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Original Article

A Dynamic Human Health Risk Assessment System

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ABSTRACT

An online human health risk assessment system (OHHRAS) has been designed and developed in the form of a prototype database-driven system and made available for the population of India through a website – www.healthriskindia.in. OHHRAS provide the three utilities, that is, health survey, health status, and bio-calculators. The first utility health survey is functional on the basis of database being developed dynamically and gives the desired output to the user on the basis of input criteria entered into the system; the second utility health status is providing the output on the basis of dynamic questionnaire and ticked (selected) answers and generates the health status reports based on multiple matches set as per advise of medical experts and the third utility bio-calculators are very useful for the scientists/researchers as online statistical analysis tool that gives more accuracy and save the time of user. The whole system and database-driven website has been designed and developed by using the software (mainly are PHP, My-SQL, Deamweaver, C++ etc.) and made available publically through a database-driven website (www.healthriskindia.in), which are very useful for researchers, academia, students, and general masses of all sectors.

Key words: Database, dynamically, health, OHHRAS, utility, www.healthriskindia.in

INTRODUCTION

Health risk due to occupational and industrial exposure has got serious attention and has been discussed at length at almost all kinds of platforms in the last couple of decades. Considerable efforts have been expended to develop the guidance for assuring and controlling the quality of activities in virtually all fields of human endeavor. Several approaches are currently in vague in many international, national, and provincial/state agencies of the European countries. Number of emerging approaches that address the need for appropriate and effective frameworks for risk assessment are at hand.

There is no comprehensive database or online database management system available for the Indian population. Thus, it is most important to assess as to how the exposure of existing and future chemicals is affecting and/or could affect the Indian population. Tools to lessen the agony of indigenous sufferers are strongly warranted that can categorize the intensity and nature of the risk factors affecting our population the most. Interaction of the risk factors with each other and their synergistic/complementary/supplementary effects on the human health can also be studied with these tools.

Therefore, attempts were made in this study to design and develop a comprehensive online system to assess the human health risk to a given population residing in eastern part of Uttar Pradesh and involved in various types of

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occupations. Special emphasis was given on occupation and socioeconomic status induced health hazards in the study. The entire study was completed in three phases: (1) HRA questionnaire-based data collection, (2) predictive online system (a health information system) development by using database and risk assessor, (3) risk assessment with the help of online human health risk assessment system (OHHRAS) by the means of risk report generation and risk communication.[1]

In the first phase, HHRA questionnaire containing 58 variables of our interest was designed and developed both English and Hindi for data collection. Online version of developed questionnaire form was designed and developed for wider availability and variety of data collection.[2] In the second phase, database was developed with the help of various advanced computer software, namely Excel, Visual PHP, SQL, C^{++}, and Macromedia etc., to scrutinize the collected data after its computation. Bio-calculators were also developed for the statistical analysis of the entire information provided in the questionnaire. An Online Human Health Risk Assessment System developed was uploaded on public domain – "http://www.healthriskindia.in". As a last phase of the study, people have encouraged to upload their queries and information using OHHARS. The system is working fine and a comprehensive risk reports are being generated for risk assessment as per the information provided by the respondents. Effort seems to be useful to facilitate Online Health Risk Assessment in user's friendly manner. The Online system will also be useful in providing health risk data not only in India but outside the country or globally by masses, regulatory agencies, policy makers, researchers etc.

MATERIALS AND METHODS

The following steps were involved in designing and developing an online human health risk assessment system (OHHARS) and made available on public domain that is www.healthriskindia.in [Figure 1].

After consulting and reviewing a lot literature offline and online and making sure that a dynamic human health risk assessment system is required, in the second steps, the HRAQ was made up of total 58 questions divided in four major sections of personal history, environmental status, occupational health status (clinical history and disease history), and socioeconomic status.[2,3]

To complete the third steps of the study, an online questionnaire was designed and developed by using the PHP. The collected data were included in the database dynamically for online health survey. Figure 2 shows the contents in the comprehensive questionnaire designed and used to collect the data online and facilitate the collected data for online survey.[4]

Under the fourth step, the work of data collection, a central element of the study was carried out by offline survey with the help of developed questionnaire (described in previous step). HHRA survey was aimed to know the health status of human population residing in the districts of Lucknow, Jhansi, and other adjoining areas. Later on for wider application of the tool, online survey was facilitated[5] and made available for maximum Indian population through the website.[6]

The fifth step of the study was completed by making desktop data entry for the Offline data collected. All

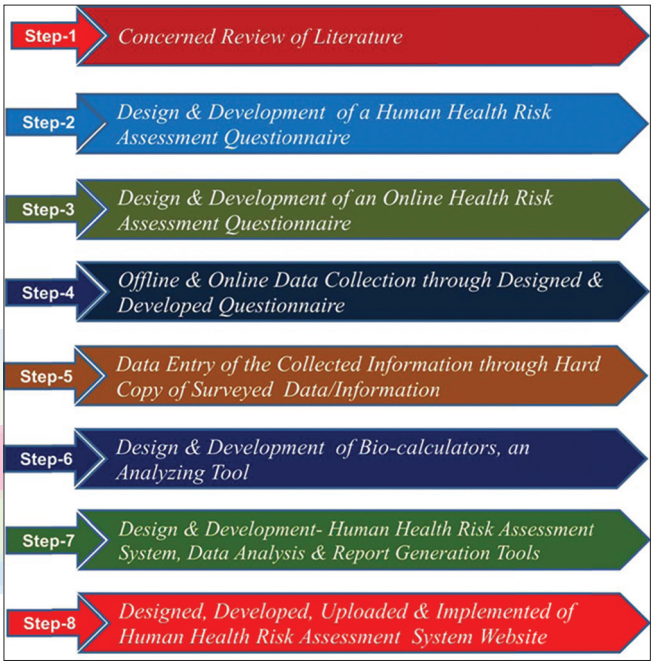


Figure 1: Schematic representation of different steps for design and development of online human health risk assessment system (OHHRAS)

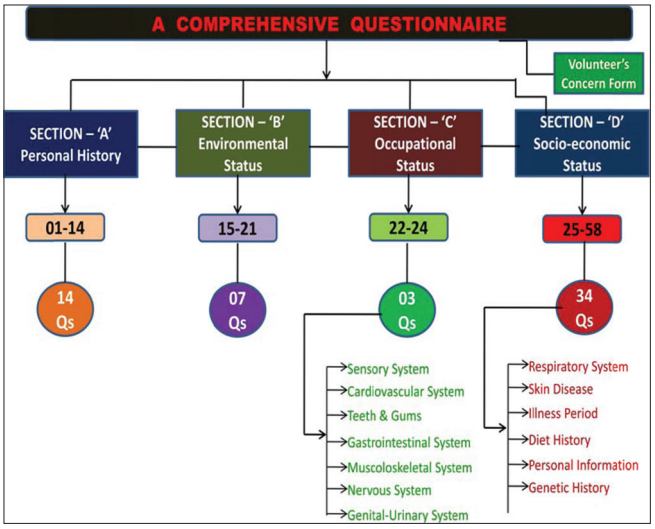


Figure 2: Contents of a comprehensive questionnaire designed

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2000 individuals' data/information that were collected through health risk assessment survey were entered into database designed and created. Entire entered data were spontaneously stored there in database[7] and could be retrieved for health risk evaluation. The look or screen shots of designed and developed database tables are given in Figure 3.

For the development of bio-calculators in the sixth step of study, initially, the calculators were developed by using the software – C++, and finally kept on database-driven website (www.healthriskindia.in) by converting it into PHP and JavaScript computer programming language[8] [Figure 4].

The main step of the study, that is, seventh step was completed by using client/server technology for the development of an OHHARS. The brief detail of the hardware and software [Figure 5] used for developing the system is as under:

Hardware

Processor : Pentium IV or Higher – Intel (3.20 GHz)
System type : 32-bit operating system or higher
RAM : 01 GB or higher
Hard disk : 20 GB or higher
Cache : 512 KB
Monitor : SVGA color monitor or higher
Keyboard : Any standard keyboard
Mouse : Any standard mouse
Internet : 128 kbps or higher with all essential accessories
Platform/OS : XP professional service pack-2, version-2002.

Software

In the last eighth step, the whole system designed and developed was kept on the database-driven website, that is, www.healthriskindia.in for the use of public. The Figure 6 shows the layout of database-driven website holding the Online Human Health Risk Assessment System (OHHRAS).

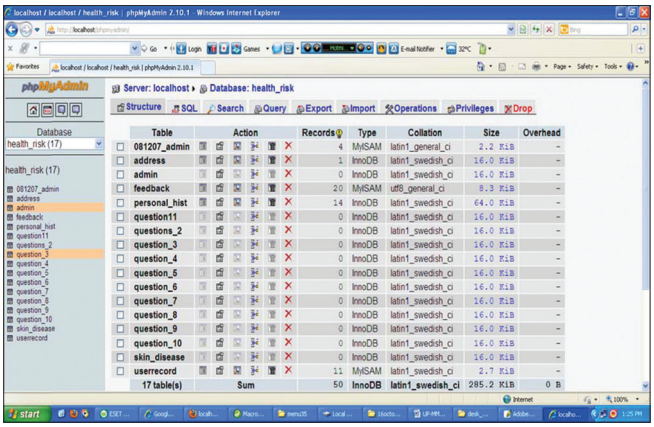


Figure 3: Internal view of designed and created database table

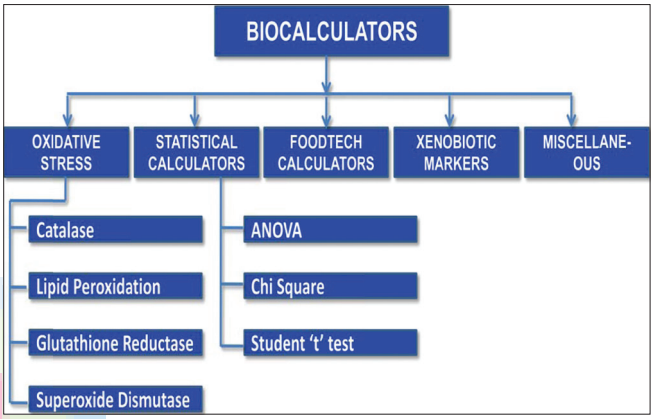


Figure 4: Different types of biocalculators – designed and developed

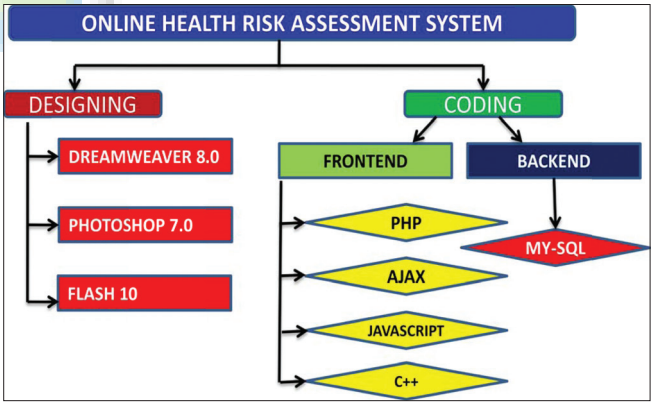


Figure 5: Software used in designing and development of human health risk assessment system

RESULTS

As a result of the study, we have been able to design and develop a comprehensive questionnaire for the assessment of human health risk assessment. Besides the hard copy, the questionnaire was also designed and uploaded on the desktop and hooked up with a database for the automatic/manual online/offline development of data bank. A survey was conducted using the said questionnaire among the people. The computation of the records was done for the formation of baseline data. Further, to make the rapid statistical analysis, bioscience calculators were formed in C++ language. Data were analyzed using these bioscience calculators. To provide the vide circulation and popularization of these calculators as well as for online survey, the questionnaire and calculators were put in the website designed during the present investigations.

The aim was to develop an OHHRAS for the complete Indian population and so the online survey questionnaire

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was developed and uploaded on developed website for wider reach, since the regions of India could not be covered through offline survey. The offline survey was initially started with the employees of IITR, at Lucknow, and extended to the other adjoining parts including Kanpur and Jhansi. In total over 2000 volunteers' data were collected during the study. Addition to that, data of over 200 volunteers were also included through online survey. Since online survey is a continuous process leading to increase the number of volunteers in the database and not possible to include in the hardcopy of dissertation for the statistics purpose. However, our website has a dynamic system that will automatically update, the statistics as and when it will be analyzed online.

An OHHRAS developed could performs integrative analysis of database files along with flexibility in their data. The system is not only efficiently using the files for performing the operations, but it is also easily understood and a menu driven application. The system can be accessed by simply browsing the internet and opening the website, as described in the following section. In the next step, health risk assessment questionnaire may be opened by clicking the respective hyperlink. The system is programmed in such a way that the users' data will automatically be stored in the database after answering all the mandatory questions of HRA questionnaire. A risk report will be generated in fraction of seconds containing risk assessment and management mitigations after submission of complete information by the end user. The system operation is shown in Figure 7.

The designed and developed OHHRAS results suggest that the exposure to environmental, socioeconomic, and occupational health hazards is strongly associated with the prevalence of ill health behaviors among volunteers irrespective their gender, habits of tobacco consumption, education, and socioeconomic status. For example, through this system, it has been observed that the association of ill health in about 48% of volunteers with occupational exposures and confounding factors such as malnutrition, education, and social well beings. The prevalence of unhealthy status was also found to be associated with the air pollution including in occupational setups as well as indoor environment due to few combustion practices. The persons using coal, Kanda, wood as a fuel were more prone to lung and respiratory disorders.

DISCUSSION

We discussed the demographic, physiology, and disease associated data in this section, that all warrant that the objectives envisaged are fulfilled. Since, we have been able to design and develop a comprehensive health survey form for offline survey and analysis for different variants of human volunteers. The statistics and trends received from these offline survey shows a mirror image with homology of more than 95% when we analyzed the same data using our online survey tool. The online survey health risk assessment tool is working fine up to the level of high satisfaction and dynamically updating the database and all range of possible calculations. Based on the perennial study now culminated as a comprehensive website (http://www.healthriskindia.in) gazetting many desired tools required for any human health risk assessment such as Health Survey (online data collection and health survey), Health Status (to know current human health status of individual users), and Biocalulators (to calculate the various health indices and experimental endpoints with precision). Besides these core feature, our website also have number of allied information that makes it more interactive and resource centre for range of persons starting from school children to top management of any organization.

We hosted our online health risk assessment survey form through our website (http://www.healthriskindia.in) in June, 2011. It is important to note that in such as short span of less than 100 days, there are more than 3000 hits and over 500 online surveys by the individuals across the country. It is further to note down that the hits to website were from age range between 15–75 years, both genders, almost every corner of the country, different castes and religion with different educational and socioeconomical backgrounds. This data clearly indicate that we have addressed an issue of every body's life and need of the hour. More interestingly, the nonresident Indians scattered across the globe have also shown their interest and field up their information the database and appreciated well. In the scientific front, the online information is showing conformity and well correlation with the prior art information available through the epidemiological surveys in the past on the issues addressed.[9,10]

Though, there is a limitation of online health survey system that the computer literacy is not adequate in country like India but we can predict that 10 years down the line both existing and future generation will be fully acquainted with the use of such kind of application based approaches. For instance, in future these online survey systems can be linked with the database of unique identification, a mandatory requirement for every Indian individual. In other instance, if we look at past 15 years back, a handful of mobile users were there in India but today we have highest number of mobile users in the world. So, nobody can predict that will happen to this. In silico revolution in the country in coming 5 years. We do hope that like the mobile system, there will be no need of any formal education or training to operate the online survey systems like ours.

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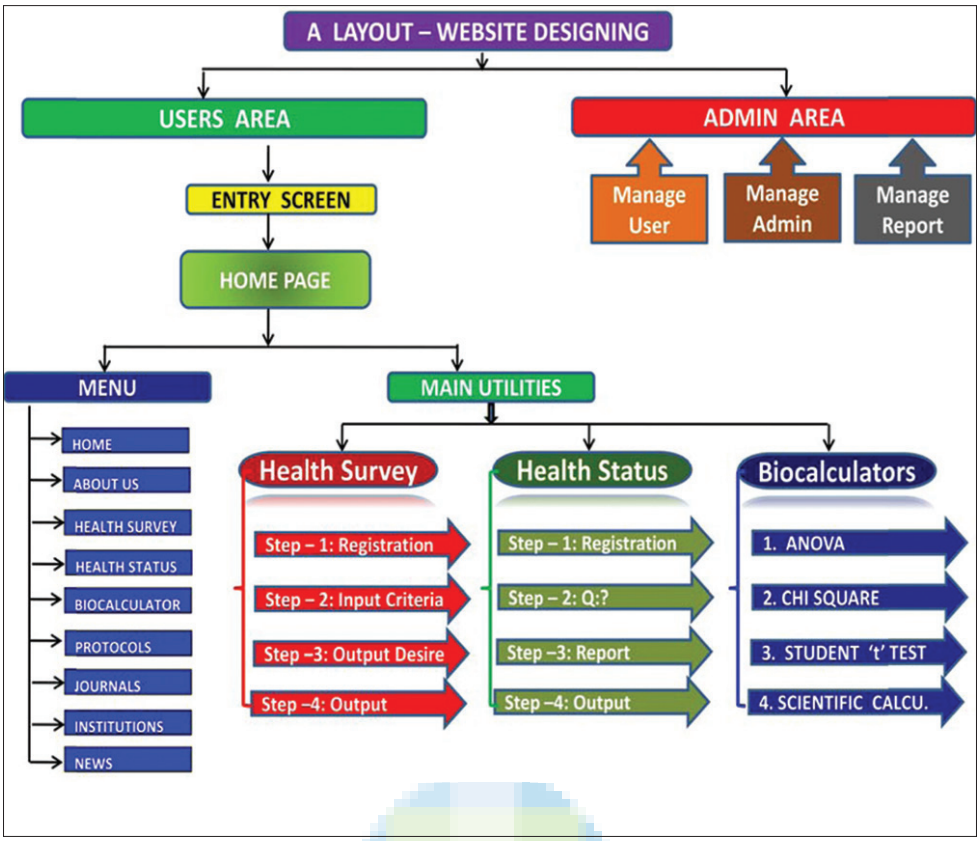


Figure 6: A layout of website for the human health risk assessment system



Figure 7: Diagram showing the system operation (overall)

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CONCLUSION

An OHHRAS designed and developed and made available for the general Indian population through a database-driven website that is http://www.healthriskindia.in may be useful for the regulatory agencies at national and regional levels, researchers, corporations for making policy strategies to prevalent diseases at local level. This online system may be used as resource centre for number of scientific and academic activities for researchers, academia, students, and general masses of all sectors.

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