Using a knowledge-based approach: the way healthy communities make decisions

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Abstract: The planning for Knowledge Cities faces significant challenges due to the lack of effective information tools. These challenges are magnified while planning healthy communities. The Australian Health Information Council (AHIC) concluded in its last report that health information needs to be shared more effectively (AHIC, 2008). Some research justifies the use of Decision Support Systems (DSS) as an E-planning tool, particularly in the context of healthy communities. However, very limited research has been conducted in this area to date, especially in terms of evaluating the impact of these tools on decision-makers within the health planning practice. The paper presents the methodological instruments which were developed to measure the impact of the E-planning tool (i.e., Health Decision Support System [HDSS]]) on a group of health planners, namely, the Logan Beaudesert Health Coalition (LBHC). The paper is focused on the culture in which decisions were made before and after the intervention of the HDSS. Subsequently, the paper presents the observed impact of the HDSS tool, to facilitate a knowledge-based decision-making approach. This study is an attempt to make some contribution to the Knowledge Cities literature in the context of planning healthy communities by adopting E-planning tools.

Keywords: Decision support systems; knowledge-based decisions; healthy communities

Introduction

The purpose of the study is to examine the impact of a knowledge-based approach on the way decisions are perceived. Specifically, we used the implementation of the HDSS tool as part of broader planning for a healthy community in the Logan-Beaudesert area. To test the impact of the knowledge-based approach, we used two decision-making surveys as our methodological instrument. The primary focus of these surveys was to identify the culture in which decisions were made across the whole LBHC. The decision-making surveys provided understanding of the climate or culture in which decisions were made across the LBHC. Practically, the decision-making surveys were conducted in two iterations. The first round was undertaken during March 2010 before the development of the HDSS (i.e., Pre HDSS Intervention Phase), and the second round during July 2011, after the deployment of the HDSS (i.e., the Post HDSS Intervention Phase). Further, to provide context for the quantitative findings in the surveys, LBHC participants were also asked to comment on their decision-making and experiences in their own words.

Both quantitative (findings of surveys) and qualitative data (feedback from LBHC participants) allowed an evaluation of the HDSS Intervention impact on decision-making. The study presents quantitative and qualitative findings about the way in which decisions were made by the LBHC, before and after the HDSS Intervention. It shows the overall impact of a knowledge-based approach implemented by the HDSS Intervention on the broader group of LBHC (i.e., the climate or culture in which decisions were made). Thus, this paper sheds light on the way decision-making changed over the period of this study, and presents the overall impact observed.

Implementing a knowledge-based approach: the health decision support system as a tool for making informed decisions in developing healthy communities

The literature emphasises that if healthy communities are to be developed, a knowledge-based approach should be adopted within urban planning initiatives (Yigitcanlar et al., 2008; Gudes et al., 2010). The literature points out that challenges faced by today's decision-makers indicate moving beyond decision-making by intuition to what was identified as Knowledge-based Decision-Making (KBDM) (Doyle, 2002). One of the tools supporting KBDM which have gained prominence is Geographical Information System (GIS). GIS has the potential to help decision-makers while planning or developing healthy communities. For example, Higgs and Gould (2001) suggested a range of GIS-based Decision Support Systems (DSS) features and points of information such as 'What If' scenarios:

identify any 'under-serviced' areas; evaluate the quality of services offered; accessibility to services and health care information; locate the nearest health care facility; health surveillance; target resources; increase proximity to recreational areas or community facilities; and produce maps. The availability of health information in a robust DSS environment is evolving (Croner, 2003; Gudes et al., 2010). DSS can be seen to provide powerful insights into contemporary community issues in a spatial, temporal, and visual form (Caldeweyher et al., 2006), with research particularly indicating that online environments have a positive impact on decision-making (Kingston et al., 2001).

The ultimate technical goal of online GIS-based DSS is to ensure that information is made available for end-users to perform analyses, and store and represent their own results within the system (Yigitcanlar & Gudes, 2008). Contrary to static presentations, information becomes dynamic when users are allowed to access or interact with a database from their own computer (Croner, 2003). As Richards et al. (1999) stressed, the application of GIS techniques in an online DSS environments allows decision-makers to ask questions on maps and to quickly, clearly, and convincingly show the results of complex analyses. Thus, as the relevant technology becomes more readily available and more industries realise its potential, the numbers of online GIS-based DSS are increasing rapidly (Su et al., 2000).

Online DSS incorporate features which can improve decision-making processes. As more industries realise the potential of these systems, these technologies are being widely used by various organisations worldwide. As Yigitcanlar and Gudes (2008) pointed out, online GIS-based DSS need to be interactive and to promote and increase knowledge. The growing interest in online systems is encouraging a rapid expansion of research, especially in the health planning context. Furthermore, as online GIS-based DSS create the potential for enhanced decision support environments (Scotch & Parmanto, 2006), the implementation of such systems in health planning (for developing healthy communities) provides new insights, and may improve decision-making processes within the dimensions of use of evidence, participation, and consensus.

Outcomes of knowledge-based approach in decision-making

The role of DSS in health planning practice continues to evolve. Application of this technology is an important step towards better understanding public health issues and their inherent complexities (Waring et al., 2005). Analysing and mapping public health data is becoming increasingly important in the attempt to improve the performance of major public health actions and promoting community health (Cromley & Mclafferty, 2003). The literature identifies a number of prospective DSS outcomes. Amongst these outcomes, but not limited are: increasing collaboration or participation, developing trust, increasing satisfaction in decision-making, growing user satisfaction, constructing knowledge, and encouraging use of evidence in decision-making processes (Igbaria & Guimaraes, 1994).

DSS is perceived to have a role in a number of settings for health planning. For example, identifying service health barriers and multicultural health needs, supporting strategies to address gaps, facilitating multi-directional communication channels, and re-affirming transparent communication and decision-making processes (Phillips et al., 2000). To encourage collaboration and reduce health inequalities, DSS may be used as an outreach vehicle for community-based public health empowerment. This, in turn, *"may help our understanding of the complex relationship between socioeconomic factors and health status"* (Phillips et al., 2000, p. 976). The ability to conduct spatial analyses promotes the provision of effective health services. Thus, decision-makers and health planners may be led to re-examine the nature of access of health services to the community and, if is found to be lacking, provide equal access.

Like any other technology, a DSS is just a tool to achieve further goals (disease prevention, supporting decision-making etc.). However, it is an important direction for those in charge of making decisions regarding social services and healthcare allocation (Kaukinen & Fulcher, 2005). Of course, decision-making does not happen in isolation, and is not formulated and implemented only by decision-makers in government offices. A range of institutions such as NGOs, community organisations and city councils mediate and intertwine between decision-makers and people's livelihoods. Thus, the DSS may be an important interface where decision-makers can meet and essential information can reside as part of a knowledge-based approach for planning healthy communities.

However, there is lack of evidence about the outcomes of DSS as part of a broader knowledge-based approach for developing healthy communities. Nevertheless, it has been acknowledged that by applying a more knowledge-based approach health planning can improve (Ridley & Jones, 2001). While Australia has an excellent tradition and track record in health and medical research (National

Health and Hospitals Reform Commission, 2008), research on health DSS is often under-resourced. For example, the research scheme commissioned in 2009 by the National Health and Medical Research Council (NHMRC) constituted less than three percent of the NHMRC's total research funding. Moreover, the National Health and Hospitals Reform Commission's health reform report outlines that the biggest challenge is to transfer DSS research findings into health planning practice (National Health and Hospitals Reform Commission, 2008). Meeting these challenges requires that research and knowledge-based decision-making be recognised as essential prerequisites of improving health outcomes. The extensive literature suggests that more research is needed to shed light on what interventions work best from the health outcome perspective. Thus, a national approach is required to drive action throughout the Australian health sector (National Health and Hospitals Reform Commission, 2008). One of the ways to do so is to adopt a knowledge-based approach, using an online tool which can be accessed locally by health planners and decision-makers. This, in turn, can expedite and improve the use of evidence, knowledge, and guidelines in response to the attempts to develop healthy communities. Thus, to address this gap in the knowledge, a case study was selected and designed at Logan- Beaudesert, Queensland, Australia.

Case study

The Logan-Beaudesert Health Coalition (LBHC), Queensland, Australia, is a partnership established in 2006 to address the growing level of chronic disease in the Logan-Beaudesert region of Queensland. The initiative was intended to enhance existing services and infrastructure, establish formal partnerships, improve existing resources, and implement additional services and strategies. It also aimed to focus on the broad determinants of health to reduce risk factors and the incidence of chronic disease in a specific locality (Kendall et al., 2007). The LBHC was a response to the acknowledgment that the cost of chronic disease to society remained significant and current management and planning methods did not appear to be having sufficient impact. Consequently, collaborative health planning was seen as an important method for progressing health decision-making and addressing chronic issues in the region.

Therefore, the LBHC was implemented with the view to improving the region's health capacity at multiple levels through enhanced and responsive localised planning. The coalition has a central Board (i.e., LBHC Board), which oversees six health programmes and advisory groups, each addressing a specific area identified as needing attention. These working groups focus on early childhood (0 to 8 years of age), multicultural health, the prevention and management of existing chronic diseases, the integration between general practices and acute settings, efficient health information management, and health promotion. Each programme has a manager and a selected group of key stakeholders from multiple sectors and relevant organisations. The six health programmes or advisory groups are responsible for facilitating decisions relating to polices or strategies by providing recommendations and information to the LBHC board. In addition, the decisions of the LBHC board are reflected back to the six health programmes. By providing recommendations and information, the programmes assist the LBHC Board to make decisions and develop policies and strategies. The role of the LBHC Board is to coordinate and direct the coalition as a whole. The Queensland State Government funds the LBHC and has given the Board a mandate to modify, alter or adapt any of the current programs in response to evidence and performance data with the scope to design and implement new health initiatives as required.

Method
Decision-making evaluation

To understand the culture in which decisions were made, data collection and analysis methods were designed. These methods were employed prior and subsequent to the HDSS Intervention. Two waves of data collection were used, one prior to the development of the HDSS and one following the deployment of the HDSS. Specifically, we designed a decision-making survey for this purpose. This, in turn, helped exploration and understanding of how decisions were perceived across the LBHC.

Decision-making surveys: data collection and analysis

The decision-making survey incorporated two sets of Pre HDSS Intervention and Post HDSS Intervention questionnaires, which were conducted to measure different decision-making constructs. After reviewing the relevant literature about decision-making scales (i.e., Dean & Sharfman, 1993; Parnell & Bell, 1994; Flood et al., 2000; Bennet et al., 2009), the constructs were tested by using the following measurements of decision-making: use of evidence in decision-making, perceived consensus in decision-making, perceived participation in decision-making, perceived satisfaction from information for decision-making, and perceived importance of decision-making. The data was collected using a 25-

item survey based on several decision-making measurements offered in the literature (Dean & Sharfman, 1993; Parnell and Bell, 1994; Flood et al., 2000; Bennet et al., 2010). A decision-making survey was then developed utilising each of these constructs (see the online questionnaire at the following link: https://prodsurvey.rcs.griffith.edu.au/prodls/index.php?sid=89878&lang=en).

The data collected from the questionnaire was divided into seven categories according to the origin of the respondents. For instance, the respondents were asked to rate their level of agreement with the 25 survey items. The seven-point Likert scale (ranging from 1 = not at all, to 7 = completely agree) was used to calculate the mean score for each item, which was then used to determine the cumulative mean score of each construct. This ranking method made it possible to triangulate the perceivedness level of the decision-making constructs. Descriptive statistics were then used to summarise the responses and make an assessment of the LBHC members' overall perceivedness with decision-making prior (i.e., Pre HDSS Intervention) and after (i.e., Post HDSS Intervention) the HDSS intervention. Subsequently, to identify the impact of HDSS Intervention on decision-making after its intervention (or the change that occurred over time), paired samples T-tests were conducted. Thus, the analysis technique enabled us to obtain important evidence to evaluate how these decision-making perceptions across the LBHC changed over time.

The culture of decision-making in the Logan-Beaudesert health coalition
Quantitative findings from the decision-making surveys
The decision-making surveys were conducted in two iterations. The first round was undertaken during March 2010 before the HDSS Intervention, while the second survey was conducted after the HDSS deployment on July 2011. At the first round, 40 LBHC participants completed the questionnaire, while 35 LBHC participants responded to the second survey. Appendix 1 shows the descriptive statistics for each of the decision-making constructs in both surveys. In the first survey (before the HDSS Intervention), satisfaction with information for decision-making was rated lowest of the five constructs. Conversely, perceived participation in decision-making was rated highest. In the second survey, perceived importance of decision-making was rated lowest of the five constructs (4.37), while perceived participation in decision-making was rated highest (5.63).

Subsequently, participants were divided into groups representing the different initiatives that were auspiced by the LBHC. Three groups were constructed representing the different focus of each initiative: governance (i.e., LBHC board members and administrative staff), health promoting (i.e., Early Years, Health Promotion and Multicultural initiatives), and service integration (i.e., GP Integration, Information Management, and Optimal Health). A One Way ANOVA test showed the difference between the groups. In the first round, consensus and participation were rated the highest by the governance group. Interestingly, importance of decision-making was rated the highest by the health promoting group. In the second survey, participation, use of evidence and satisfaction with information for decision-making were rated the highest by the governance group.

Participants were then grouped into two major age groups (i.e., to 40 years, and over 40 years). A One Way ANOVA revealed a significance difference in the means for the following constructs: use of evidence, consensus, participation, satisfaction with information, and importance. Use of evidence in decision-making showed a trend towards significance. Specifically, the younger age group reported lower scores on all five constructs. However, in the second survey, a One Way ANOVA revealed a significance difference in the means for the satisfaction with information construct. Use of evidence and importance of decision-making showed a trend towards significance. Specifically, the younger age group reported lower scores on all five constructs in both surveys.

Qualitative findings from the decision-making surveys
To increase our understanding in evaluating the surveys' findings, we included one item in the survey that asked participants to provide feedback about the culture of decision-making across the LBHC. This feedback revealed further detail about the way decisions were perceived by LBHC participants. In the first survey, for example, one participant noted that: *"Very few decisions have ever been made by the LBHC board - most decisions are made by a few outside the meeting, and therefore there is no rigour or transparency to the processes".* Another participant commented on the relative absence of decision-making: "I'm not sure if any actual planning for the future is made", but in the second survey, for instance, a participant noted: *"the HDSS provided information that forced us to discuss and consider implications of future options and plan ahead to maximise positive decisions".* Thus, although there was some evidence of increasing usage of information, consensus, and participation in decision-making, one participant noted that: *"Evaluations and reflections need to be better communicated and*

time needs to be set aside for groups, programmes and the LBHC board to understand key messages of evaluations".

In the first survey, the majority of comments made by LBHC participants revealed the difficulty associated with making decisions in the absence of adequate information. One participant stated that: *"we need to identify priority actions, need to be more pro-evidence in our decision making".* Therefore, despite high scores (in the first survey) on consensus and participation constructs, some LBHC participants noted that problems existed in relation to the sense of disconnectedness of the LBHC as a whole and that this may have a significant impact on decision-making processes. Thus, the lack of control over decisions made by the LBHC was a recurrent theme observed in the participants' comments.

However, in the second survey, the majority of comments made by survey participants revealed that the HDSS was perceived as a tool that can provide the necessary information for decision-making. Some participants also noted the importance of sufficient time allocation and improving communication mechanisms of decision-making as a crucial and complementary component for any information tool (e.g., HDSS). Thus, the value of the HDSS was clear. Despite evidence of positive comments by LBHC participants, however, the major HDSS impact was observed across the following specific groups: governance group, veterans, and those who served in the LBHC between 12 and 24 months.

Overall findings from the decision-making surveys
The Pre HDSS Intervention quantitative and qualitative findings confirmed that overall there were low levels of satisfaction with decision-making across the LBHC. However, some groups within the LBHC were more satisfied than others (i.e., those who were over 40 years). There was also a tendency for LBHC board members to be more satisfied with information and perceive higher levels of consensus, participation and use of evidence in decision-making. The qualitative data in the survey findings suggested that the lack of satisfaction with information for decision-making may be due to a complete lack of evidence on which to base decisions. This lack of evidence seemed to contribute to a sense of disconnectedness between the different elements of the LBHC. For example, some elements in the LBHC perceived that decision-making was not being practiced consensually and in a participatory manner. The findings indicated that within some groups (i.e., LBHC board), there were high levels of consensus and participation, but this may not occur across the whole LBHC. Therefore, the findings have shown that there is some diversity in the way members of a LBHC view decision-making. Thus, in the first survey, there was an overall sense that decisions were ineffective, presumably because they were not based on information or evidence.

In the Post HDSS Intervention Phase, quantitative and qualitative findings of this survey confirmed that overall participants rated the decision-making constructs higher than they did in the Pre PAR Intervention survey (out of importance of decision-making construct). However, some groups within the LBHC were more satisfied than others, for example, those who were over 40 years, had served between 12 and 24 months in the LBHC, and were associated with the governance group. Consequently, these groups were more satisfied with information and reported higher levels of consensus, participation and use of evidence in decision-making. To validate these findings, qualitative data from the survey was analysed as well. The qualitative data in the survey suggested that the HDSS was perceived as a tool that can provide the necessary information for decision-making. However, some participants noted the importance of sufficient time allocation and improving communication mechanisms of decision-making as a crucial and complementary component for any information tool (e.g., HDSS). The quantitative findings indicated that within some groups (i.e., governance group, veterans, and those who had served in the LBHC between 12 and 24 months), there were high levels of decision-making constructs, but that this may not occur across the whole LBHC. This was also supported by the qualitative findings, as negative comments by participants were mostly associated with lower scores across the decision-making constructs. Therefore, findings showed that there is some diversity in the way members of the LBHC view decision-making. Indeed, there was an overall sense that decision-making were affected by the HDSS mostly within these groups.

The survey findings showed that (in general) most of the decision-making constructs were rated higher in the Post PAR Intervention Phase. Figure 1 illustrates the results of decision-making constructs throughout the study. However, some groups within the LBHC were more satisfied than others (i.e., those who were over 40 years, had served 12 to 24 months in the LBHC, and were associated with the governance group). This, in turn, implies that the decision-making processes in the LBHC had

changed over time towards greater use of evidence, participation, consensus, and information. However, the qualitative data in the surveys suggested that there is still lack of allocated time and communication mechanisms for decision-makers, and this area requires further attention and development. Therefore, the findings indicated that there was an overall sense that decisions were more effective, presumably because they were made with greater information, use of evidence, participation, and consensus.
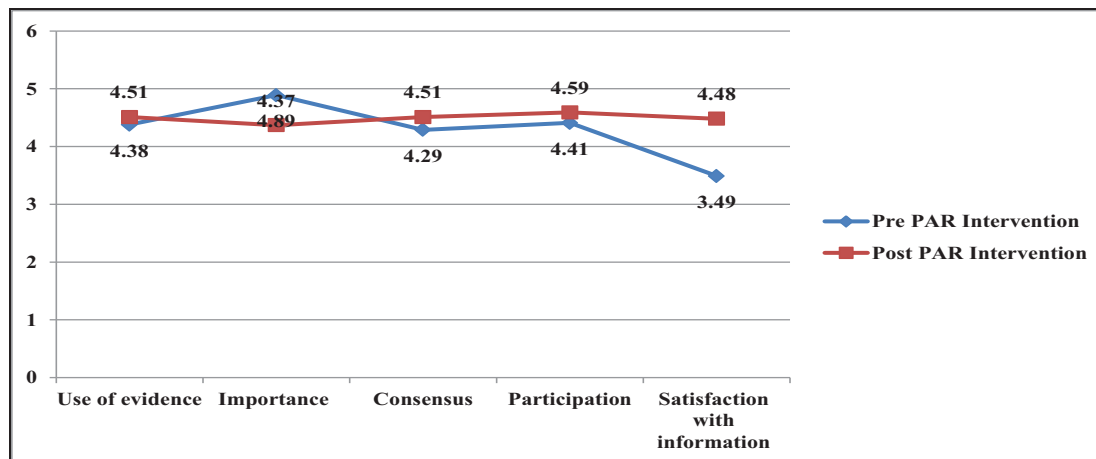

Figure 1. Decision-making constructs results Pre and Post PAR Intervention

Discussion

The decision-making survey encompassed the whole LBHC and aimed to understand the climate or culture in which decisions were made across the LBHC. Also, the survey aimed to identify whether the culture in which decisions were made had changed as a result of the HDSS Intervention throughout the study period. The way decision-making was rated before the HDSS Intervention showed generally poor to moderate scores. Findings indicated that the LBHC did not use solid evidence as an integral part of their decision-making processes. Consequently, this was found to be contributing to the overall sense of disconnectedness, non-participation, and low consensus sense in the LBHC. However, after the deployment of the HDSS Intervention, findings showed that more decisions were characterised by either moderate or high level of participation, consensus and use of evidence in that phase, than in the Pre HDSS Intervention Phase. This implied that the decision-making processes of the LBHC positively changed and improved over time. However, and although not significant, findings indicated that there was some diversity across the LBHC. For example, males tended to be more satisfied with the way decision-making was carried out, as did those who had been members of the LBHC for either longer or shorter periods. This finding indicated the likelihood of an acculturation curve for LBHC participants, that is, new members were enthusiastic, but become more critical of decision-making over time and then eventually resolved this situation in some way, either by withdrawing or seeking other sources of information or evidence. In addition, finding showed that the age of members had an important influence on the way decision-making was perceived. It is possible that younger people could be more demanding in terms of their need for involvement in the decision-making processes, whereas veterans are likely to have access to more intrinsic sources of information based on years of experience in the region. As a result, they may be less demanding of the decision-making processes. Thus, the decision-making survey findings pointed out that as a result of the HDSS intervention, the climate in which decisions were made has positively changed. However, the findings also showed some diversity in the way members of a LBHC view decision-making processes, and it is important to be aware of this, particularly in terms of designing and making future decisions and polices in the LBHC.

Conclusion

Despite growing awareness that decisions about social policies and health programmes have a significant impact on health outputs, decision-makers still lack the frameworks and tools to make these decisions in an informed manner. To enable health planners to make effective decisions, this study highlighted the importance and need for a knowledge-based approach and useful planning tools to underpin planning for healthy communities. The literature supported the premise that healthy communities will need to encourage decision-making processes which are based on a broader knowledge-based approach. Practically, in this study, this was measured by the use of evidence,

participation, and consensus, in the way decision-making was perceived. Furthermore, these decisions may subsequently transfer into informed actions.

However, to make informed actions, simply increasing access to effective information through HDSS may not be sufficient to generate the type of decision-making that can lead to healthy communities, unless health planning is also practised in a collaborative manner. For example, it was observed that the 'knowledge' that data was accessible to the LBHC in a form that had not been dominated by any other parties (e.g., governmental domination) and in a spatial form, positively contributed to the notion of 'collaboration' and the sense of vision, in that all LBHC parties were committed to constant improvement and refinement of the HDSS.

As for the variation across the LBHC, the tendency towards significant differences between the sub-groups of the LBHC indicated that there may be considerable diversity in decision-making processes that may require different approaches to planning. In summary, it can be concluded that adopting a knowledge-based approach which is based on practical planning tools such as the HDSS, had a positive impact on the culture in which decisions were made. Hence, it is concluded that HDSS can produce the type of information and effectiveness that facilitates elements of knowledge-based approach, which improves decision-making and supports knowledge-based approach for developing healthy communities.

Acknowledgment

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Appendices

Appendix 1. Comparison of five constructs of decision-making with LBHC initiatives groups Pre and Post HDSS Intervention

Constructs Survey 1	Governance group	Health promoting group	Service integration group	
	Mean (SD) N=9	Mean (SD) N=14	Mean (SD) N=14	Sig
Use of evidence in decision-making	4.2 (0.9)	4.1 (1.1)	4.4 (0.8)	0.789
Importance of decision-making	4.3(1.2)	5.6 (1.6)	4.4 (1.4)	.075**
Consensus in decision-making	4.8 (1.2)	4.3 (1.6)	4.4 (1.4)	0.755
Participation in decision-making	5.2 (0.9)	4.6 (1.7)	4.6 (1.3)	0.552
Satisfaction with information for decision-making	3.5 (1.4)	3.3 (1.4)	3.6 (1.9)	0.848
Constructs Survey 2	Governance group	Health promoting group	Service integration group	
	Mean (SD) N=10	Mean (SD) N=15	Mean (SD) N=10	Sig
Use of evidence in decision-making	5.36 (0.96)	3.89 (1.84)	4.6 (1.07)	.050 *
Importance of decision-making	4.8 (1.56)	3.93 (1.86)	4.60 (1.16)	0.37
Consensus in decision-making	5.20 (1.45)	3.75 (1.98)	4.97 (1.29)	0.077 **
Participation in decision-making	5.63 (1.55)	4.04 (2.31)	4.36 (1.36)	0.12
Satisfaction with information for decision-making	5.38 (1.06)	3.96 (2.33)	4.37 (1.47)	0.17