

Design and implementation of a Delphi Method with visual and qualitative feedback to promote communication among a multidisciplinary team: selection of strategies to reduce antimicrobial resistance in hospital settings

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Abstract — *The antimicrobial resistance represents a threat to public health. Portugal has high values of multiresistant strains mainly in hospital settings. New initiatives are being implemented to tackle antimicrobial resistance, focusing on areas like prescription and awareness of the population. However it is impracticable to implement all of these initiatives simultaneously due to lack of resources. Therefore is imperative to query the opinion of different health care professionals, what has not been done so far. This study has as a primary goal the development of a methodology that promotes communication among a multidisciplinary group in the context stated. The methodology will depart from the Delphi method associated, in a unique way, with two resources: a technique of data visualization and a forum to promote discussion online. The objective of these two innovations is overtaking flaws of Delphi method, allowing participants to engage in an active discussion, always anonymously. The methodology proposed was applied in the case-study of antimicrobial resistance. In a global perspective, the participants had a positive reaction to the methodology highlighting the flexibility of participation provided by the Delphi component. The visual representation of information associated with the colours scale was considered a useful and attractive way to structure the gathered information. The potential of the forum was recognized. However, the participants felt difficulties in using it, suggesting a clarification session, done at the beginning of the process. The participants recognized the potential to apply this methodology to other groups and problematics, in this context or any other context.*

Keywords — Participatory Methods; Delphi Method; Data Visualisation Methods (DVM); Quantitative and Qualitative Information (QQI); Antimicrobial Resistance; Stewardship Programs (SP).

1. INTRODUCTION

The first antimicrobial, the Penicillin, was discovered in 1927 by Alexander Fleming (Davies & Davies, 2010). This groundbreaking discovery was paramount because it cured most infectious diseases, deadly at the time (Centers for Disease Control and Prevention (CDC), 1999). Today there are about sixteen different classes of antibiotics and all of them have its value in fighting against infectious diseases, increasing average life expectancy and decreasing mortality (Davies & Davies, 2010). Antimicrobials, taken here as synonymous of antibiotics, are compounds that kill or inhibit the growth of microorganisms responsible for different types of diseases (National Pesticide Information Center, 2010). However, microbes are evolving at a higher rate than expected (Levy, 2002). The microorganisms are mutating and adapting to adverse environments, which mean they are no longer being affected, still growing and reproducing even when in the presence of the antimicrobial (Alanis, 2005). This genetic mutation is called resistance, which is becoming a threat to public health, affecting the whole ecosystem (WHO, 2014). This resistance is caused mainly by misuse and overuse of antimicrobials in hospital settings and in the community (Davies, 2006). The pressure applied by patients during an

appointment, the fact that diagnoses are highly uncertain and the auto medication by population with disregard for the instructions given by doctors and pharmaceuticals are key drivers for overuse and misuse (Grigoryan et al., 2007; Levy, 2002).

This problem can have social and economic consequences (Laxminarayan et al., 2013). If resistant microorganisms infect a patient, the treatments will become less effective, more invasive and more expensive, the recovery will be longer, the hospitalization will be more frequent and longer, and the number of doctor appointments will increase (Mayo Clinic Staff, 2014). These consequences will cause repercussions in the budget of the national health system, in the budget of the hospital and even in the savings of the patients. If nothing is done to stop the spread of resistance, it is expected that by 2050 there will be 10 million deaths in the whole world due to infectious diseases (Gallagher, 2016).

The “Programa de Prevenção e Controlo de Infeções e de Resistência aos Antimicrobianos” (PPCIRA) is the program responsible for the surveillance of resistance in Portugal, as well as one of the supporters of awareness campaigns (Direcção Geral de Saúde, 2016). In the report of 2015 is possible to see that Portugal has values of resistance higher than 50% and greater than the average of other European countries, for some of the strains of resistant bacteria

(Fernandes et al., 2015). In fact, for the *Klebsiella pneumoniae*, the trend of resistance in Portugal is increasing throughout the years. Concerning the data on consumption of antimicrobials in hospital settings, Portugal is the second European country with the highest consumption of one of the classes of antibiotics, the carbapenems (Fernandes et al., 2015). Therefore, there is the need to design of strategies aimed at preventing this situation from getting worse (Alanis, 2005). Even though there are already a few solutions implemented, the majority of them rely on too many strategies, which makes them difficult to apply in general. Therefore, for practical reasons, it is imperative to select the central policies. A possible course of action is to ask to a group of experts or stakeholders their opinion. It is in this context that the development of the methodology suggested by this study arises. The methodology comprises the implementation of a participatory method, to gather opinions and promote communication among a multidisciplinary group of experts. This participatory method was integrated with two technologic tools: a technique of data visualization to improve the interpretation of data and a forum to gather qualitative information, where participants can interact with the other participants involved in the study and ask questions regarding the process implemented. The primary objective of this study is to develop the methodology previous explained and apply it to the case study of antimicrobials resistance.

A. Objectives

The specific aims of this study, in order to achieve the primary goal, are:

- Select the best participatory method to promote an efficient discussion;
- Implement the method selected;
- Define strategies to increase response rates and help in the interpretation of data;
- Development of a cognitive map and application of scale of colors to the map;
- Development of a forum to promote discussion among participants in real-time;
- Research about antimicrobial resistance, in order to adapt the methodology to the context;
- Collect opinions of participants and understand their response to the use of the tools created;

The study here presented is concept proof, so the most important part will be the validation of the methodology and understanding the reaction of participants to the process. Therefore, it will be necessary to develop a user-friendly forum, design questionnaires specific to the case study and represent the data with a visualization method.

B. Article Outline

In the following chapter, Chapter 2, it was done an analysis of the main solutions for controlling antibiotic resistance implemented throughout the world. Then a review of the main participatory methods as well as their applications was performed. This way, it was easier to select which participatory method is more suitable for this case-study. In chapter 3 a description of the methodology was performed, as well as the detailing of the tools used and built from scratch. In chapter 4 it was presented the application of the

methodology, along with the main assumptions followed and results obtained. In chapter 5 a discussion of the methodology was done as well as a description of the limitations of the study developed. In chapter 6, it was possible to explore the final remarks of this study and its potential for the future.

2. REVIEW OF CONCEPTS

A. Strategic objectives for control of antibiotic resistance

Prevention is mandatory in Portugal as well as in other European countries. The interventions are meant to diminish risks and threats to public health, reducing the impact and preventing the spread of resistance. The World Health Organization (WHO) sets, in the global action plan 2013/2020, five strategic objectives (WHO, 2015):

- Improve awareness and increase understanding of antimicrobial resistance;
- Strengthen knowledge through surveillance and research;
- Reduce incidence of infection;
- Optimize the use of antimicrobial agents;
- Develop an economic case for sustainable investment that takes into account the needs of all countries and increases investment in new medicines, diagnostic tools, vaccines and other intervention.

In agreement with these objectives, the PPCIRA suggests for 2016 the following strategies in Portugal (Fernandes et al., 2015):

- 1) Improve the capacity to detect outbreaks of resistance bacteria;
- 2) Increase the number of institutions with surveillance of infections acquired during internment;
- 3) Increase the awareness campaigns, improving the literacy of the population;
- 4) Spread the implementation of a decision support system for antibiotic prescription.

B. Solutions

The best way to fulfil these main objectives is through the implementation of a set of different types of solutions. Some of the solutions implemented are global and try to achieve multiple goals like antibiotic SP (Paterson, 2006). Others are more specific and only accomplish one of the objectives previously stated like HEPIC implemented only in “José Mello Saúde” group as a platform for surveillance of resistance (objective 2) or the kit developed by FasTinov as the fastest diagnose tool (objective 1). Due to the holistic feature of stewardship program, they were the main focus of this study.

1) Antibiotic Stewardship programs

Antibiotic SP are overarching and flexible programs that control the antimicrobial use at a health care institution. These programs concentrate on obtaining the best patient outcomes, promote cost-effectiveness and reduce or stabilize levels of resistance in an institution (Paterson, 2006). The main pillars of the programs are Education and Legislation, Monitorization, Reports and Communication and Accountability (CDC, 2014). All of these pillars are based in a multidisciplinary team to assure that the whole structure of

health care institutions is involved in the development of these programs (CDC, 2014).

However, as these kinds of programs comprises so many areas and multiple strategies, it is advisable that each country adapts them to its reality (CDC, 2014) and for the reality of each institution. To accomplish this adaptation, the problem of antimicrobial resistance in Portugal should be well defined.

C. Structuring Problems

There are multiple strategies of problem structuring, like Strategic Options Development and Analysis and Soft Systems Methodology (Eden, 1995; Wang, Liu, & Mingers, 2015).

1) Methods to gather information

To gather information for structuring the problem one can use questionnaires, interviews or participatory methods (PM's). PM's are useful to structure a problem and select the main strategies for it, to resolve conflicts or to achieve consensus when different opinions exist (Slocum, 2003). The PM's are able to respond to uncertainty and inequality and are used as a democratic tool that represents all relevant intervenients and allow all opinions to have the same value (Slocum, 2003). The decision in group gathers multiple advantages over individual decisions. On group decision making, participants are more motivated, have higher creativity influenced by others ideas and each idea is evaluated on the site, due to the communication among participants (French, Maule, & Papamichail, 2009). The efficacy of these decisions depends on the strategy used as a decision support system.

These kinds of methods are used for selection of policies and resources allocation (Bana e Costa, Lourenço, Oliveira, & Bana e Costa, 2014; O'Brien, 1978). The methods are used in a wide range of areas like water planning, energies, education planning, public administration and health. Through an extensive analysis of the five key features of these methods, it was possible to construct a scheme to choose the method for each occasion represented in Figure 2. The features contemplated were goals to achieve, nature of the problem, participants that contribute, execution time and if it was needed a budget (Slocum, 2003).

In Table 1 is possible to observe a summary of the main studies performed with participatory methods. For each study is possible to see the method applied, the area of implementation, the primary objective and if they used a data visualization method or not. The papers selected for this review have to have one of two of these features. The studies needed to be from the health care field of research or have to use a technique of data visualization. Priority was given to papers with these two features simultaneously. In Table 1 were also included the papers that had similar objectives to the ones proposed in this study.

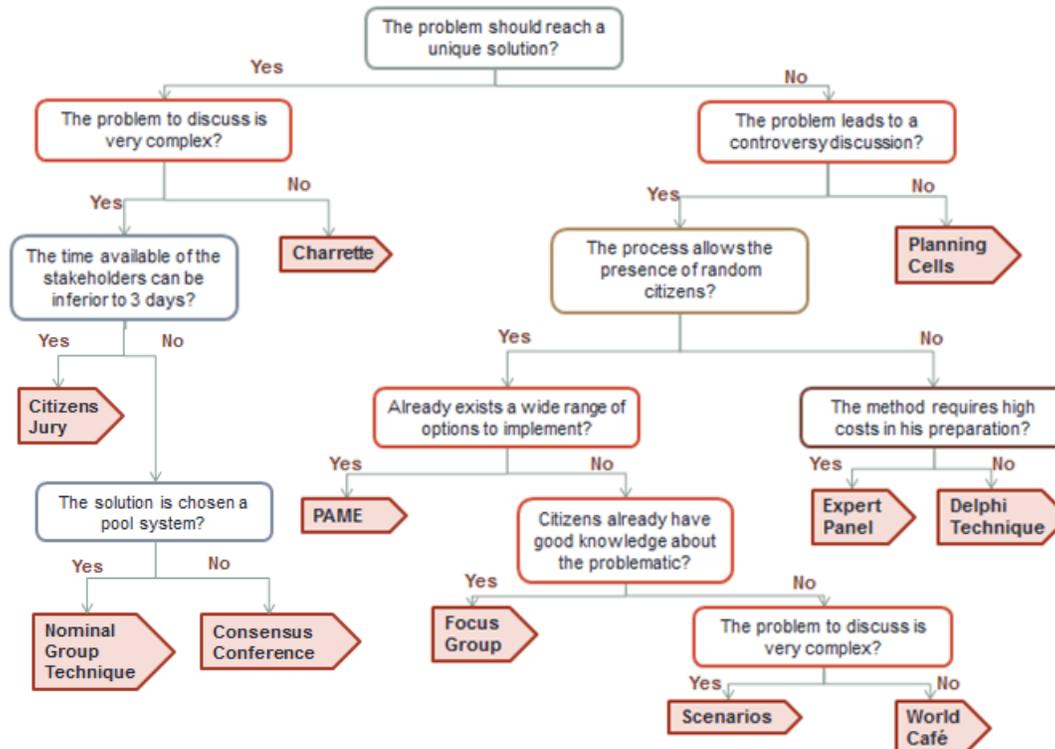


Figure 1 – Scheme to choose a PM according to the characteristics of the problem.

Table 1 – Summary of different papers with different participatory methods. For each paper is identified the field of research, the objective of the study and if they use techniques of data visualization.

Method	Paper	Field of Research	Objectives	Techniques of data visualization
Delphi Method	(Kassem, Al-Haddad, Komljenovic, & Schiffauerova, 2016)	Solar thermal energies	Identify criteria to evaluate solar thermal technologies.	Yes
	(Blume, Weert, Busari, & Delnoij, 2016)	Health	Find a solution for the hospital to respond to external demand by asking experts.	No
Charrete	(Fay, Carll-White, & Harrell, 2016)	Construction	Identify threats important in department of on emergency post occupancy evaluation.	No
Citizens Jury	(Henderson et al., 2013)	Food Regulation	Validation of the method to get involved citizens in food regulation	No
	(Scuffham et al., 2016)	Health	Find solutions for improving service in emergency services asking patients.	No
Focus Group	(Aggarwal, Cedeño, Guarnaccia, Kleinman, & Lewis-Fernández, 2016)	Health	Define behaviors beliefs and policies to promote better outcomes in mental health department.	No
Experts Panel	(Bingham & Cornell, 2016)	Health	Evaluate the effect of nursing care in maternal health outcomes	No
Decision Conference	(Mateus, Costa, & Matos, 2016)	Territorial Organization	Find the key solution to built in a brownfield.	Yes
	(Oliveira, Rodrigues, Costa, & Sá, 2012)	Health	Development of a model to allocation human resources in community care programs.	Yes
Nominal Group Technique	(Parra et al., 2008)	Health	Identify and validate important health indicators to improve paediatrician prescription.	No
Scenarios	(Salmeron, 2010)	Risk Analysis	Evaluate risks in implementation of Information Technology Projects.	Yes

2) Data Visualization

The feedback can be presented in quantitative information like averages, median or in qualitative information through comments and arguments. The statistic information can create conformity in responses and participants change their options without knowing really why (Woudenberg, 1991). The qualitative information is often ignored by participants that make arguments not precise or clear (Bolger, Stranieri, Wright, & Yearwood, 2011). In this context arises the need for a data visualization technique and a better way to collect qualitative information. Data Visualization techniques enable, for example, a better and faster interpretation of data and the identification of relationships and patterns (Data Visualization and Presentation, 2012). However, it is necessary to ensure a

balance between the visual form and the functionality of the representation. Moreover, qualitative information is also key in a Delphi method, so is relevant to collect justification for each selection. With these arguments participants can change their opinions with a full picture of the situation. This need makes an opportunity to implement a Forum as a tool to promote communication and discussion, collecting the comments of participants.

D. Selection of the participatory method

The participatory method used in this study is the Delphi Method because it allows the participation of individuals from different locations and enables them to respond in their own pace (Keeney et al., 2011). As seen in Table 1, this is one of

the most used methods in health care and also has successful examples with visual representation of data, so is the best fit in this context. The Delphi can have multiple rounds (Keeney et al., 2011). The traditional Delphi starts with an exploratory round with open-ended questions. In the second round, the questions are built from the responses gave in the first round. There the participants can rank the options, and assign points. The rounds are then repeated in an iterative manner until a consensus is reached (Keeney et al., 2011). In each round, the participants have access to its options and can keep or alter them after a second analysis or after seeing the choices of other participants (Keeney et al., 2011). There are other kinds of process, like the modified one, the real-time Delphi or the online Delphi. Although the characteristics are somehow different, the objectives are very similar (Keeney et al., 2011). A Delphi can be used to: select or define priorities of policies in short, medium or long-term or reach consensus (this term can have multiple definitions; however, this discussion will not be the focus of this study) (Keeney et al., 2011). According to the type of problem and the objectives, some inclusion criteria are defined to select participants. The number of rounds is variable, but according to Delbecq et al. (1975), if the goal is not to reach consensus than 2 or 3 are more than enough. The last but not the least important feature of the Delphi is anonymity. The responses given in a Delphi should always be given in an anonymous way, only being identified by the participant that provided them. Sometimes there is a quasi-anonymous concept that appears in this context. This concept means that sometimes some participants may know each other, but the responses are not identifiable (Keeney et al., 2011).

The feedback gave to participants between rounds is typically given through statistics, however, in this case, it was decided that the numbers should be replaced by a visual representation method to improve interpretation.

One of the main disadvantages of a Delphi Method is that participants change their option without justifying it and mainly because the majority of people chose an option. Other participants do not alter their choices because do not know the arguments of the other participants for choosing other options

(Keeney et al., 2011). A Forum was implemented to overtake these difficulties. In literature it was not found a forum associated with a participatory method, however, is recognized its relevance to promoting communication and gather qualitative data (Im & Chee, 2006). The forum also allows the communication in real-time (Im & Chee, 2006).

In the next chapter, it was possible to describe the methodology developed in this study, taking into account the information gather in this chapter.

3. METHODOLOGY: DELPHI WITH A VISUALIZATION DATA TECHNIQUE AND A FORUM

After the analysis done in chapter 2 and after the Delphi method has been chosen, it is now possible to describe the methodology proposed in this study.

A. Methodology Overview

This study will apply a Delphi method, combined with cognitive maps as feedback between rounds and a Forum to help promoting communication between participants. The Delphi method was chosen because it can meet the objectives of this case study. The fact that a Delphi allows anonymity, does not require displacement of the participants, is easy and individual, and the fact that each participant answers to the questions when it is more convenient to them is perfect for the context of this case study (Keeney et al., 2011). The cognitive map will be associated with a scale of colors which represents the number of people who selected one strategy or area (Venable, 2016). Side by side, it will be developed a Forum to gather qualitative information and complement the Delphi. The participation will be made through a web platform which will allow to collect and treat data more efficiently, decrease costs of implementation and adapt in a flexible way the design of the Delphi Method (Boynton & Greenhalgh, 2004). These characteristics will potentiate the response rate (Boynton & Greenhalgh, 2004). In Figure 3 is possible to see the main steps to develop the methodology in this study.

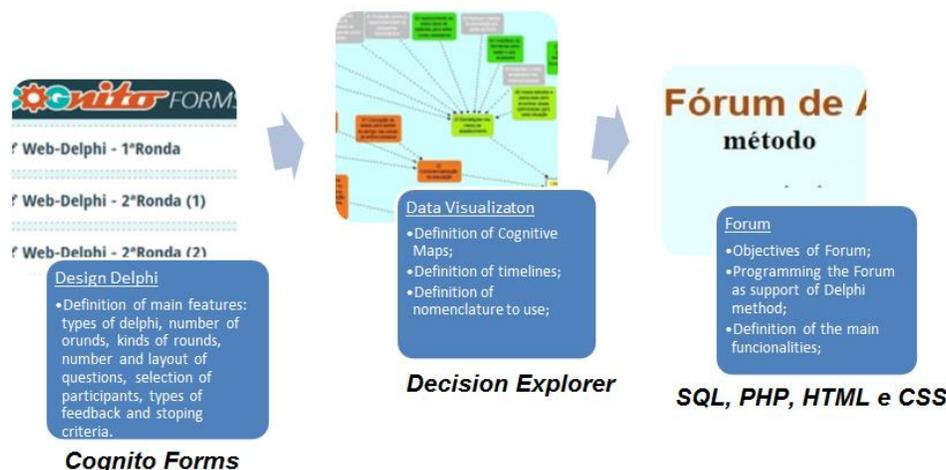


Figure 2 – Representation of the three main steps of the development of the methodology and the tools needed to implement each step.

The primary goal of this methodology is to develop a tool that promotes communication between experts in a user-friendly way, increases the response rate, makes it easier to interpret data, and saves time for the participants.

In the next sub-chapter, the design of the Delphi applied in this study was explored.

B. Design of Delphi Method

The Delphi implemented was a modified one combined with a web platform, which means the first round had close-ended questions. The main goal of this Delphi is to select the main areas and viable strategies in the fight against antimicrobial resistance. The Delphi will have two rounds and will be applied to a small group of participants with theoretical knowledge and practical experience in the field of antimicrobial resistance; some participants may know each other (quasi-anonymous).

The questions developed and implemented in this Delphi were all close-ended questions, where one uses a scale Disagree/Fully Agree, another a radio button option, other a scale "Resources Already Existent/+5 years" and the majority of the items will use a checkbox option. These last kinds of questions were implemented because they can overtake the limitation that close-ended questions represent.

C. Data Visualization

The representation of the data was done by using cognitive maps. The nomenclature of these maps will follow the one suggested by Eden Colin and Fran Ackermann (Bryson, Ackermann, Finn, & Eden, 2004). Therefore, cognitive maps are composed of concepts interlinked with arrows which represent influence. This technique is very useful for analysis of the different solutions that may influence the problem. Associated to the cognitive map, it was applied a scale of colors that represent the percentage of participants that choose a policy or strategy. This scale of colors is based in the one suggested by John Venable (Venable, 2016). In Figure 4 it is possible to see the nomenclature used in the maps developed in this study. These maps were developed using Decision Explorer that allow representing concepts in an attractive way as well as implement the color scale.

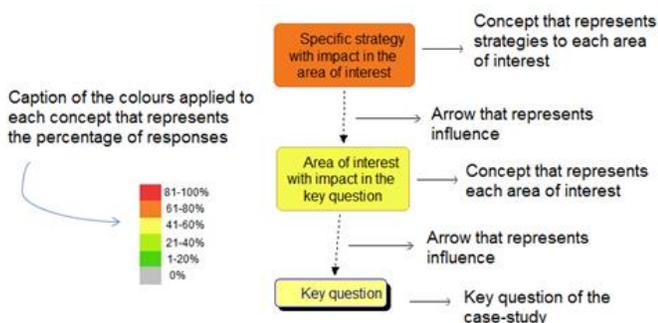


Figure 3 – Nomenclature used in cognitive maps. The colors of the concepts are the ones represented in the caption (left of the figure).

D. Development of the Forum

Alongside with the Delphi will be running a forum which goal is to complement the process and promote the communication and an active discussion between participants. The Forum was built using SQL, PHP, HTML and CSS. The main functionalities, to surpass some of the limitations of the process, are:

- Account with only a password to guarantee safety of data and the anonymity;
- Creation of two different areas on to interaction between participant-facilitator (Doubts) and other to interaction participant-participant (Comments);
- E-mail sent every day with the new posts in each day;
- The participant can edit their own messages;
- Help sections on every page of the forum to make easier the process;
- When the participant responds to a message should mark to whom he is responding to.

In the next chapter, the results of applying this methodology to the case study were shown.

4. CASE STUDY: APPLICATION AND RESULTS

The methodology was implemented to promote communication among a multidisciplinary group to select strategies relevant to fight against resistance. The results will follow the steps of the process from a perspective of a participant. The main steps are represented in Figure 4.

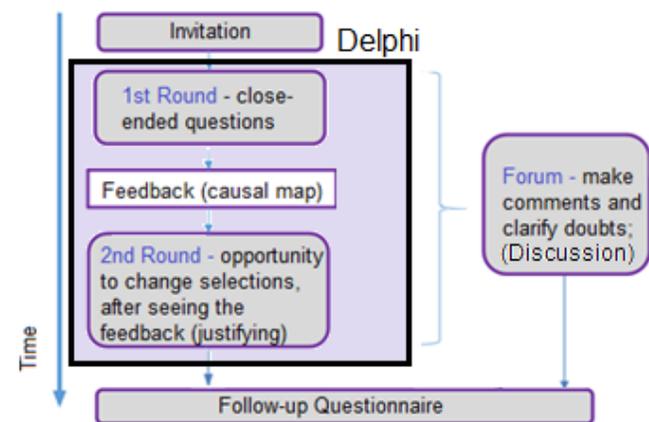


Figure 4 – Steps of the Delphi method that each participant will follow.

A. Step 1 – Sending invitation to participants

The first step is sending the invitation. The request was sent to a total of 6 persons, one doctor specialist in infectious diseases, one doctor from the epidemiology group, three prescription physicians and one pharmaceutical. All of the backgrounds are validated within the experiences suggested by the SP presented in chapter 2.

B. Step 2 – Beginning of 1st Round

After the invitation, the participant can have access to the first round questionnaire, in <http://web.ist.utl.pt/ist173150/round1.html>.

The main areas included in this case study and found in literature are (Colson, 2008; Laxminarayan, Malani, Howard, & Smith, 2007; Nathwani & Sneddon, 2013; Simões, Gregório, Póvoa, & Lapão, 2015):

- Communication between healthcare professionals and between healthcare institutions;
- Monitorization of resistance in hospital settings;
- Monitorization of consumption of different antimicrobials;
- Implementation of decision support systems in prescription;
- Implementation of strategies in demand branch (e.g., Prescription, sell to client);
- Education of healthcare professionals;
- Awareness of population;
- Implementation of strategies in supply means (e.g., Pharmacies and Laboratories).

The questionnaires will be divided into two parts, in both rounds. In the first part participants will have to select the main areas of expertise and, for each one, the main strategies or information that can influence each one. In the second part of area e), g) and h) participants will have to assign a value to define the starting point to implement each strategy, from the scale that goes from “Resources that already exist” to “More than five years”. The questions from the first part will enable the construction of the cognitive map and the questions from the second part will enable the development of the timelines that represent the starting point to implement each strategy. Not all questions are answered by all participants. The questions that refer to a particular area only appear if that area is selected in the first question. At most, a participant responds to 17 questions in the first round and at least to 7 questions. The language chosen to the questionnaire was Portuguese because this case-study is focused on implementing the methodology created in a Portuguese context.

C. Step 3 – Beginning of 2nd Round

After gathering the data, the cognitive map and timelines are constructed and presented to the participant. The responses of each participant are identified using a blue circle each area and each strategy, as well as in the timeline. This way the participant can review their responses and decide either to maintain or to alter them based on a second reflection or in the replies gave by his/her pairs. In the second round, the questions are very similar to the ones implemented in the first round. The cognitive map and the timelines were integrated into the questionnaire, and the cognitive map was divided into

areas to be easier for the participant to understand each section of the map. In Figure 5 is possible to see an example of this statement.

Comunicação entre os diferentes profissionais de saúde de diferentes centros hospitalares.



3. Acima encontra-se o mapa construído com as medidas selecionadas pelos participantes. Caso pretenda alterar alguma das opções, mude em baixo a seleção. Caso a venha a alterar peça-lhe que comente no Fórum na secção adequada.*

Criar mecanismos de partilha automática de relatórios de infeções e uso de antimicrobianos para todos os profissionais de saúde.

Reuniões presenciais para explorar as taxas de resistência de hospitais.

Promover reuniões com especialistas de diferentes hospitais da região para partilha de informação.

Promover uma maior participação de todas as instituições hospitalares nas atividades europeias no combate à resistência a antimicrobianos, como participação no "Dia Europeu dos Antibióticos"

Comentários

Caso tenha alterado a sua seleção ou caso tenha optado por manter, deixe um comentário na secção adequada do Fórum, clicando no link abaixo. Pode também aceder aos comentários dos seus pares e partilhar a sua opinião.

<http://web.ist.utl.pt/ist173150/round1.php>

Anterior Próxima

Figure 5 – Example of the feedback return to the participant. This question is related to the area of communication between health care professionals. In a blue circle is possible to see the responses given by a participant

Using the data gathered from the second round it is possible to represent the final cognitive map and the final timelines. The timelines represent the opinion of the majority (more than 50% of participants chose a level). When two points in time are selected by the same number of participants, the strategies are extended between those 2 points. In Figure 7 is possible to see a section of the final cognitive map and in Figure 6 is possible to observe one of the three timelines developed, in this case the timeline to strategies for improve awareness of population. Because of space constraints, it was not feasible to add to the global map to neither this extended abstract nor all the timelines constructed. For more information contact the author of this extended abstract.

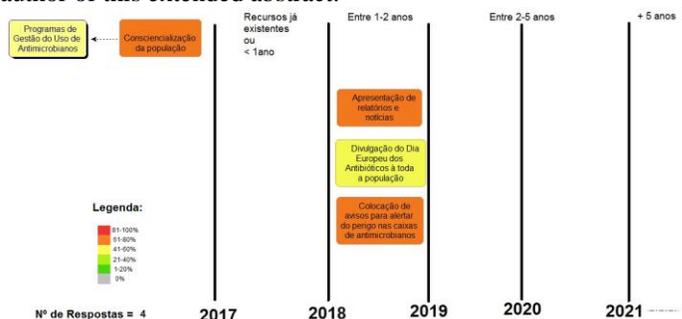


Figure 6 – Example of a final timeline that represents the period when a strategy should begin to be implemented. The timeline is for the area of awareness of population.

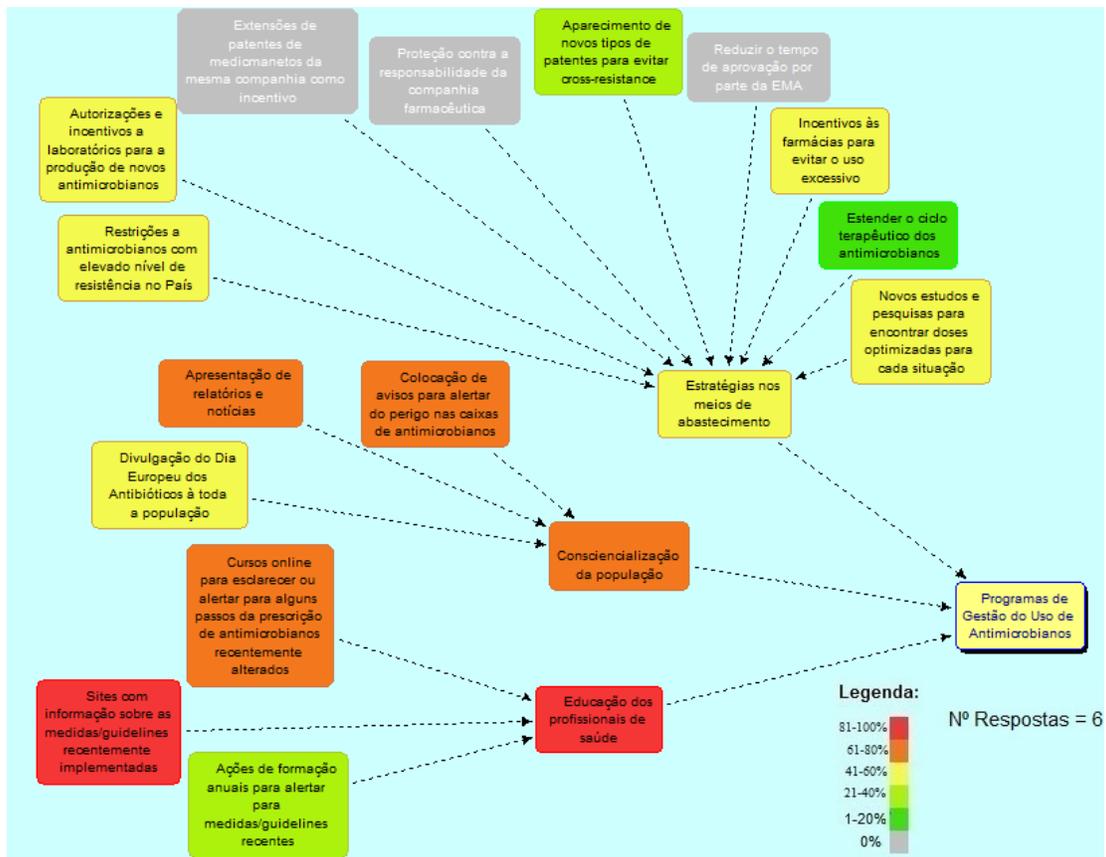


Figure 7 – Section of the cognitive map constructed with the results after the 2nd round of the Delphi process.

The areas selected by the majority of the participants (percentage higher than 61%) are b), c), f) and g). From the first round to the second round some participants changed their selection, yet no area had fewer choices than before, only higher.

D. Step 4 – Forum application

The Forum was always available through the link <http://web.ist.utl.pt/ist173150/inicial.php>. The cognitive map was integrated into the Forum and subdivided into sections each section represented one area of interest. The Forum had low participation. Only eight publications were done, all reflection points but no one responded to these observations points. Since this study is mainly focused on the expectations of participants when using this methodology rather than the results itself, a follow-up questionnaire was applied in the end through a phone conversation. The discussion of the methodology, the reaction of the participants and the limitations encountered will be explored in the next chapter.

5. DISCUSSION

The application of the methodology was partly evaluated by the follow-up questionnaire. The questions were divided into five main categories: the process, the questionnaires, the visualization methods, the forum and global remarks.

A. The process

For the participants, the Delphi was the correct option for this context. The fact that was implemented on the web made it

attractive and easier to gather information by the facilitator of the process. Another advantage highlighted was anonymity because this way the hierarchical pressure was avoided. In fact, these features are also responsible for the high response rate. Health professionals have limited availability, so they were very enthusiastic about the fact they could collaborate when is more convenient to them. A participatory method that relies on a face-to-face meeting is harder to implement in this context because it would require a good management of the schedule of the different participants. Regarding the number of rounds, the participants have all the same opinion, two rounds or three rounds are the correct number of rounds. More than that it would also be difficult to keep up with the Delphi, because of the availability of the participants.

The team included in this case-study was mainly composed by physicians, one of them specialized in infectious diseases and pharmaceuticals. For the future, participants suggest that it should be included elements from microbiology, nursing and informatics. This suggestion is in the same line of sight of the proposal made by stewardship programs.

B. The questionnaires

All the participants had no difficulties in accessing the surveys, and said that the layout was very clear. The questions were well developed and very easy to understand. The fact that the questions were close-ended questions was not a significant limitation for the most participants, in fact, the questionnaire was very broad and had the main relevant topics included. One participant suggested that the survey should be

more accurate for one type of service, and for example, divide the questions by pathologies.

C. Cognitive Maps and Timelines

Concerning cognitive maps, the participants considered a very useful way to represent data and structure the information gathered. For some participants would be more interesting if the maps were more distinct and described the reality of a particular group making them easier to interpret. All participants agreed that the colors made the map easier to understand. The timelines represented the starting point for every strategy. The participants understood the importance of evaluating each strategy and start for implementing the ones which the resources are easier to obtain. However, most participants admitted that they don't have enough information regarding some of the strategies.

D. The Forum

The participants, who never published in the forum, justified that they didn't do that because of lack of available time, forgetting to go there. The ones that posted messages in the forum had some difficulties in understanding the operation of it. The layout was attractive, but they felt difficulties in understanding where to click to publish the messages. All participants support a workshop at the beginning of the process as an enlightening session where all the doubts can be clarified, and the operation of the forum specified too.

E. Global remarks

All participants recognized the potential of implementing this methodology to a particular group. Some participants advised against the implementation of this methodology at a national level.

F. Limitations

Some of the limitations of this methodology to be corrected in the future are:

- Sample unrepresentative of the main players of this problem;
- The sample was chosen without using any of the method existing in the literature;
- Construction of the cognitive maps and timelines in a manual way;
- Weak quality of images;
- No availability for organizing a workshop in the beginning.

6. FINAL REMARKS & FUTURE WORK

All the objectives were achieved. This study implements a methodology that comprises a Delphi method integrated with two tools, cognitive maps to represent the information gathered and a forum to promote an active discussion between participants. This study was the first study found in the literature that applied a participatory method in the context of antimicrobial resistance in hospital settings.

The study allows understanding the behavior of the participants to the use of online tools to discover the main barriers and understand how they can be overtaken. It was also possible to validate the importance of data visualization in

problem structuring. Furthermore, it was enabled to verify the value of combining quantitative with qualitative information. With the description done in chapter 3 it is possible to replicate that methodology for other contexts or small workgroups within an institution. Before that, is advised to reread the limitations and try to propose an innovative solution to overtaking them.

A. Future Work

As future work in this context and after the study done:

- Use multicriteria M-MACBETH to evaluate preferences of participants for each area of interest by attributing qualitative judgements to the performance of each strategy between two reference points. This way, it is possible to infer the importance of each strategy, and combine this information with the information that comes from the timelines to know what strategy is the first one to be implemented.
- Develop tools to integrate the responses in cognitive maps in an automated way and in real time;
- Prioritization study and a cost-effectiveness analysis of each strategy.

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