathway</li> <li>• Pathway fluidity</li> <li>• Health determinants</li> <li>• Pathway determinants</li> <li>• Complex pathway</li> <li>• Territorial coordination</li> <li>• Health project</li> <li>• Territorial health organization (GHT, CPTS, etc.)</li> <li>• Episode of care</li> <li>• Care trajectory</li> <li>• Care pathway</li> <li>• Clinical pathway</li> <li>• Patient tracer</li> </ul> </li> </ul>
Determinants of care pathways	<ul style="list-style-type: none"> <li>- Identify the main determinants considered as pathway invariants by all types of professionals</li> <li>- Define them as precisely as possible</li> </ul>	<ul style="list-style-type: none"> <li>- What does the concept of care pathway determinants/key factors mean to you?</li> <li>- What differences do you see between the concepts of “health determinants” and “care pathway determinants”?</li> <li>- What do you think are the most important pathway determinants?</li> <li>- In your opinion, which pathway determinants can be described as invariant (i.e., key pathway orientation factors, regardless of the areas concerned)? Could you classify them according to their importance, and explain why?</li> <li>- Why is it relevant to consider pathway determinants?</li> <li>- Why is it relevant to consider the so-called invariant pathway determinants?</li> </ul>
Care pathway modeling	Project the professional in a broader perspective of systemic description of the pathways	<ul style="list-style-type: none"> <li>- What does the notion of “care pathway modeling” mean to you? Do you think that care pathway modeling is possible or illusory?               <ul style="list-style-type: none"> <li>• What is the purpose of a care pathway model?</li> <li>• What do you think are the key characteristics of such a model?</li> <li>• In your opinion, what is the role of so-called invariant determinants in care pathway modeling?</li> <li>• In your opinion, what is the place of variable/inconsistent determinants in care pathway modeling?</li> </ul> </li> </ul>

### Description of the Interview and Data Collection

The semi structured interviews will be conducted by one researcher (B.D.), who is used to this kind of interview, using tele-conference or phone, according to the participant’s availability and preference. For ethical reasons and respect for confidentiality, the research manager (F.C.) will be the only person to be aware of personal data and to know the table of correspondence. The researcher that will conduct the

interviews will not know the identity of participants. The correspondence table showing the link between the identification code and the socio-demographic criteria of the participants will be kept within the research team.

The interview will begin with an introduction of the facilitator and a reminder of the objective of the interview. The interview will last approximately 1 hour. The guide will be used as sparingly as possible, only, when necessary, in such a way as to obtain spontaneous answers and to reduce the risk of



directing the respondents' answers. Recalls or requests for rephrasing will be proposed as a priority to expand the investigation. The audio recording will be deleted after this operation is completed.

### Data Analysis

The analysis of the qualitative data will follow the methodological framework proposed by Braun and Clarke (2006) (Braun & Clarke, 2006), which consists of a thematic analysis. First, the recordings of the conversations will be transcribed verbatim and checked, tracking the exact course of the interview and indicating all components of the communication to understand the interactions (including laughter, hesitations). Second, two researchers will carry out open coding with an in-depth reading of each verbatim transcription. They will use a mixt content analytic method: inductive and deductive. Third, the two researchers will discuss the initial codes until they reach an agreement and draw up a first codebook. In case of divergent opinions, a third researcher, member of the research team, will be solicited. Fourth, researchers will use the structure of this code to analyze the remaining answers, remaining open to the inclusion of new codes or to the refining of existing ones. Fifth, the final structure with themes and subthemes will be finalized and occurrences will be measured to weigh the results.

Reliability during thematic data analysis will be guaranteed by systematically storing raw data, reporting detailed notes on the development and organization of concepts and themes, the establishment of a consensus on the themes, the provision of precise descriptions of the context and the description of the coding and analysis process (Kastner et al., 2016; Whittemore et al., 2014). The NVivo® software (QSR International) will be used for data analysis.

### Ethical Approval

Ethical approval was obtained from the Research Ethics Committee of the University of Lyon (n°2022-05-19-003 on 27 October 2022) and a declaration (MR004) to the National Commission for Computing and Liberties (CNIL) (2226244 v zero was made on 5 May 2022. Written informed consent will be obtained from eligible participants before data collection.

### Discussion

The implementation of care pathways is associated with better outcomes for patients and teams, and better organized care processes (Seys et al., 2017). At patient level, fewer post-operative complications are reported, with shorter lengths of stay (Austin et al., 2015; Kalmet et al., 2016; Rotter et al., 2010) and lower hospitalization costs (Barbieri et al., 2009). In addition, at team level, communication and relationships are improved, and the risk of burnout is reduced (Ahmed et al., 2013;

Deneckere et al., 2013; Rotter et al., 2010). When a care pathway is put in place, staff feel the need to collaborate within the hospital and with primary care, leading to better organization of care processes (Furåker et al., 2004). Other examples of better organization of care are standardization of the care process, improved documentation and communication with patients and healthcare professionals, better monitoring of the care process and greater confidence in the performance of tasks (Ahmed et al., 2013; Allen et al., 2009; Clark et al., 2012; Rotter et al., 2010).

This study of the organizational dimensions of health will have a systemic approach. It will provide a better understanding of the system with a view to improving it. Based on a qualitative analysis of interviews with health professionals, this study will permit to identify and define a list of IDCP. They will be classified into facilitators or barriers (Tavender et al., 2016). Thanks to them, it will be possible to start modeling and to obtain a view of the main structure of all care pathways. However, identifying and describing is only a first step in the relevance of this systemic approach. Although these IDCP are systematically found in the care pathways, their impact differs from one care pathway to another. The second step will be to assign importance scores or situational impact weights to these IDCP, in order to clarify the implementation of specific strategies. Then, as each care pathway has its own characteristics, the third step will be to explore specific factors: the variant determinants.

### Author's Note

This study protocol will be conducted in partial fulfilment of the first author's PhD in Education science and Public Health at Lyon University, under the supervision of the last author (50%) and the third author (50%), and under the local sponsorship of the fourth author. The first author will independently conduct all aspects of the study protocol, as indicated by the use of the first pronoun therein, unless otherwise specified.

### Declaration of Conflicting Interests


The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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