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Information system needs in health promotion: Case study of Safe Community program using requirements engineering methods

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Abstract

Objectives: To explore the need for information system support in health promotion programs.

Methods: The international Safe Community program was used as the setting for a case study. The 14 Safe Communities active in Sweden during 2002 were invited to participate. 13 of them accepted. A questionnaire containing questions about computer usage and a critical incident technique instrument was distributed to all practitioners involved in the programs either at a municipality office or a county council (n=202). The Voice of the Customer Table method was used to transform the critical incident data into needs for information system support. Descriptive statistics were used to analyze data on computer usage.

Results: Sharing of management information, creating social capital for safety promotion, and injury data recording were found to be key areas that need to be further supported by computer-based information systems in safety promotion practice. 90% (111/123) of the respondents reported having access to a personal computer workstation with standard office software. The interest in using more advanced computer applications was low among the practitioners, and there was considerable need for technical user support.

Conclusions: Areas where information systems can be used to make health promotion practice more efficient were identified, and patterns of computers usage were described. These results can be used to guide future information systems development projects in health and safety promotion.

Key words: community-based safety promotion, requirements engineering, information system development, public health

1. Introduction

For more than 150 years, it has been recognized that maintenance of public health calls for an approach to interventions that is broader than merely treatment of disease. As early as in the 19th century, health and social reformers were concerned with the political role of medicine in creating egalitarian societies [1]. Following the Second World War, public health developed in two directions; a preventive philosophy driven by the management of individual risk factors for chronic diseases [2], and a health promotion strategy based on population-based interventions. The latter idea – that collective action is necessary to manage health-threatening living conditions – has today been modernized and reformulated. Stachtchenko and Jenicek [3] describe modern public health as “the process of enabling [individuals and groups] to increase control over [relevant health determinants] and [thereby] improve their health.” In light of this, modern public health programs can be described as being founded on three basic propositions; health is more than absence of disease (“positive health”), promotion of health includes promoting exposure to supporting environments and living conditions ("health promotion is more than disease prevention”), and empowerment of people by supplying them with knowledge is a central strategy to increase their influence over their health.

The need to manage a large amount of data in public health programs led to the early adoption of computer-based systems for epidemiological purposes [4]. Today, there is a wide range of other computer-based technologies available that can be applied in the area [5]. The use of computers and

computer networks is, however, still mainly restricted to epidemiological analyses. Reasons for the limited use of computer systems can be found both in the heterogeneous nature of the problem area, restricting possibilities for generic systems designs, and in difficulties related to the implementation and use of computer applications in public health organizations. The systems developers' task is first challenged by the fact that the content and scope of public health practice differs with regard to geographical conditions and socioeconomic environment. For example, chronic diseases, such as coronary heart disease, are leading contributors to the disease burden in Western countries, while infectious diseases, with entirely different presentations, constitute the dominating health issues in developing countries. The possibility to transfer system designs between regions and nations is thus limited. The disease burden in an area may also rapidly change over time, e.g. with the emergence of new virus subtypes or drug-resistant bacteria . Nevertheless, some health problems still have global impact and display low seasonal variation. Unintentional injuries constitute a burden on societies worldwide. In Sweden, the tangible costs of injuries are estimated at about 4 % of the BNP [6], not accounting for the pain and suffering of the victims.

In addition to barriers to the development of generic systems designs, there are also specific obstacles to the implementation of computer systems in public health organizations ranging from issues related to the protection of data security [7] to problems with system inter-operability [8]. These implementation barriers are, however, not only technical. One important

implementation barrier is that the users do not accept and use the systems that are available. A low acceptance of disease prevention systems has been explained by system developers failing to prove the benefits of the system for individual users [9]. Evidently, it may be difficult to make a business case for disease prevention systems among clinical practitioners who care for those who are already ill. It is therefore essential that a full circle of information and knowledge management is visualized for all user groups when implementing these systems, starting with the gathering of data in computerized patient records and ending in both educational materials for use at the population level, and screening protocols and decision-support systems to be used at the clinic level. In other areas of public health, however, the nature of barriers may be different. In contrast to disease prevention that is focused on risk factors carried by individual persons, health promotion addresses health issues from a community perspective. Returning to the idea of integration between social and health reforms, identification and implementation of interventions are built on voluntary participation from community members and broad recruitment of resources [10]. Health promotion is at its very core based on cooperation between 'experts' and laypersons in the pursuit of solutions to common health problems, and arenas for open communication and democratic decision-making are consequently central components in the strategy. To be widely adopted, information systems for use in this rapidly growing area of public health must therefore be designed with a focus on high general usability, i.e. that the systems are made accessible and easy to use for broad sets of low-intensity users [11].

The development of computer-based information systems in public health is thus more than simply a technical challenge, it requires consideration of behavioral, social, and organizational issues associated with information management. The objective of this study is to examine the need for information systems support in modern health promotion programs, using the international Safe Community program as an example. In particular, the aim is to use requirements engineering methods in a case study involving the Safe Communities in Sweden.

2. Case study context: Computer systems requirements for Safe Community programs

This research was conducted in the context of the international Safe Community movement. Despite several decades of concerted efforts, unintentional injuries remain a dominant public health problem [12]. To act on this situation, the World Health Organization (WHO) has defined a global action plan for injury prevention based on a framework for local injury prevention initiatives. In 1989, the first world conference on accident and injury prevention was held in Stockholm, Sweden. The Safe Community concept was established at the conference. Underlying the Safe Community idea is the principle that local injury prevention should rely on local community initiatives and resources with minimal external involvement [13]. The notion of 'community' is broad, and can include "a municipality, a county, a city, or a city district working with safety promotion, injury, violence, and suicide prevention, covering all age groups,

genders, and areas and is a part of an international network of accredited programs" [14]. Since the population in a Safe Community may range between two thousand and two million, the local program organization may vary accordingly. Generally, the programs include five risk areas/groups; the elderly, children, sports and leisure, workplace, and traffic. The study was conducted during the requirements engineering phase of the development of an information system design for the Scandinavian sites in this program. The term requirements engineering is used in informatics literature to denote methods aimed at specifying what information systems should accomplish, rather than saying how it should be done [15]. Because the introduction of information systems is a means for organizational change and affects a large number of people, several researchers have emphasized the importance of capturing the social aspects of systems requirements [16,17]. Furthermore, it has been claimed that in order to get a correct view of professional users' requirements, these need to be captured in the context of work practice [16]. The absence of an understanding of the use context might result in information systems not meeting the expectations of the users, thereby resulting in lack of acceptance and unnecessary costs [15]. On the other hand, identification of the most central needs at an early stage provides the possibility to focus systems development on those features that are most valuable to the users [18]. Various approaches, methods, and techniques have been developed for the performance of such requirements engineering [19].

3. Methods

The study used the case study approach to data collection and analysis [20]. The collection of data on user needs was based on the fact that future system users can often describe situations that are problematic for them at present. The Critical Incident Technique (CIT) was developed in the early 1950s by J.C. Flanagan in the U.S. Army Air Force [21]. The CIT provides a simple method for identification of phenomena that interfere with routines and cause problems in practice settings. The technique can thereby be used to identify problems that can be addressed when trying to improve a process towards an optimal outcome. The results from CIT studies have been found useful in several different types of settings, e.g. as an input for development of information systems and to discover possibilities for improvement in service quality [18,22]. Data has been collected in CIT-based studies through interviews and questionnaires. However, traversal of the conceptual design gap between experienced problems, ideas, and a real-life functioning information system that is ready to use is more difficult. To deal with this problem, the *Voice of the Customer Table* (VCT) was developed in industry [18,23]. The VCT is included in Quality Function Deployment [24], which is a validated set of procedures used for coordination between market analyses and production processes in product development. In Quality Function Deployment, the VCT is used for interpretation of customer statements in order to capture concrete needs that, later in the process, are translated into production processes and products that efficiently meet customers' needs. Table 1 provides an example of how stakeholder statements can be analyzed using VCT in a public health setting.

Table 1. *Example of how a stakeholder statement is analyzed in the Voice of the Customer Table.*

My manager does not understand safety promotion.	Geriatrics head nurse	Lack of understanding for safety promotion	Meetings with policy makers	At the municipal office	To obtain funding for safety promotion	To inform policy-makers about the possibilities of safety promotion	Support for marketing of safety promotion

3.1. Data collection

In Sweden, municipal administrative offices and county councils constitute the organizational backbone of the Safe Community movement. All the 14 Safe Community programs active in Sweden during 2002 were invited to participate in the study. One of these declined to participate due to lack of administrative resources. The study population consisted of the public health practitioners active in the 13 participating Safe Communities in Sweden. Data were collected using a questionnaire that was divided into two parts. The first part asked about present computer usage, while the second part consisted of a CIT instrument [25]. To validate the particular instantiation of the CIT instrument, the questionnaire was first distributed in a pilot study (n=5). When it was found that no changes were needed, the questionnaire was distributed to the study population (n=197). This resulted in a final study population of 202 public health practitioners.

3.2. Data analyses

Data on computer usage were analyzed using descriptive statistical methods. The CIT data were first analyzed using qualitative methods to identify

categories of critical incidents. Thereafter, a modified version of VCT was used to determine practitioners' needs for information system support. The modified VCT consisted of six columns:

1. Critical incident categories (aggregated stakeholder statements)
2. Who (the problem owners)
3. What (what they wanted to do when they experienced the problem)
4. Why (why they wanted to do it)
5. How (if there were any specific technical demands)
6. The actual needs of safety promotion programs

In this analysis, only totally complete CIT responses were inserted into the VCT. Each individual's statement was first refined using the stepwise VCT procedure. Thereafter, the results were grouped into categories of needs, using iterative comparisons and revisions. The VCT evaluation was first performed by two public health informaticians, and thereafter revised by a senior public health practitioner. The final matching of the incident categories to system need categories was conducted using a review of computer technologies possible to adapt for use in health promotion [26] as a background.

4. Results

The primary response rate was 70% (142/202). From the set of 142 primary returned questionnaires, 19 were excluded due to missing data, leaving a final study sample of 123 Safe Community practitioners. Of these, 100 worked in a municipal administrative office (81%), and 21 (17%) worked at a county council. The remaining two respondents worked in other

organizations. The overall rate of computer usage was high, as 90% (111/123) reported that they used a computer every day at work. The main software applications used were standard email, word processing, and statistical packages. Twelve percent (15/123) of the respondents stated that they used Geographical Information Systems (GISs) on a regular basis. Fifty percent (62/123) of the respondents reported a problem that they had experienced in safety promotion practice. From these reports, four general needs of improvement were identified.

Need 1: A community-wide program management information system for safety promotion programs

A central problem in the safety promotion practice was the distribution of program management information (Table 2). In safety promotion programs, it is essential to be able to provide different key groups, such as the general public, policy-makers, and practitioners in the organizations involved, with information at the 'right' level of detail about the program structure, its goals and core activities. A particular managerial information need was related to the distribution of responsibilities and work tasks. Sharing structural information about mid-level leadership was found essential for day-to-day program management in the majority of the programs, because all practitioners needed to know from whom they could get hands-on directives and advice. However, information about top-level leadership and organizational structure was reported to be of special importance in communities where resources were limited. In those settings, safety

Table 2. *Voice of the customer (VoC) analysis of the critical incident category 'Ignorance of program structure and goals in the community'.*

Critical incident category	Who	What	When	Where	Why	How	The Customer Need
Safety work is performed outside ordinary working hours	Safety promotion practitioners	Lack of commitment for inter-organizational work among middle management	Performance of safety promotion tasks	Community organizations involved in safety promotion	Lack of communication in the inter-organizational network	Inter-organizational group communication system	Group communication systems for practitioners and managers in the inter-organizational safety promotion network

Table 3. *Voice of the customer (VoC) analysis of the critical incident category 'Safety work is performed outside ordinary working' hours.*

Critical incident category	Who	What	When	Where	Why	How	The Customer Need
Ignorance of program structure, goals, and main procedures	The general public, safety practitioners, and policy makers	Program management information	Planning and performing safety interventions	Throughout the community	Lack of community-wide systems for distribution of information	Web-based information system	A community-wide program management information system for safety promotion

promotion was generally not highly prioritized, and the allocation of resources had often to be renegotiated at the highest management level.

Need 2: Group communication systems for practitioners and managers in inter-organizational safety promotion networks

The safety promotion practitioners commonly experienced that they had insufficient time allocated for safety promotion work (Table 3). Many of the practitioners reported that they often worked more or less voluntarily and outside ordinary working hours with safety promotion. Because the inter-organizational safety promotion program was given low priority by mid-level management in the participating organizations, it was hard for the practitioners to allocate time for safety work without causing a conflict with ordinary tasks. A large proportion of the respondents, 71%, spent 5% or less of their normal working hours on work related to Safe Community issues. Based on this observation, that a Safe Community had to be grounded on voluntary work, a strong need was identified for a group communication system that can be used for creating an atmosphere of inter-organizational trust and reciprocity with regard to the local safety program in each participating organization. If no such social capital is established and distributed at all organizational levels, little preventive work will be performed. In particular, a need was identified for creating a channel for regular interaction between mid-level management in the organizations involved in the program, and the politicians and policy-makers in the municipal administrative offices and county councils that provide the long-term commitment and basic financing.

Need 3. Integrated injury data recording and analysis systems for evidence-based safety promotion

Another weighty set of critical incidents was related to a need for improving injury data registration (Table 4). The practitioners who used injury data for statistical analyses reported that the data frequently were both incomplete and suffered from a time lag. The poor data quality resulted in an unnecessarily poor foundation for the study of causal relations and for decision-making regarding interventions. In particular, a need for including routines for computer-based recording of injury codes in all information systems used to manage patient diagnoses in primary health care and at hospitals was identified. Moreover, it was found important to implement routines for geographical location of the sites where injuries occurred to allow for presenting and analyzing the injury data from a spatial perspective. A particular problem associated with data quality was the lack of dialogue with those working 'upstream' in the chain of data collection. Providing feedback was here identified as a primary need, because the feedback can provide those working at the grassroots level with an understanding of the final outcome of their work, and recognition of the importance of their efforts.

Need 4. Technical support services

Malfunctioning technical systems was a common source of annoyance among safety practitioners. Technical support services were thus found to be needed in different forms, both as access to technical support staff, and as

Table 4. *Voice of the customer (VoC) analysis of the critical incident category 'Incomplete injury data sets'.*

Critical incident category	**Who**	**What**	**When**	**Where**	**Why**	**How**	**The Customer Need**
Injury data sets collected in the community are incomplete	Injury data analysts	Not all parts of injury data sets are reported	During injury data collection and analyses	At the data collection sites in the community	Lack of shared routines and standards	Computer-based protocol for injury data collection	Integrated community-wide injury data recording and analysis system for evidence-based safety promotion

built-in help functions in the information systems that were used. In addition to the need for technical support, a general need for training in the use of information technology was also identified. The need for technical support services was especially pronounced concerning the use of GIS.

5. Discussion

In this study, requirements engineering methods were used to investigate safety promotion practitioners' needs for information system support. Results show that sharing of management information, the establishment of social capital for the safety promotion program in the community, and the routines for distributed injury data recording are areas where information management needs to be further developed in present safety promotion practice. Abundant technical information system user support services are also needed. The interest in using more advanced computer applications, such as GISs, was modest.

The purpose of addressing general critical incidents in needs assessment is twofold. First, a general approach contributes to a broader understanding of the practice environment in public health. Second, it enables the possibility to design computer-based systems that address public health problems previously overseen in systems development. By combining the CIT with VCTs, it was possible to translate users' statements into needs for subsequent translation into technical system design features. The need for support program management by a community-wide computer network was

found to be fundamental to collaboration in the safety promotion setting, where practitioners are spread out in different organizations. Well-functioning program management was also found to be of importance for sharing of injury data between organizations in the establishment of evidence-based safety promotion programs. Even though a functional computer network would be in place, there are many organizational barriers that may hinder the sharing and analysis of data in the planning of community interventions [27]. A group communication system for the inter-organizational safety task force was found to be an important possibility for the development of mutual trust and reciprocity in safety promotion programs. The maintenance of such trust may, in practice, be a critical factor in being able to sustain the program over longer periods of time. Whether or not such systems can motivate mid-level management in different organizations to become involved in safety work is, here, a crucial issue.

Much of the planning in a Safe Community is assumed to rely on analyses of local injury data. It is therefore important that these data are of high quality, both with reference to content and coherence in time. We found that a recurring problem was that injury data records often were incomplete, and that epidemiologists and policy-makers needed more data than was supplied for planning interventions. A key explanation identified in this study was that the practitioners who recorded data were practicing organizationally far from those who used it. Moreover, the recording of data was performed at the emergency rooms and primary care centers in parallel to regular clinical

duties, and it was difficult to establish commitment to the extra burden this task entailed. An immediate solution to the problem of incomplete records, as suggested by the respondents in the study, was to include the recording of injury data as a mandatory step when entering the patient case into the computer-based patient record systems at hospitals and in primary care. However, lack of motivation among coworkers is frequently discussed in literature on organizational theory, and it has been pointed out that it must be recognized that the members of an organization have different short-term and long-term goals. Suggested interventions for encouraging certain behaviors include, e.g. further training, education, and alterations in the reward system [28]. From this perspective, modification of the data entry system may not be sufficient. Feedback from those in the safety promotion program performing the analyses may still be an important contributing solution to the data quality problem [29].

The present study has several limitations that have to be considered when interpreting results. First, the study was performed in a network-based, bottom-up safety promotion program, aimed at establishing a safety-promoting environment rather than addressing a specific injury problem. The results are therefore not applicable to prevention programs in public health that address risk factors for specific diseases or injury types carried by individual persons. Second, even though the CIT and the VCTs are well-established methods in requirements engineering, the data were collected in a Scandinavian setting and generalization of the results to health and safety

promotion programs in other socioeconomic contexts has to be done with caution.

6. Conclusion

This study identified areas where computer-based information systems that can be employed to make health and safety promotion practice more efficient, and patterns of present computers usage were outlined. Results can be used to guide the development of computer-based systems in health and safety promotion. Further research into systems design for health promotion is warranted.

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