

Original Article

Description of an integrated e-health monitoring system in a Portuguese higher education institution: the e.cuidHaMUstm program

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Abstract:

Background: The World Health Organization and the International Labour Organization recognize that workplace health is not only affected by occupational hazards, but is mainly affected by social determinants and individual factors. An accelerated rise in noncommunicable diseases has fostered the importance of creating supportive environments and encouraging healthy behaviours. Therefore, an operational approach to making workplaces healthy and sustainable is needed. This paper describes the development of an e-Health monitoring program entitled 'Integrated eHealth Monitoring System for Health Management in Universities' (e.cuidHaMUs™) as a possible solution to that operational approach.

Methods: We developed the program e.cuidHaMUs™ that proposes to detect risk behaviours related to noncommunicable diseases and to implement problem-solving measures by establishing a health-promoting workspace in a Portuguese higher education institution. Based on the 'I-Change' conceptual model, our program provides personalized feedback; improves health-related knowledge, attitude and good practices; and encourages actions to promote healthy lifestyles through individual health capacitation. Focusing on evaluation as an activity that generates knowledge, the e.cuidHaMUs™ program aggregates all the relevant health information, shares the results with decision-makers and evaluates health-related policy changes in the workplace.

Discussion: This paper presents the design of the e.cuidHaMUs™ program, the development of an eHealth web platform to share information between the different stakeholders, and a questionnaire to evaluate the health status of higher education institution workers (e.cuidHaMUs.QueST®). Also, the procedures for data collection and analysis are outlined. The e.cuidHaMUs™ program can enhance health surveillance through cross-sectional and longitudinal studies and provide scientific evidence to support the envisioned interventions and promotions of healthy lifestyles. This program is an effort to incorporate a holistic culture of health-promoting workspace in higher education institution policies.

Keywords: health status, noncommunicable diseases, occupational medicine, workplace health promotion, universities

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Background

For nearly a decade, the World Health Organization (WHO) and the International Labour Organization, supported by research, have reinforced the premise that workplace health is not only affected by occupational hazards, but is mainly affected by social determinants and individual factors which require new answers and an attentive and operational approach to making workplaces healthy and sustainable (1–3). One way to address these challenges is to use the concept/tool of workplace health promotion (WHP) (4–6). This concept places the joint commitment between employers, employees and society in order to contribute to the improvement of the health and well-being of people in the workplace (7). The rationale for seeking to improve health in settings where ‘people work, live and socialize’ (6) is based on the premise that health is largely determined outside health services and that health sustains organizational and social productivity (8).

Higher education institutions (HEIs) in general, and their employees in particular, play an important role in shaping the knowledge and skills of the next generation, and therefore in shaping future society. It is expected that HEI staff, with their beliefs and attitudes as well as their behaviour towards health, could influence their peers and themselves. They can also influence the next generation, future decision-makers, and thus have an impact on tomorrow's societies. For this to happen, it is important to resort to means capable of raising awareness and even incorporating measures and attitudes capable of generating the promotion of healthy lifestyle behaviours, either individually or in a group (e.g. employment, family and society). As recommended by the Ottawa Charter for Health Promotion in 1986 (6), ‘health must be understood as a resource for life and not as a purpose of life’. Although the Ottawa Charter stressed the urgency of countries to achieve Health for All by the year 2000 and beyond, a recent study on the state of health and safety policies at work in the European Union (EU) in 5 member states shows that in over 40,000 companies, only 29.5% have measures to promote workers' health at the workplace (9). In this same respect, other scientific evidence has shown that the workplace has been viewed as playing a lower role in supporting employee health (2,4,5,9). In addition,

the holistic approach to health promotion is being neglected. In that case, it is in fact necessary and urgent to adopt an integrated approach combining the prevention of diseases and the promotion of healthy lifestyles in the workplace (10).

Occupational medicine in Portugal has been one of the main instruments since the 1990s in preventing the onset of occupational diseases in workers, thereby supporting employee health. Its mission is embodied in two fundamental diplomas (DL no. 441/91 and DL no. 26/94) which attribute to safety, hygiene and health services at work (SHST): (a) prevention of occupational risks; and (b) promotion and surveillance of workers' health. However, there is still much to be done. Although the majority of large companies in Portugal (> 250 workers) have access to an occupational physician with access to medical examinations and some complementary examinations, health promotion and disease prevention are oriented towards the worker as an individual, but not oriented to the whole organization. Thus far, the activities related to health surveillance, health promotion and non-communicable disease prevention from occupational medicine routines at HEIs in Portugal have remained well below expectations.

Portuguese workers with a high level of education (as in the case of HEIs) have been neglected when it comes to health promotion. Currently, there are not any known published works in Portugal related to this topic. Therefore, the study of epidemiological profiles related to morbidity and mortality caused by, or related to, work and the improvement of the health and quality of life in an HEI population is a priority.

The principles from the Health Promoting Workplace (HPW) and Comprehensive Workplace Health Promotion Approach (CWHP) (11) are an excellent initiative towards a holistic approach for health promotion in work environments (10). Those principles are based upon the assumption that employers need to create and to support a healthy and safe workplace culture, and employees need to find ways to stay healthy and support their own well-being. The research team intends to incorporate these health promotion concepts in HEIs, encouraging employees to care for their well-being, and encouraging the employer to create a supportive management culture in support of these concepts, thereby combining health promotion with occupational health and safety (12). In this

way, to create knowledge about the different contexts of, and groups involved in, health and well-being at work, the design of a program that might influence all organizational hierarchy levels including workplace environment and organizational culture from the individual employee behaviour change is crucial.

This paper describes the research stage and the process of establishing a workplace health-related program, 'Integrated e-Health Monitoring System for Health Management in Universities' (e.cuidHaMUs™), in a Portuguese HEI.

Methods/design

Development of the e.cuidHaMUs™ program

The program

Health problem patterns, with regard to sociodemographic factors (e.g. age, sex, education status), built environment (e.g. use of materials and acoustic conditions of facilities), organizational culture (e.g. leadership's role in supporting a healthy and safe workplace), medical issues (e.g. stress and musculoskeletal injuries) and working relationships (e.g. planning and organization of work) were not known in Portuguese HEI. Thus, we designed a program that, in addition to being able to identify these patterns, help to instil in the employees the will and need to change unhealthy practices, not only at an individual level but also at the group level (in each university department and service) and across the community. To encourage employees to take care of their well-being, they need to be aware of their current unhealthy behaviour in order to be able to assume a change in their habits. However, it takes time for this change to take place.

There are several conceptual models to change behaviours over time, such as the 'I-Change' model (13–15). This model is based on a personalized approach of three stages (Awareness, Motivation, and Action) that, in addition to giving the theoretical orientations underlying health problems, empowers and motivates individuals to generate their solutions to these problems.

Based on the 'I-Change' model, the e.cuidHaMUs™ program was conceptualized as a monitoring instrument that will provide workers with the tools to raise awareness, to improve motivation and encourage actions to promote

healthy lifestyles. This instrument will also help HEI's decision-makers to take actions according to the results found and has the possibility of changing local workplace politics guided by the principles from the CWHP approach (11).

Furthermore, the e.cuidHaMUs™ program is able to do what occupational medicine does not: it can aggregate all the relevant health information for a specific period in time (retrospective analysis), and help improve health policies by sharing the results with decision-makers and evaluate health-related policy changes in the future (prospective analysis).

The e.cuidHaMUs™ program has two main functions: (a) health monitoring with screening and prospective surveillance; and (b) intervention, from avoidable events to noncommunicable disease (NCD) prevention and health promotion. The former consists of an online platform and the latter function allows the opportunity to build a worker's health registry for the conduct of research on NCD topics. More detailed descriptions are presented in the next section.

The results of this program should be used to assess feasibility and acceptability on two main lines of action from an individual point of view and from a collective one: (a) health surveillance; and (b) health intervention. Because occupational health surveillance cannot in itself be applied to aspects related to work only (10), these two lines can contribute to supporting a holistic approach to health promotion across the workplace and to reduce the most critical health problems found.

Inasmuch as the orientations of the WHO regarding occupational safety and health encourage a range of activities, including the implementation of a program that promotes the prevention of occupational risks and promotes the health and safety of workers (16), the e.cuidHaMUs™ program can be integrated in the context of SHST in HEIs as a support and complement.

The target population

The target population is the entire population of workers (teachers, researchers and technical, administrative and management staff) above 18 years of age at the University of Aveiro (UA). The UA is considered here as the context incubator of this program. However, the e.cuidHaMUs™ program can be adjusted to fit any other organization's

rouines. UA is one of the most dynamic and innovative universities in Portugal. Attended by about 2100 workers (distributed amongst 16 departments, 4 polytechnic Schools and 7 services under the management of UA administration), and 13,600 students in undergraduate and postgraduate programmes, the UA has achieved a significant position amongst HEIs in Portugal.

UA provides annual medical consultation in occupational medicine to its staff members only. Because of this, such workers will all be invited to participate in the e.cuidHaMUs™ program at the time of the medical consultation. Exclusion criteria is not considered.

Development of the e-health platform

The e-health platform was designed to be dynamic and easy to use, which is where collaboration with communication design experts plays an important role. This resource includes a toolkit, comprising storage, gathering and displaying information (both current and historical data) related to NCDs. All data are stored in the so-called ‘e.cuidHaMUs™ database’. The data can be exported to other software applications (such as the R foundation) for further statistical analysis. The platform will comply with the European Union (EU) General Data Protection Regulation best practices (17).

To develop this fully functional web platform, several factors are taken into account: (a) the participant/user’s needs; (b) the functional and non-functional requirements (such as authentication, authorization levels, platform performance, and scalability); (c) the prototype; and (d) developing and testing. In future developments, each stage of evaluation testing will be carried out by panels of experts and end-users.

To access their own data, all users can voluntarily register in the platform. In the registration it is necessary to fill the numeric code attributed in the e.cuidHaMUs.QueST® (for more details about the e.cuidHaMUs.QueST®, see the section below). The numeric code for each questionnaire is randomly generated, certifying that each questionnaire is unique and individual.

In this platform, the program invites all users to participate in other validated scales, among which are worth mentioning: (a) the pain survey (the location and intensity associated with pain will be

assessed through the Brief Pain Inventory Scale (18)); (b) the diet survey (evaluation of the diet of the people participating in the study will be made using the semi-quantitative food frequency questionnaire (QFA) (19)); and (c) the physical activity survey (information on physical activity will be based on the application of a questionnaire validated for the Portuguese population (20)). The purpose of these scales is to complement the questions presented in the e.cuidHaMUs.QueST®, allowing further analyses.

The platform is designed to help monitor different types of studies. The observational studies will help to describe the health status of this population each year. As the study population is very stable, allowing for multiple, repeated measures over time for selected NCD indicators, such as overweightness and obesity, diabetes, hypercholesterolemia, etc., several studies could be prepared for each NCD indicator found (prospective cohort studies).

One of the goals of this platform is to disseminate information between the different stakeholders, but with different levels of access, namely:

1. **The decision-makers** (composed of a variety of people from different levels of the organization: rector, directors of departments, schools and services) – they will analyse the data from a collective perspective. The information presented in the platform can help to make some decisions according to the prevalence of the most relevant health problems found in specific places within the University (Global University, Departments, Schools, and Services) and to facilitate the implementation of problem-solving measures;
2. **The researchers** – they can work the raw data to gather more information about a specific health problem. Another important role is to propose and design new observational studies, but also randomized controlled studies. Using the e.cuidHaMUs™ database, the researchers can propose and manage new research projects within the platform. These projects should be related to working health problems.
3. **The users** (the most important stakeholder) – the platform can be used to answer other validated scales, analyse their records and historical data, and to compare against other reference values (national, institutional, departmental). Another important characteristic is the possibility of

receiving personalized alerts and/or content about healthy lifestyles.

This e-health platform will take an active role in monitoring the health of the population of workers. In this way, the platform will provide scientific information that may be the basis for decision-making in matters of risk, prevention, and health promotion.

An evaluation tool: the e.cuidHaMUs. QueST®

A specific, epidemiological questionnaire for employees entitled 'e.cuidHaMUs. QueST®' was designed to collect general data on social and demographic characteristics, physical and mental health, smoking habits, status of pain, eating habits, physical and sporting activity, and diagnostic exams with screening tests (see questionnaire in Appendix A). This is a short and self-administered questionnaire that was designed based on a questionnaire used by doctors in occupational medicine at the UA, and the opinions of a panel of experts consisting of four members (occupational health physician, epidemiologist, physiotherapist and cardiologist) who helped to build the questionnaire for its use in the e.cuidHaMUs™ program. First, the questionnaire was pre-tested on 12 users and then applied to the population that attended the occupational medicine department between June 2017 and June 2018.

The first parts of the questionnaire are completed while employees (users) are waiting for the consultation in the lounge; it takes around four to five minutes to complete. The last part related to 'diagnostic exams with screening tests' is fulfilled with the help of the occupational medicine doctors.

A trained interviewer presents the objectives of the questionnaire, and, if the user agrees to participate, an informed consent declaration in hardcopy is given and signed by him or her. The user is provided with an individual numeric code to prevent personal identification. Whenever the users go to the doctor's office at work, they will receive a different numeric code.

The questionnaires are entered in the e.cuidHaMUs™ platform (see details in previous section) by the researcher and will be kept as long as the users desire. The data will be analysed only in aggregate while the participants are employed at UA.

The e.cuidHaMUs. QueST® is registered by Inspeção Geral das Atividades Culturais (IGAC) from an organization, part of the Portuguese Ministry of Culture with reference no. 4244/2017 and no. SIIGAC/2017/8834. Favourable organizational permission and favourable ethical opinion was gained from the Rectory of the UA and the Ethics Committee (CE) (see section 'Ethical considerations') prior to starting the program.

Results from a preliminary pilot study

With the purpose of establishing a data cohort for the health of the UA workers, using the e.cuidHaMUs. QueST® for data recollection, a preliminary study was conducted between June 2017 and June 2018. The sample size was 322 (18.7% of the staff of the UA population, at that time) and the response rate of those invited to participate in our study was 93.3%. The main findings of this preliminary study show that the majority of participants (69.5%) do not walk over 30m/day as recommended (21,22) and over one-third (43.2%) had hypercholesterolemia (a biological NCD risk factor) (13,23).

Procedures for data collection and sharing information

In Figure 1, it is possible to see the study procedures in the e.cuidHaMUs™ program. The first procedure is related to the collection of data using the e.cuidHaMUs. QueST®. Cross-sectional studies can be made only with this type of data.

The second procedure is how the information is stored and displayed in the e.cuidHaMUs™ platform. The privacy and security of the system is ensured by using two independent encrypted databases, one for personal data, and a second one for health data. All passwords and codes are encrypted by bcrypt and data access requests are centralized in encrypted SQL Server Stored Procedures. Mechanisms for the prevention and detection of brute force attacks have also been implemented.

Participants access their private area on the platform and insert the questionnaire code, associating the questionnaire to their account. In this way, participants will associate several questionnaire codes to their account over the years.

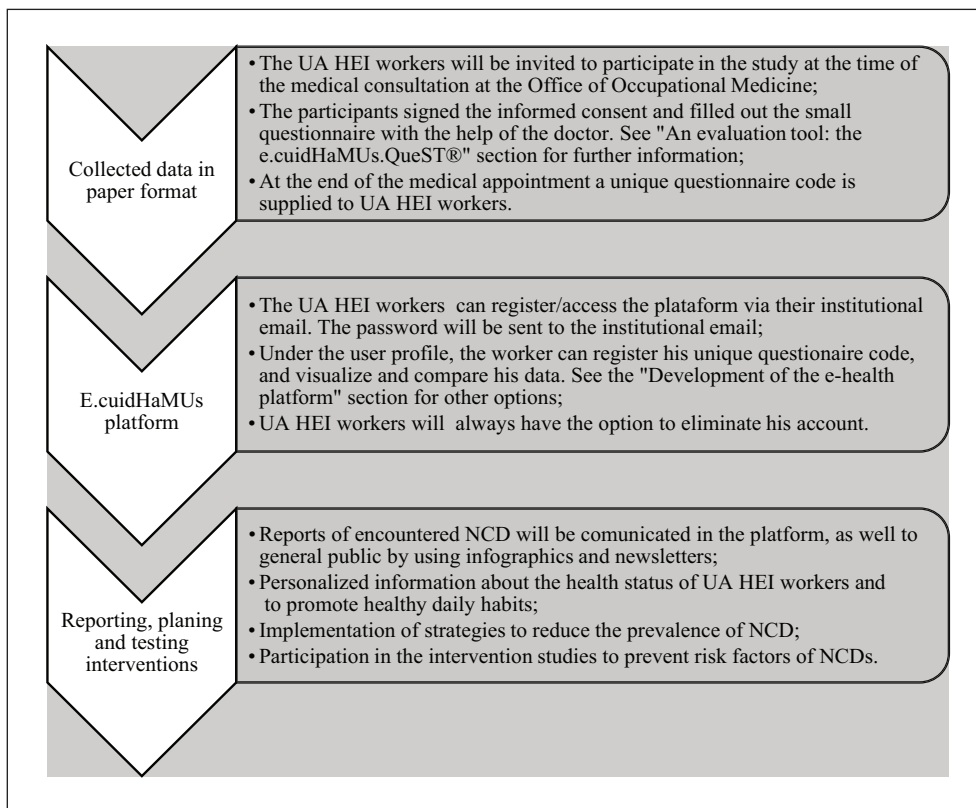


Figure 1. Schematic presentation of study procedures in the e.cuidHaMUs program.

In the platform, the user will authorize the sharing of his or her information for data visualization and statistical treatment as outlined in the informed consent waiver. The anonymity of personal information is guaranteed by the platform. All public data will not present any personal information. For example, overall results with fewer than 10 records will not be displayed.

The third procedure is related to reporting the results, planning and testing interventions. Reports will present the statistical analyses of NCDs and health habits of workers.

Conferences, infographics, newsletters and scientific papers will be the means of disseminating information. The implementation of specific protocols to solve health issues will also be available on the platform. Finally, registered users in the platform are invited to answer validated scales and participate in the intervention's study designs.

Ethical considerations

The studies included in the e.cuidHaMUs™ program comply with all ethical standards contained in the Helsinki Declaration of the World Medical Association and the guidelines of Portuguese Data Protection Impact Assessment (DPIA) (14).

The CE of UA approved the preliminary study (no. 14/2016) to ensure that the study procedures comply with ethical and legal standards (Law no. 3/2014, of January 28) namely:

1. The instruments are simple and non-invasive.
2. Participation in the project is voluntary and participants can withdraw at any time from the study, requesting the elimination of data in person or via email (inserted in Informed Consent), without this causing any type of harm to them.

The following guidelines were also considered:

1. The data are kept as long as the users desire so, or as long as they work at UA, and they will be presented only in an aggregated format.
2. The data can be erased by a worker's request or when they leave the institution.
3. During registration in the e.cuidHaMUs™ platform, the users are encouraged (not mandatory) to give their contact information, namely, their email addresses. This feature had been planned to be used as an element of association with: (a) the questionnaire numeric code; (b) the personal data. Both were stored in two independent servers to prevent the crossing of data.

The Data Protection Officer (DPO) at UA gave a favourable opinion on the project.

Discussion

Current status of the e.cuidHaMUs™ program

The e.cuidHaMUs™ is considered an 'organizational' structure of multiple projects and related initiatives. It is proposed to design and implement health-related strategies and to share relevant information with workers, managers and health professionals of occupational medicine in HEIs. The ambition is to improve occupational health by adopting a holistic approach (10). For this purpose, the e.cuidHaMUs™ program can help to improve access to better-quality health information, both at the individual level and at the community level, promoting active participation of all the stakeholders, contributing to the community's health and well-being. The e.cuidHaMUs™ program is currently dependent on the consultations in occupational medicine at UA. All workers at UA will be called to this appointment at regular intervals (usually annually). Thus, the population study is quite stable, allowing the construction of cohorts for longitudinal and interventional study designs. It is very common to have workers with 30 or more years in the same institution. However, it is expected to have some fluctuation represented by the incorporation of new workers replacing the retiring ones.

To our knowledge, we are the first team to implement a targeted monitoring program in Portugal for people during their active life in their workplace that

aims to research, support and encourage strategies for health promotion and disease prevention in a relationship between a group of researchers and a team of occupational medicine staff. This is an effort to incorporate a culture of health promotion in university policies, approaching the concept of the health promoting university (HPU). One strategic approach of the HPU is to consider information about the needs of the worker's community and evaluate the efficacy of the implemented actions (15,24–27).

The e.cuidHaMUs.QueST® allows, in a short time and with few questions, the coverage of a very wide set of domains to understand the needs of workers' health. Results about social and demographic characteristics, physical and mental health, smoking habits, status of pain, eating habits, physical and sporting activity, and diagnostic exams with screening tests are now available for all the stakeholders. This evaluation tool can be used to draw an annual health profile of the population, and at the same time could be used to identify risk factors to inform the planning of health promotion programmes in HEIs.

The preliminary study provided new information to the medical community and decision-makers on risk factors that lead to NCDs. This means that it is now possible to aggregate information about each problem, each risk factor and each trend in the workplace. From the preliminary pilot study, we found that most participants (69.5%) do not walk over 30m/day and over one-third (43.2%) had hypercholesterolemia. We can now address these issues.

The e.cuidHaMUs™ platform will allow employees to visualize their health status over the years. Additionally, with the e.cuidHaMUs™ program, we hope to be able to motivate workers to participate in health promotion strategies and help improve their health and/or prevent health problems by meeting WHP goals (1,2,5). In our preliminary pilot study, the response rate was 93.3%, which reveals a great interest on the part of the participants to know more about their health status.

A very recent systematic review shows that the effectiveness of strategies for implementing health promotion measures and practices directed at modifiable risk factors for chronic diseases in the workplace is sparse and inconsistent (5). In that review, no strategies based on e-platforms or personal health history applied to HEIs could be found.

Therefore, we believe that the e.cuidHaMUs™ program can have a very substantial impact on employee awareness of their lifestyles and could lead to consequent results (28). Thus, by involving all workers communally, including decision-makers, we believe that the e.cuidHaMUs™ program will have a significant impact on UA and other organizations that want to join this program, as it contemplates a change in routine behaviours, giving wider attention to long-term needs and lifestyles, and, consequently, will lead to healthier and more productive citizens.

Next steps

In addition to the health monitoring and surveillance of HEI workers, the e.cuidHaMUs™ program provides the chance for conducting observational studies, namely cross-sectional studies and longitudinal studies (both prospective and retrospective). In this respect, a set of longitudinal observational studies is envisioned at 5, 10 and 20 years. The first longitudinal study is envisioned for the next five-year period. The e.cuidHaMUs™ program can also conduct randomized controlled studies (RCTs). For example, workers who have a risk factor for NCDs can be directed to non-pharmacological/lifestyle options (29). Based on the initial results, we will implement and evaluate an RCT for the most prevalent risk factor: hypercholesterolemia (43.2%). The addition of new study areas, namely those related to the psychosocial and organizational work culture (30), is also planned.

Based on the viability of this program for the HEI workers, one of the highest priorities in the future will be to extend this program to the rest of the community: the students of this institution.

Conclusion

Workplaces are excellent places to implement health promotion initiatives because people spend most of their lives in these places, making adherence outside these contexts much more difficult. Therefore, the managers or regulatory decision-makers of institutions should take more initiatives to care and to improve the safety and health of their workers in the context of growing longevity with strategies to prevent health problems. Therefore, monitoring health in workplaces, complemented by research and strategies to promote the health of the workers, could be the key to healthier workers.

The outcomes of the e.cuidHaMUs™ program will have the potential to: (a) be replicated in other HEIs to allow health surveillance and adjust health policies; (b) draw governmental attention to adjust some health decisions for educational institutions; (c) disseminate the results concerning good practices in health promotion; and (d) improve global health of the workers and decrease the burden of diseases to contribute to the spread of the HPW.

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Supplemental material

Supplemental material for this article is available online.

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