Development of a Methodology to Support the Commissioning of Services in Primary Health Care

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Abstract

Primary Health Care (PHC) is a key component of the Portuguese health system, representing the first level of contact between populations and the National Health Service (NHS). In the scope of the PHC reform, which started in 2005, a commissioning system was introduced in order to increase the efficiency and effectiveness of PHC providers. However, there are still several challenges inherent to this commissioning system, namely in respect to the selection of performance indicators, as well as to the performance measurement process itself.

This thesis aims to answer to these challenges, by developing a methodology to support the processes of indicator selection and performance measurement.

The developed methodology combines the utilization of multicriteria cognitive mapping with the MACBETH approach in order to: structure the influence of each performance indicator on the PHC unit's objectives; determine the contribution of each indicator to achieving the unit's objectives; evaluating the effort inherent to achieving an improvement in each indicator and; evaluating the performance of each contracted PHC unit.

The presented methodology was designed in a generic way, so that it allows for it to be applied in different commissioning contexts and situations.

In order to evaluate the applicability of the presented methodology to real PHC commissioning contexts, semistructured interviews were conducted with experts on the Portuguese PHC commissioning framework.

The results of the conducted interviews showed that the presented methodology might prove to be useful in sense to support the commissioning process, by increasing the transparency and flexibility inherent to this process.

KEYWORDS: Primary Health Care, Health Care Commissioning, Performance Measurement, Multicriteria Cognitive Mapping

1. Introduction

Primary Health Care (PHC) plays a key role in the Portuguese health system, representing the first level of contact between populations and the National Health Service (NHS) [1]. It provides universal and essential care, available for everyone, which aims not only to treat health problems, but also to promote health, prevent illness and provide rehabilitation care [2].

As a response to the numerous challenges that PHC faced, a structural and organizational reform began in 2005, in order to make PHC the basis of all health care provision in the NHS [3]. The goal of said reform was to create more and better health for populations as well as to improve cost-effectiveness, proximity, quality and accessibility in health care provision. Besides this, it was expected that the new organizational structure of PHC would improve professional satisfaction, as PHC providing units became more autonomous [3].

In order to achieve such results, Family Health Units (FHU) were created. FHUs consist on small functional units with organizational and technical autonomy and are considered to be the organizational cell of PHC provision in Portugal.

Along with this restructuration of PHC, a commissioning system was also introduced, aiming to increase accountability in the primary care system as well as to achieve better health outcomes, having in mind the available resources [4].

This commissioning system comprises several stages, such as the selection of performance indicators to include in the evaluation of PHC providers' performance, the definition of target performances to be achieved by each PHC provider, the monitoring of the contracted units' performance and, if the provider's performance is satisfactory, the attribution of financial and institutional incentives [4].

However, there are still several limitations and challenges inherent to the way the commissioning process takes place in Portugal [5]. Many of these challenges refer to the selection of the performance indicators which will be included in the evaluation of each of the contracted PHC providers' performance as well as to the performance evaluation process itself.

In fact, the current process by which performance indicators are selected leads to similar indicators being contracted with every PHC unit across the country, regardless of its epidemiological, social or demographic contexts. In addition, this process does not take into account the effort that the contracted unit will have make in order to ameliorate its performance on each of the selected performance indicators

Thus, this thesis' aim is to provide an answer to those challenges, by building a PHC commissioning support

methodology which informs the selection of indicators and that assists performance evaluation.
In order to identify existing frameworks which could prove to be useful on supporting the PHC commissioning process, section 2 presents the results of a literature review.

2. Literature Review

Given the problem at hand, an extensive literature review was conducted, aiming to find methodologies which could prove to be useful in order to support the commissioning process. Online databases were consulted using queries as *Primary Care Commissioning*, *Primary Care Contracting*, *Health care Indicator Selection* and *Incentive Setting.*
The review conducted revealed a lack of studies proposing methods to support the overall commissioning process. In fact, most studies describe health care commissioning practices implemented in different countries and do not present tools to support this process.
We have also searched frameworks which could prove to be useful in supporting each of the stages that compose the commissioning process, namely the selection of performance indicators and the evaluation of contracted units' performance.
The results of said review are summarized as follows:

2.1. Performance indicator selection in health care:

The selection of performance indicators has proven to be a key stage in the health care commissioning process [6]. In fact, contracted providers tend to focus their resources in achieving improvements on criteria on which they will be evaluated and, as so, selecting the indicators which contribute the most for improving health care provision is a determinant factor for the success of the commissioning process [6].
In respect to the selection of performance indicators in the context of health care commissioning, the most used methodology is the RAND/UCLA Appropriateness Method (RAM) [7]. In fact, this framework allows to combine expert opinion with scientific evidence in order to evaluate the appropriateness of a given indicator for inclusion in the subsequent performance evaluation process [7].
Nonetheless, this methodology does not comprise the definition of weights for each indicator, nor does it consider the definition of target performances for the selected measures. In addition, the RAM approach for selecting indicators is not aligned with the performance evaluation stage in which the selected indicators will be included and, therefore, its application in order to support the commissioning process proves to be inadequate.

2.2. Performance evaluation in health care:

Performance measurement has gained increasing importance in health care provision. In fact, due to increasing restrictions on the health sector, the development of management tools that enable the evaluation of the extent to which various aspects of health systems meet key objectives has assumed critical importance to the delivery of effective and efficient health care [6].
In this sense, over the past thirty years there has been a significant growth in health system performance measurement caused by a growing demand for cost effectiveness and accountability in health institutions. This growth in performance measurement has been supported by the evolution of information technology, which has made it simpler and cheaper to collect and analyse data [6].
During this period of time, several methodologies have been developed in order to support the performance measurement process in health care context. These methodologies include the Six-Sigma Approach, the European Foundation for Quality Management Model, the Performance Pyramid, Results and Determinants Framework, the Performance Prism, Brown's Input, Process and Output Framework and the Balanced Scorecard. However, these frameworks focus on defining the types of measures that determine the success of an health care organization but do not comprise methods to select indicators in order to evaluate such measures [8]. Furthermore, these frameworks provide no information about its aggregation mechanisms [9]. In fact, it is common for the weights of different performance indicators to be determined by considering only their importance to the organization to be evaluated, which is a critical mistake in decision analysis [10].
Thus, we found it difficult to adapt these frameworks in order to support the commissioning process in a transparent and rational way.

2.3. Multicriteria Models for Indicator Selection and Performance Measurement in health care

As an alternative, the use of a Multicriteria Decision Analysis (MCDA) approach could prove to be helpful regarding its application to support the different stages of the commissioning process.
In fact, MCDA allows to evaluate the contracted units' performance taking into account several criteria and objectives simultaneously. A weighting factor is attributed to each criteria, taking into consideration the performance levels inherent to it [11]. In respect to the indicator selection process, MCDA enables to identify performance indicators which contribute the most to the contracted unit's objectives, facilitating their selection.
However, multicriteria models found in health care literature are scarce and the existing models focus solely on the performance evaluation process and do not comprise the indicator selection process that precedes it. In addition, most multicriteria models found in health care literature are inaccurate in the sense that they do not take into account possible

synergies or interactions between performance indicators[11].
In order to tackle the challenges mentioned above, this work presents a methodology based on multicriteria evaluation techniques, in order to support the performance indicator selection and performance evaluation processes.
This methodology was designed in a way so that it allows for it to be applied to PHC units in different epidemiological, demographical and social contexts.

3. Methodological Framework

The design of the multicriteria framework aimed to support the commissioning process by comprising its performance indicator selection and performance evaluation stages. As an overview, the proposed model was designed to:

- Structure and clarify the influence of each performance indicator on the PHC unit's fundamental objectives by structuring a network of means-objectives. This structure is depicted in figure 1;
- Determine the indicators which contribute the most towards achieving the contracted unit's fundamental objectives (this will be done by calculating the intensity of each influence relationship depicted on the means-ends network, which respect to the k_i coefficients depicted in figure 1);
- Evaluate the effort that said unit will have to make in order to ameliorate its performance on each of the considered indicators;
- Select the most adequate performance indicators for inclusion on the commissioning process;
- Evaluate the PHC unit's overall performance, based on selected indicators, as well as on the structured multicriteria cognitive map;

The presented model is based on the adaptation of the Multicriteria Cognitive Mapping (MCM) approach [12], which consists on the application of a multicriteria model to a cognitive map structure so as to, firstly; capturing the issues and their systemic relationships in a means-ends network; and secondly; determining the impact that indicators have in the values of decision-makers (DM) by using the MACBETH approach [12].

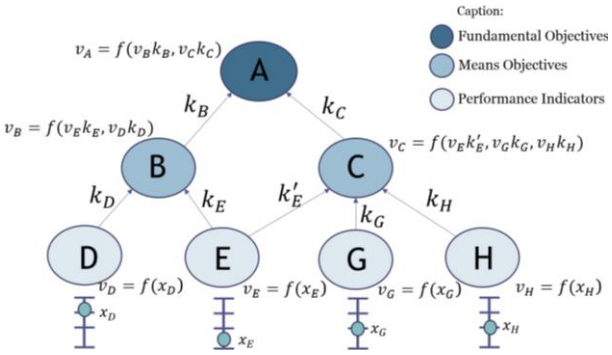


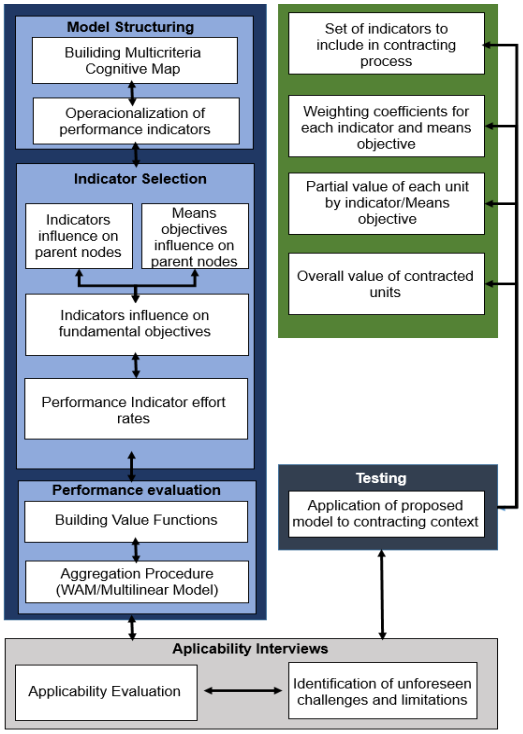
Figure 1- Illustrative global vision of the presented model

The presented model comprises several and interconnected steps built by using a socio-technical approach: (1) structuring a multicriteria cognitive map; (2) operationalization of each performance indicator; (3) determining the influence of each indicator on its respective parent nodes; (4) determining the influence of each means objective on its parent nodes; (5) computing the influence of each performance indicator on the PHC units fundamental objectives; (6) determining the effort that the contracted PHC unit will have to make in order to ameliorate its performance on each indicator; (7) building a value function for each performance indicator; (8) evaluating the unit's performance, based on the structured multicriteria cognitive map.
The activities inherent to this thesis comprise three different stages, as depicted in figure 2. Firstly, a methodological framework will be presented in order to tackle the challenges inherent to the commissioning process; Secondly, semistructured interviews will be conducted in order to evaluate the proposed model's applicability to real commissioning context; Finally, the proposed methodology is intended to be implemented in a PHC commissioning situation.

3.1. Model Structuring

The MCM approach, whose adaptation is on the basis of the presented methodology, uses a cognitive map as a structuring tool. A cognitive map consists on a network of nodes, each of them associated with a concept or idea, connected in order to represent a person's speech. Each connection between nodes represents an influence relationship between them. In these relationships, the influenced node is named "parent node", while the influencing node is named "child node" [12].
When applied in a decision making context, cognitive maps usually assume a hierarchical structure of alternatives (or, in this case, performance indicators), means objectives and fundamental objectives, as illustrated in figure 1. This structure allows to clarify the influence of each indicator on the defined fundamental objectives [12].
The structuring stage of the presented model involves the building of a multicriteria cognitive map, as well as the operationalization of indicators included in it.

Figure 2- Set of activities to be developed



3.1.1. Building the multicriteria cognitive map

In order to evaluate the relationships between the different objectives and indicators inherent to the commissioning process, a multicriteria cognitive map will be built. This map consists on a hierarchical structure in which performance indicators stand at the bottom and fundamental objectives of the contracted PHC unit stand at the top [13]. Intermediately, a network of means objectives is defined in order to clarify the influence of each performance indicator on the defined fundamental objectives.

Thus, the building of the map begins by defining the fundamental objectives inherent to the commissioning process. These objectives will guide the whole provision of primary care and, therefore, reflect key factors for the success of the commissioning process [14].

After these fundamental objectives are defined, it is crucial to structure a network of means objectives which allows to clarify the influence of each performance indicator on the defined final objectives.

This network is structured by following two different approaches: (1) a top-down approach, in which the means objectives network is expanded towards hierarchichally inferior concepts, by clarifying which are the nodes that influence a given objective [15]. Considering the example depicted in figure 3a), this would be done by asking DM's "How can adult health be improved, other than improving hypertension and diabetes vigilance?"; (2) a bottom-up approach, which allows to expand the means objectives network towards hierarchically superior nodes, by clarifying the importance of each node regarding superior means objectives. Considering the example depicted in figure 3b), this would be done by asking DMs "Why is reducing the cost of invoiced means of diagnosis important, regarding a better provision of PHC?".

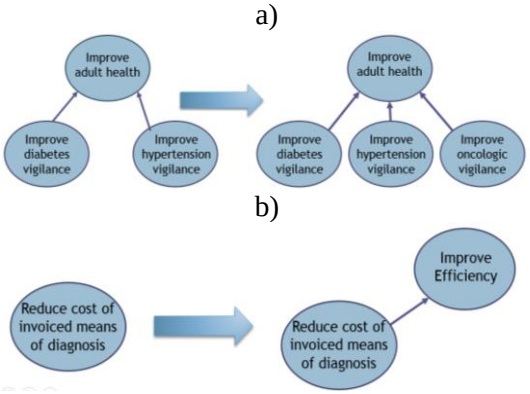


Figure 3- a) Top-down approach for structuring the multicriteria cognitive map; b) Bottom-up approach for structuring the map

3.1.2. Operationalization of performance indicators

Due to the commissioning process' nature, all of the considered performance indicators are associated with a predefined mathematical formula which allows for an evaluation of the contracted PHC unit's performance. These formulas are associated with a continuum of values on which the contracted unit's performance may fall.

Among this continuum of performance levels, DMs will be asked to define a set of five discrete levels for each indicator [12]. The definition of each of these levels is represented in table 1

Table 1-Set of performance levels to be defined for each performance indicator

Performance level	Definition
Maximum Plausible	Represents the maximum achievable level by the contracted unit on the considered indicator
Target	Represents the target level to be achieved by the PHC unit on each indicator
Minimum Acceptable	Corresponds to the minimum acceptable level for the PHC unit's performance on the considered performance indicator
Status Quo	Corresponds to the PHC unit's performance on each indicator at the beginning of the commissioning cycle
Minimum Plausible	Represents the minimum achievable level by the contracted unit on the considered indicator

In addition, two reference levels will be defined for each performance indicator. In this work, the target level will be defined as an upper reference level, while the *status quo* level will represent a lower reference level. These reference levels allow to [16]:

- Improve the intelligibility of each performance indicator;

- Objectify the notion of intrinsic attractiveness of the performance of each PHC provider;
- Apply weighting procedures, which will allow to evaluate the influence of each indicator on their respective parent nodes;

By convention, to the upper and lower reference levels defined, scores of 0 and 100 are usually assigned, respectively [10].

3.2. Selection of performance indicators

After structuring the multicriteria cognitive map which allows for the clarification of the influence of each indicator and means objectives on the defined fundamental objectives, it is possible to proceed to the selection of the most adequate performance indicators. Considering the example depicted in figure 4, this would mean identifying an appropriate set of indicators in order to evaluate the means objectives "Improve hypertension vigilance" and "Improve diabetes vigilance".

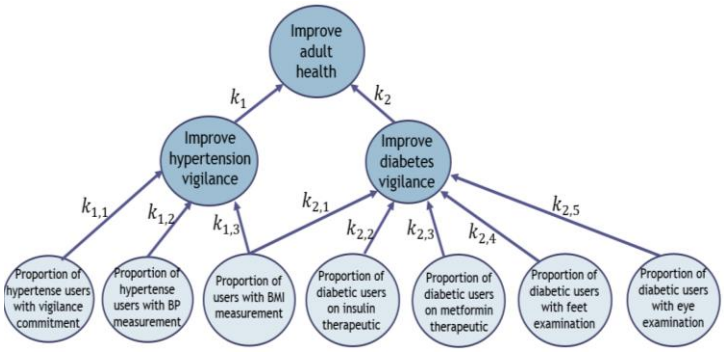


Figure 4- Illustrative submap referent to the node "Improve adult health"

This selection will be supported by the determination of the contribution of each indicator towards achieving the defined fundamental objectives as well as the effort that each of the contracted PHC providers will have to make in order to ameliorate its performance on each of the considered indicators.

3.2.1. Assessing the influence of performance indicators on parent nodes

Initially, in order to determine the contribution of each performance indicator towards the fundamental objectives, it is necessary to assess the influence of said performance indicators on their respective parent nodes[12]. This will be done by separately analyzing the submap corresponding to each indicator's parent node.

In this sense, considering the example depicted in figure 4, this stage would require determining the $k_{i,j}$ coefficients, correspondent to the influence of each indicator on the parent nodes "Improve hypertension vigilance" and "Improve diabetes vigilance".

In line with what's proposed by the MCM approach, the intensity of these influence relationships will be done by calculating a set of coefficients associated with an adaptation of the multilinear model (MLM), proposed by Keeney and Raiffa [12],[17].

This adaptation allows for the MLM to be applied to bipolar scales, and its associated aggregation function is given by [12]:

$$v_j(x_i,\dots,x_n)=\sum_{i=1}^{n} k_i\, v_i(x_i)+\sum_{i=1}^{n}\sum_{k>i}(-1)^l k_{ik}|v_i(x_i)|\,|v_k(x_k)|+\dots +(-1)^l k_{1\dots n}|v_1(x_1)|\dots|v_n(x_n)| \quad \textbf{(1)}$$

Where $v_j(x_i,\dots,x_n)$ refers to the performance value of the contracted units in terms of the parent node under analysis, $v_i(x_i)$ is the performance value of said unit on each indicator i and l corresponds to a coefficient resulting from the adaptation of the MML to bipolar scales so that $l = 2$ if $v_i(x_i) > 0, i \in 1,\dots,n$ and $l = 1$ otherwise [12].

In addition, the application of the MLM to the structure of the multicriteria cognitive map as to determine the influence of each performance indicator on its respective parent nodes requires the determination of a set of coefficients, namely [12]:

- Impact parameters, $k_i > 0$ – Correspondent to the intensity of the influence of the child node i on parent node j;
- Synergic coefficients, k_{ik} – Correspondent to the synergic effect between nodes i and k;

These parameters may be determined by using the following expressions:

$$k_i = v(x_i^+, \bar{x}_i^0) \quad \textbf{(2)}$$

$$k_{ik} = v(x_i^+, x_k^+, \bar{x}_{ik}^0) - k_i - k_k \quad \textbf{(3)}$$

And, generally:

$$k_{123\dots n}=v\left(x^+_{123..n},\bar{x}^0_{123..n}\right) - \sum_i k_{1\dots n} - \dots - \sum_{i,k>i} k_{ik} - \sum_i k_i \quad \textbf{(4)}$$

Where the terms $v(x_i^+, \bar{x}_i^0)$ respect to the attractiveness of a hypothetical PHC provider whose performance on indicator i is equal to the target level (upper reference level) defined to said indicator and its performance on all other indicators is equal to the *status quo* level (lower reference level).

Before determining the values of these parameters, it's necessary to confirm that the condition of weak difference independence is verified between all indicators which influence the parent node under analysis.

A child node i is weak-different independent of the remaining child nodes if the ordering of preference difference between different elements of i is not affected by the combination level for which the remaining nodes are held constant [14].

After confirming that necessary independence conditions are held, it's possible to determine the parameters of the MLM which model the influence of each performance indicator on its respective parent nodes. This will be done by using the MACBETH approach, supported by the M-MACBETH software [12]. One of the mains advantages of this approach is that it only asks for qualitative pairwise comparisons of the difference in attractiveness between a set of hypothetical PHC units. To facilitate these comparisons, the DMs are asked to choose one of

seven semantic levels ("Null", "Very weak", "Weak", "Moderate", "Strong", "Very Strong" and "Extreme") [12]. Based on these judgments, the M-MACBETH system allows to compute a quantitative scale which will then enable the determination of the required coefficients [18]

In fact, it's necessary for the DMs to consider $\sum_{i=1}^{n}\binom{n}{i}+1$ hypothetical units, where n corresponds to the number of indicators that simultaneously influence the parent node under analysis.

Considering the example of the node parent "Improve hypertension vigilance" depicted in figure 4, since 3 indicators influence this node it would be necessary to consider 8 fictitious PHC units, whose performance profiles correspond to combinations of the lower and upper reference levels defined for each of each indicator.

DMs will then be asked to order and then pairwise compare the considered hypothetical units regarding their attractiveness. Considering the example presented above, this would involve asking DMs questions such as "How do you compare, regarding their attractiveness, a PHC unit whose performance on all three indicators which influence the parent node "Improve hypertension vigilance" is equal to the target level set for those indicators and a PHC unit whose performance on indicator 'Proportion of users with BMI measurement' is equal to the target level, and on indicators 'Proportion of hypertensive users with blood pressure measurement' and 'Proportion of hypertensive users with vigilance commitment' is equal to the status quo level?"

During the questioning process, the facilitator fills in a matrix with the DM's judgments. Each time a qualitative judgment is elicited, its consistency is verified and suggestions are offered to solve eventual inconsistencies. After consistency verification, the software computes a numerical scale adequate to the DMs judgments, which will allow to determine the MLM parameters by making use of equations 2, 3 and 4 [17].

Since it requires that DMs pairwise compare the intrinsic attractiveness of $\sum_{i=1}^{n}\binom{n}{i}+1$ hypothetical units, this process would prove to be impractical in cases where a large number of indicators simultaneously influence the same parent node. Thus, in cases where 5 or more indicators influence the same parent node, in order to reduce the necessary number of pairwise comparisons to be made, DMs will be asked to identify sets of indicators which present a high synergic potential, among all considered indicators. This way, only synergies among those indicators will be considered, therefore reducing the number of comparisons to be made and, consequently, the complexity of the process.

3.2.2. Assessing the influence of means objectives on parent nodes

The process described above allows to determine the influence of each indicator on its respective parent nodes. However, in order to determine the actual contribution of performance indicators towards the defined fundamental objectives it is necessary to expand the assessment of the intensity of influence relationships to the means objectives network. In other words, it will be also necessary to evaluate the influence of each means objective on its respective parent nodes. Considering the example depicted on figure 4, this would mean determining the values of k_1 and k_2.

In order to do this, this work proposes the use of the MACBETH approach, which implies an additive value model. The mathematical formulation of its aggregation operator is given by:

$$v_j(x_i,\ldots,x_n)=\sum_{i=1}^{n} k_i\, v_i(x_i)\ with\ \sum_{i=1}^{n} k_i = 1 \qquad \textbf{(5)}$$

Where v_j is the aggregate value on the parent node j, $v_i(x_i)$ respects to the units value on each of the n child nodes and k_i corresponds to the intensity of the influence of child node i on parent node j.

Even though this approach does not take into account possible synergic effects between child nodes, it was adopted since the use of the MLM in order to model the influence relationships between means objectives and their parent nodes could prove to be, in some cases, excessively complex [12].

In addition, the use of the MACBETH approach in order to assess these coefficients proves to be more adequate than other procedures such as the swing weighting or trade-off procedures, since it only requires eliciting qualitative information in order to assess quantitative data.

In order to determine the values of the k_i coefficients, referent to the intensity of the influence of each means objective on its parent nodes, DMs will be asked to consider a set n of fictitious PHC units, being n the number of child nodes which influence the parent node under analysis.

DMs would then be asked to order and then pairwise compare the considered fictitious units by making use of the semantic categories presented above. Considering the example depicted on figure 4, in order to determine the value of k_1 and k_2, two fictitious PHC units would have to be considered. DMs would then be asked "How do you compare, regarding their attractiveness, a PHC unit whose performance on all indicators which influence the node "Improve hypertension vigilance" is equal to the target level set for those indicators and equal to the status quo level on all other indicators, and a PHC unit whose performance on all indicators which influence the node "Improve diabetes vigilance" is equal to the target level and equal to the status quo level on all other indicators?"

These judgments will allow to fill up a matrix on the M-MACBETH software which, in case the judgments are consistent, will compute a numeric scale that will enable to calculate the values of k_i, representative of

the intensity of the influence of each means objective on its respective parent nodes.

3.2.3. Assessing the influence of indicators on fundamental objectives

After assessing the intensity of the influence of each indicator and means objective on its respective parent nodes, it is necessary to define an approach which allows to determine the contribution of each indicator towards achieving the defined fundamental objectives. In order to do this, two operators will be used: (1) Partial Effect (PE) and (2) Total Effect (TE) [13].

The PE operator respects to the influence of each indicator on the defined fundamental objective throughout a particular path, where a path corresponds to a sequence of linked nodes which connects the mentioned indicator and fundamental objective [13].

In order to define an approach to calculate the PE of an indicator on a fundamental objective through a particular path, some conditions should be considered: (1) the range of possible values for the PE of a particular path should not depend on the length of that path; (2) every influence relationship that constitutes the path should be considered while calculating this operator [19].

With this in mind, in order to calculate the PE associated with a particular path, the following formula will be used [13]

$$PE(C_{ij}) = \prod_{l \in C_{ij}} k_l \quad \textbf{(6)}$$

Where k_l corresponds to the intensity of each influence relationship that composes the analysed path, C_{ij}.

On the other hand, the TE of an indicator/set of indicators on fundamental objectives corresponds to the total contribution of said indicator/set towards achieving the defined fundamental objectives, considering the PEs of all paths that connect them.

In order to calculate this operator, the following formula will be used [13]

$$TE_{i \to j} = \sum_{q=1}^{n_{C_{ij}}} PE(C_{ij}^q) \quad \textbf{(7)}$$

Where $PE(C_{ij}^q)$ refers to the partial effect of each of the $n_{C_{ij}}$ paths that connect the performance indicator and the fundamental objective under analysis.

By using both these operators it is then possible to determine which are the indicators which contribute the most towards achieving final objectives.

3.2.4. Assessing the effort associated with an improvement on each performance indicator

In order to select the most appropriate indicators for inclusion on the commissioning process, solely analyzing each indicator's contribution towards fundamental objectives may prove to be insufficient. In fact, contracted units may not have the capacity or resources to achieve significant improvements on all considered indicators.

Selecting indicators based solely on their contribution towards fundamental objectives, not considering the effort that the contracted PHC unit will have to make in order to achieve an improvement on each indicator may lead to inappropriate performance indicators being included on the commissioning process.

Having this in mind, this work presents an approach which allows to evaluate this effort rate.

This evaluation will, once again, be done by analyzing each parent node separately.

In order to assess this effort rate, DMs will initially be asked to qualitatively evaluate the effort that the contracted unit would have to make in order to improve its performance on each indicator/set of indicators from the *status quo* level to the target level. This step will allow to order each of the indicators/set of indicators regarding the effort that an improvement on each of them would require.

After this, DMs will be asked to pairwise compare the difference in effort that an improvement on each indicator/set of indicators would require, by using the same semantic levels presented above.

Considering, as an example, the case of the node "Improve hypertension vigilance" depicted in figure 4, this would require asking DMs "How do you compare the effort that a PHC unit would have to make in order to improve its performance from the status quo level to the target level on indicator "Proportion of users with BMI measurement" with the effort that same unit had to make to achieve that same improvement on indicator "Proportion of hypertensive users with a blood pressure measurement?".

These judgments will allow to fill in a matrix on the M-MACBETH software which will compute a numerical scale that allows to assess the effort rate inherent to each indicator/set of indicators.

3.2.5. Selecting the most appropriate performance indicators

After evaluating both the contribution of each performance indicator/set of indicators on the defined fundamental objectives, as well as the effort associated with an improvement on each of those indicators, it is possible to support the selection of the most appropriate indicators, in order to include them on the commissioning process.

This work does not propose an explicit approach towards identifying the most appropriate indicators for inclusion on the commissioning process. However, DMs will be given information regarding each indicator's/set of indicators' contribution towards fundamental objectives, as well as the effort that ameliorating the contracted unit's performance on each indicator would require, enabling to conduct an analysis similar to the one depicted on figure 3, in order to support selection of indicators.

Figure 5- Illustrative plot for a "Contribution towards final objectives" vs "Effort to improve unit's performance" analysis

3.3. Evaluating contracted units' performance

In a final stage of the commissioning process, a performance evaluation of contracted units is conducted in order to identify potential points to be improved as well as to reward contracted units with a satisfactory performance.
This work presents an approach which allows for a multicriteria performance evaluation of contracted PHC units, based on the previously structured multicriteria cognitive map, as well as on the performance indicators included in it [12].
This evaluation process comprises the building of a value function for each selected performance indicator and the use of aggregation operators in order to assess a global performance value for the contracted unit.

3.3.1. Building value functions

The process of building a value function for each of the selected performance indicators permits the translation of performance into value. Thus, it allows to measure the contracted unit's attractiveness at the indicator level.
In order to build these value functions, this work proposes the adoption of the MACBETH approach. This adoption was motivated by an intent to avoid the difficulties of some DMs in eliciting, as this approach allows for the building of value functions by means of pairwise comparing the attractiveness of performance levels defined for each indicator. This comparisons will be made by using a set of semantic levels (namely, "null", "very weak", "weak", "moderate", "strong", "very strong" or "extreme" difference in attractiveness [10].
Judgments elicited by DM's will allow to fill up a matrix on the M-MACBETH software which, in case these judgments are consistent, will derive a value function for each indicator, that will then be validated by DMs [10].

3.3.2. Assessing the global performance value of each contracted PHC unit

The definition of a value function for each of the selected performance indicators allows to measure the contracted unit's attractiveness at the indicator level.
In order to assess a global performance score for each contracted unit, it is required that said unit's partial scores on each indicator and means objective are collapsed by using adequate aggregation operators.
In this sense, in order to aggregate a unit's score on different performance indicators, this work proposes the utilization of the MLM aggregation function, which is given by equation 1, which allows to take into account possible synergies between the considered performance indicators.
Regarding the contracted units score on each means objective, these will be aggregated by using the weighted arithmetic mean aggregation function, whose formulation is given by equation 5.

4. Applicability Interviews

After completing the definition of the proposed methodology, as well as of the different stages it comprises, a series of interviews were conducted with four specialists on the PHC commissioning area. These interviews aimed to: (1) evaluate the applicability of the proposed methodology to real PHC commissioning context and (2) identify unforeseen limitations and challenges which could compromise the methodology's application.
With that in mind, a series of semi structured interviews were conducted, thus combining the use of open-ended and closed questions. The choice of this type of interview was based on the fact that it allowed interviewees to mention relevant issues for the commissioning process which may had not been considered by the interview protocol, exploring them in detail.
Conducted interviews were divided in three sections: (1) a section which aimed to evaluate the current PHC commissioning process in Portugal, identifying potential limitations and advantages inherent to it; (2) a section which aimed to evaluate the applicability of each of the stages which constitute the proposed methodology as well as to identify potential obstacles to its implementation and, finally; (3) a section whose objective was to provide a global evaluation of the proposed methodology, identifying its main advantages and limitations, comparing to the current commissioning process. The results of said interviews are discussed below

4.1. Results

4.1.1. Evaluation of the current PHC commissioning process

In order to identify the main advantages and limitations of the current PHC commissioning process, a series of open ended questions were posed to the interviewed specialists.
In respect to the main advantages of the current commissioning process, reference was made to:

- The accountability ideal inherent to commissioning , decentralizing the decision making process;
- The greater autonomy granted to PHC providing units;

On the other hand, in respect to the main limitations of this process, the interviewed specialists made reference to:

- The fact that many of the contracted performance indicators are the same for every PHC unit, regardless of its epidemiological and social context;
- The fact that target performance levels defined for each indicator do not consider the effort that the contracted unit will have to make in order to achieve those levels;
- The fact that performance indicators have an identical weight for all PHC units, not taking into account their context;

4.1.2. Evaluation of the proposed methodology's applicability

In order to evaluate the presented methodology's applicability to a commissioning context, a series of closed questions were posed to the interviewed specialists.

On these questions, specialists were asked to evaluate the complexity of each of the proposed methodology's stages on a Likert-type scale. This scale comprised 7 evaluation items, namely: "1-Null", "2-Very Reduced", "3-Reduced", "4-Moderate", "5-High", "6-Very High" and "7-Extreme". In order to analyze the responses provided by the interviewed specialists, a numeric code from 1 to 7 was attributed to each of these response items (being 1 attributed to the response item "Null" and 7 to the response item "Extreme"). Specialists' responses to the complexity of each stage of the proposed methodology are synthetized on Table 2 (namely the corresponding median and interquartile range, IQR):

Evaluated Stage	Median	IQR
Model Structuring		
Building the Multicriteria cognitive map	3	1
Operationalizing performance indicators	3,5	2
Determining indicator's influence on parent nodes		
Ordering considered fictitious PHC units	2,5	1
Pairwise comparing fictitious PHC units	2	0
Identifying indicators with highest synergic potential	3	0
Determining means objectives influence on parent nodes		
Ordering considered fictitious units	3	0
Pairwise comparing fictitious units	3	0
Evaluating the effort inherent to improving performance on each indicator		
Evaluating effort on each indicator	3,5	1
Pairwise comparing effort inherent to different indicators	4	0
PHC units performance evaluation		
Building value functions	2	0

Table 2- Synthesis of interview's quantitative results

As it is possible to perceive by the information synthetized in table 2, the interviewed specialists did not find obstacles which compromised the application of the proposed methodology. This idea is supported by the fact that the median of the specialists' evaluations was equal or lower than 4 for all the stages comprised on the proposed methodology. In addition, the average value of these medians was 2.9545, considering a minimum value of 1 (respective to null difficulty in all the evaluated stages) and a maximum value of 7 (respective to extreme difficulty in all evaluated stages).

4.1.3. Global evaluation of the proposed methodology

After evaluating the complexity of each of each of the stages of the proposed model, specialists were asked to identify those which they thought to be the main advantages and limitations of the proposed methodology, comparing to the current PHC commissioning process.

In respect to the main advantages of the presented model, the interviewed specialists highlighted:

- The fact that it allows to select the most adequate performance indicators for each unit, considering its social and epidemiological context;
- The possibility to take into account the effort that each unit will have to make in order to improve its performance on each performance indicator;
- The higher transparency inherent to the indicator selection process, as well as to the determination of weighting coefficients for said indicators;

However, the interviewed specialists pointed out some limitations and challenges to the presented model. These included:

- The fact that, if not supported by scientific evidence, DMs judgments may not be the most adequate, considering the PHC unit's objectives;
- The inexistence of an explicit definition for the concept of "effort", that allows to quantify it in terms of financial and human capital;

5. Discussion

The designed model intended to answer to some of the challenges that the PHC commissioning process currently faces in Portugal.

This methodology aimed to support the performance indicator selection and performance evaluation

processes by combining the utilization of multicriteria cognitive mapping with the MACBETH approach in order to: (1) structure the influence of each performance indicator on the PHC's units objectives; (2) determine the contribution of each indicator towards achieving the unit's objectives; (3) evaluate the effort inherent to achieving an improving in each indicator and; (4) perform a multicriteria evaluation of the overall performance of each contracted PHC unit.
The proposed model was discussed with a group of specialists on the commissioning process and a series of interviews were conducted as to evaluate the applicability of the proposed methodology to commissioning situations as well as to identify possible unforeseen limitations and challenges associated with the presented methodology.
The results of the conducted interviews reflect that interviewed specialists did not find significant obstacles to the implementation of the presented model to a commissioning context. In addition, interviewees highlighted several advantages regarding the proposed model, comparing to the current commissioning process.
Namely, such advantages were related with the model's flexibility and transparency, allowing to identify and select the most appropriate performance indicators for inclusion on the commissioning process, considering each unit's epidemiological and social context. Besides this, the interviewed experts referred to the possibility to take into account the effort that each unit will have to make in order to improve its performance on each indicator as a significant advantage of the model's indicator selection method
Despite this positive results, the interviewed experts also pointed out some limitations and challenges to the way that the presented methodology is posed. These challenges include:

- The definition of an explicit procedure to support the setting of target levels for each indicator, considering each unit's resources;
- The clarification of the concept of "effort", on the different components it comprises, defining it in terms of financial and human resources;
- The definition of an explicit method for selecting the most adequate performance indicators;
- The definition of which DMs will be included in the building process of the presented model, as well as of the scientific evidence which will be provided to DMs in order to support their judgments throughout the model building process;

Concluding, the results of the conducted interviews show that the presented model may allow to support PHC units commissioning processes effectively. However, its advantages when compared with the current commissioning process, the presented methodology still has several challenges to overcome in order to respond to all needs of a process as complex as PHC commissioning.

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