

## Development of a virtual learning environment addressing adverse events in nursing<sup>1</sup>

Rosicler Xelegati<sup>2</sup>

Yolanda Dora Martinez Évora<sup>3</sup>

The authors have developed a Virtual Learning Environment (VLE) addressing the management of adverse events to promote continuing education for nurses, including the following themes: pressure ulcer, medication errors, phlebitis, fall, and loss of nasogastroenteral probes. The pedagogical framework was grounded on the information processing theory and this applied study used the Computer Assisted Instruction (CAI) model to develop the program. The environment was developed with HTML language through Microsoft Office Word 2003®. The authors developed evaluation exercises in each module through the Hot Potatoes program, version 6.0 for Windows. The conclusion is that the methodology utilized was appropriate for achieving the proposed objectives. In the future, the authors will assess the developed product and verify the possibility of using it in nursing services.

Descriptors: Nursing; Sentinel Surveillance; Software; Distance Education.

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<sup>2</sup> RN, M.Sc. Nursing, Escola de Enfermagem de Ribeirão Preto, Universidade de São Paulo, WHO Collaborating Centre for Nursing Research Development, SP, Brazil. E-mail: rxelegati@eerp.usp.br.

<sup>3</sup> RN, Ph.D. in Nursing, Full Professor, Escola de Enfermagem de Ribeirão Preto, Universidade de São Paulo, WHO Collaborating Centre for Nursing Research Development, SP, Brazil. E-mail: yolanda@eerp.usp.br.

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Corresponding Author:

Rosicler Xelegati  
Universidade de São Paulo. Escola de Enfermagem de Ribeirão Preto  
Departamento de Enfermagem Geral e Especializada  
Av. dos Bandeirantes, 3900  
Monte Alegre  
CEP: 14040-902, Ribeirão Preto, SP, Brasil  
E-mail: rxelegati@eerp.usp.br

## **Desenvolvimento de ambiente virtual de aprendizagem em eventos adversos em enfermagem**

O estudo teve como objetivo desenvolver um ambiente virtual de aprendizagem (AVA) sobre gerenciamento em eventos adversos, para educação permanente de enfermeiros, abordando as temáticas: úlcera por pressão, erros de medicação, flebite, queda e perda de sonda nasogastroenteral. O referencial pedagógico foi fundamentado na teoria de processamento de informação e a metodologia, uma pesquisa aplicada, utilizou o modelo de desenvolvimento de programas de instrução auxiliada pelo computador (CAI). O ambiente foi desenvolvido na linguagem HTML, utilizando o programa Microsoft Office Word 2003®. Os exercícios de avaliação, inseridos em cada módulo, foram criados pelas autoras deste estudo, com a utilização do programa Hot Potatoes, versão 6.0, para Windows. Conclui-se que a metodologia adotada foi adequada para o alcance do objetivo proposto. Como metas futuras, as autoras avaliarão o produto desenvolvido e verificarão a possibilidade de seu uso nos serviços de enfermagem.

Descritores: Enfermagem; Vigilância de Evento Sentinela; Software; Educação a Distância.

## **Desarrollo de ambiente virtual de aprendizaje en eventos adversos en enfermería**

El estudio tuvo como objetivo desarrollar un ambiente virtual de aprendizaje (AVA) sobre administración en eventos adversos para educación permanente de enfermeros, abordando las temáticas: úlcera por presión, errores de medicación, flebitis, caída y pérdida de sonda nasogastroenteral. El marco pedagógico fue fundamentado en la teoría de procesamiento de información y la metodología, una investigación aplicada, utilizó el Modelo de desarrollo de programas de Instrucción Auxiliado por Computador (IAC). El ambiente fue desarrollado en el lenguaje HTML utilizando el programa Microsoft Office Word 2003®. Los ejercicios de evaluación de cada módulo fueron creados por las autoras de este estudio con la utilización del programa Hot Potatoes versión 6.0 para Windows. Se concluyó que la metodología adoptada fue adecuada para el alcance del objetivo propuesto. Como metas futuras, las autoras evaluarán el producto desarrollado y verificarán la posibilidad de su uso en los servicios de enfermería.

Descriptorios: Enfermería; Vigilancia de Guardia; Programas Informáticos; Educación a Distancia.

## **Introduction**

Given the rapid development of computer science currently in the world, computer technology tends to be routinely used in all areas of knowledge, including health and education, which in turn have experienced increasing changes given the current global computerization process.

The internet has a high level of connectivity that enables rapid access and sharing of information. Search engines, e-mail, access to databases, forums, videoconferences and homepages are some of the

resources available. The distance between educational centers and researchers is minimized, enabling an increased exchange and development of studies<sup>(1)</sup>.

Distance education has also greatly benefited from this optimization of resources from the Internet. The creation of sites intended for distance education in nursing enabled professional qualification and continuing education of professionals and professors<sup>(2)</sup>.

Appropriating new education technologies and monitoring current ones, nurses have researched

and developed distance learning courses, websites, educational software, learning virtual environments, among others.

The search for knowledge to improve nursing health care is a daily quest and the adoption of new technologies would greatly favor professionals' continuing education. Many issues relevant to care, such as adverse events, could be learned and discussed in virtual environments.

Adverse events are defined as non-intentional injuries that result in temporary or permanent disability and/or prolonged hospitalization or death as a consequence of health care delivery<sup>(3-4)</sup>.

The magnitude of the problem that involves the occurrence of adverse events and its consequences is still poorly investigated in Brazil, even though the National Sanitary Surveillance Agency (ANVISA) has taken the initiative to report adverse events caused by medication (pharmaco-surveillance), hemotherapy (hemosurveillance), and equipment and medical-hospital items (technosurveillance)<sup>(5)</sup>.

The analysis of adverse events is an essential tool to indicate the quality of nursing care and it has currently been used as an indicator of care results by organizations such as: Commitment to hospital Quality (CHQ), National Accreditation Organization (NAO) and Joint Commission on Accreditation of Healthcare Organizations (JCAHO).

Based upon the preceding discussion, the following guiding question emerged: "Does the use of new educational technologies such as a Virtual Learning Environment (VLE) work with the service of continuing nursing education to prevent the occurrence of adverse events?"

The general objective of this study was to develop a VLE concerning the management of adverse events focused on the continuous education of nurses working in health care services. We opted to include pressure ulcers, medication errors, phlebitis, falls and loss of nasogastroenteral probe, disregarding events that occur in specific units such as accidental extubation in intensive care units and perioperative injury in surgical centers, among others.

## Method

The pedagogical reference of this study is based on the theory of information processing, which holds that the individual learns in the face of successive treatments

of information, including processing of information in the mind. There are eight learning phases in this theory: attending, motivation, apprehension, acquisition, retention, retrieval, generalization, performance and feedback<sup>(6)</sup>.

This is an applied study that focuses on discovering an immediate problem. The final goal is the scientific planning of change required by the identified situation<sup>(7)</sup>.

The VLE was constructed using a three-stage Computer Assisted Instruction (CAI) model to develop programs: 1. Initial planning; 2. Planning and development of instructional content; 3. Evaluation and review<sup>(8)</sup>.

CAI programs can be classified into the categories: Exercise and Practice, Tutorial and Simulation, and Problem Solving. The tutorial uses branch techniques that permit users to move from an easier leaning level to a more difficult one and the non-linear "interactive book" structure that encompasses resources such as interactions of hypertexts, videos, sounds, static images or animation, among others<sup>(9)</sup>.

This study opted for the category Tutorial as "interactive book" of non-linear structure. During stage 1 the target public was characterized, the theme was chosen, and the educational objectives and available resources were defined, as well as the instructional design and modeling techniques. In stage 2, content was developed in modules constituted by the following structures: identification of the module, learning objectives, content, exercises, references and support texts.

The VLE was developed in Hyper Text Markup Language (HTML) language using Microsoft Office Word 2003<sup>®</sup>, since this is the best language for developing websites.

The content of the presentation and of the five modules, as well as the evaluation of exercises included in each module, were developed by the study's author. The content was formatted in Microsoft Office PowerPoint 2003<sup>®</sup> and the exercises in Hot Potatoes for Windows version 6.0.

## Results

A VLE addressing adverse events in nursing services is available at <http://www.eerp.usp.br/nepien/eventosadversos>. Figure 1 presents the environment navigation structure.

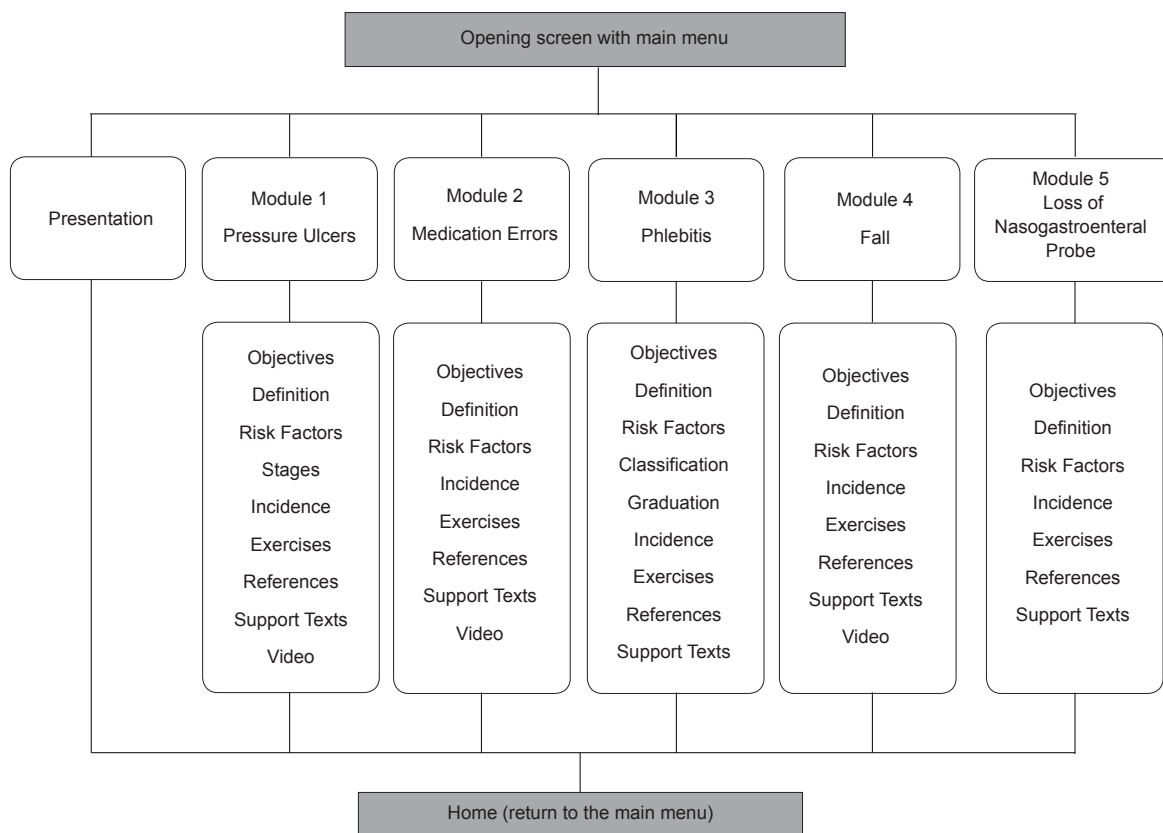


Figure 1 – VLE navigation structure addressing Adverse Events in Nursing Services. Ribeirão Preto, SP, Brazil, 2010

The environment developed is presented on an opening screen containing the title, authorship, and main menu, which includes the presentation and navigation to the five modules (Pressure Ulcers, Medication Errors, Phlebitis, Fall, Loss of Nasogastrintestinal Probe).

The environment is composed of approximately 123 pages (HTML language): one is the main menu and six are considered sub-menus that guide the themes of interest. The link 'Presentation of the Main Menu' contains a welcome message to users, the description of the environment's general objective, content to be navigated, and three links—two national and one international— and organizations involved with the studied theme.

On the access screen of each module, the user finds learning objectives, the definition of the adverse event in question, risk factors that predispose the occurrence of such an event, incidents of the event, fixation exercises, references used in constructing content, and support texts indicated to improve the theme. There are also hypertext links for specific module content, such as the link for stages in module 1 (pressure ulcers) and classification and graduation in module 3 (phlebitis). It is worth noting that links of videos were made available

for modules 1 (ulcer pressure), 2 (medication errors) and 4 (Fall).

Aiming to promote interactivity and provide feedback to the VLE users, the Exercises link offer three fixation exercises for each module: one in the format of crossword puzzles and two in the format of a multiple choice test.

## Discussion

VLE are computer systems available on the internet, intended to support activities mediated by information and communication technology. Such environments allow integrating multiple media, languages and resources, presenting information in an organized manner, developing interactions among people and objects of knowledge and developing and the socializing of productions. The activities are developed at the time, speed, and place of each participant according to each one's purpose<sup>(10)</sup>.

Digital learning environment resources enable the management of information according to a pre-established organization criterion defined according to the characteristics of each software program. These programs have information databases represented

in different media (such as texts, images, videos, hypertexts) interconnected with texts, internal or external, in the system<sup>(10)</sup>.

The representation of information in hypertexts with the use of distinct media and languages permit breaking with static and linear sequences of a one-way route, with a previously fixed beginning, middle and end. A hypertext makes available a range of possibilities of information that allow a reader to interconnect information according to his/her interests and needs, navigating and constructing his/her own sequences and routes. When the user jumps among groups of information and establishes his/her own connections and associations, s/he interacts with the hypertext and can assume a more active role than merely reading a text in the linear space of a printed material<sup>(10)</sup>.

The use of hypertext in the nursing field has great potential for professionals who work in direct care with patients. It can be employed as a rapid means to access clinical information and guidance concern nursing care<sup>(11)</sup>.

The use of hypertexts in the environment in question enables a greater level of interactivity of users with the resource as well as the creation of non-linear sequences of study or consultation, in which the starting point of the visited subject can also be the point of arrival. The use of hypertexts enables users to navigate quickly through a great quantity of information.

The use of VLE configures a new educational possibility that can be explored by nursing professionals, be it in teaching at universities or in continuing education provided in services.

In addition to competencies already employed during their activities, nursing professionals are being required to show new competencies to meet political, social, and productive transformations of human work. Hence, such professionals need to acquire knowledge concerning new resources enabled by computer technologies in their field as a source of information and strategies of action<sup>(12)</sup>.

This virtual learning environment on "Management of Adverse Events in Nursing Services" was created to follow the tendency of introducing new technologies in nursing teaching as part of the continuing education of nurses.

During the development of this environment the following stages were followed in the process of creation: development of content, programing, navigation tests and creation of an interface.

When the diagram of navigation of a VLE interface is examined as a whole, it may shown to the author

to determine whether the elements of the program are where they were expected to be, whether the questions are being used at appropriate intervals, and whether there is balance between the visual and textual aspects of the program<sup>(8)</sup>.

An interface is defined as a connection between the system and the user, the means that allows access to the system. When defining an interface, one has the responsibility to demonstrate, through icons and menus, the entire content of the VLE, all its functionalities, to minimize the resources available in the system. However, it is not advisable to show the content in a single screen, since it would cause an excess of information, possibly confusing the user<sup>(13)</sup>.

To construct the interfaces, rules and techniques of interface are utilized that cover characteristics such as: layout, size and representations of icons, colors, balance of objects arranged on the screen and other important points to obtain applications with visual resources at an acceptable level of interactivity<sup>(8,14)</sup>.

Each module in this environment has a similar layout of elements and titles; the links among the screens are highlighted with different colors and with fonts larger than the normal text. We opted to reveal content over several pages to avoid an excess of information in a single screen and enable greater interactivity for the user.

Language used in the interfaces should be simple; clarity, objectivity, and accessibility are the most important characteristics in language offered by distance education environments. The purpose is to make content more accessible to users, so they learn and easily advance through the program<sup>(15-16)</sup>.

The advantage of using the HTML language, that is, hypertexts, is the possibility to rapidly navigate through a large quantity of information. It allows exploring the subject in a non-linear manner, because access to texts of interest occurs through simply clicking on the desired link<sup>(17)</sup>.

Some authors highlight the use of techniques that facilitate study in environments through the Web, such as: the style of language adopted should be simple and adapted to normal usages; sans serif fonts (Arial, Verdana, and Tahoma) should be used because these are more readable on screen; paragraphs and sentences should be short; the usage of hyperlinks at the end of each screen should be encouraged; massive bodies of information should be divided into parts; quantity of text per screen should be limited; citations and bibliographies should come from reputable sources, among others<sup>(15-16)</sup>.

The same information should appear in the same position on the screen during an activity or in various activities of a module. The use of various windows offers the user the advantage of accessing multiple sources of information. An activity may be identified through the title of the activity, the option in use marked in the menu or by icons. Links should be clearly indicated to the users, presented in colors and styles different from the standard text<sup>(16)</sup>.

In relation to the use of colors in the interface, these should be sparingly used in order to avoid distracting users from the main objective. It is not advisable to use dark background colors or textures that may reduce the readability of the text or interfere when users print the material<sup>(16)</sup>.

Only three colors were used in the title fonts, content and links. The background was white (except for the exercises screens, in which two light colors were used).

In relation to the inclusion of exercises, some authors assert that the use of this resource enables users to evaluate knowledge they acquire and that responses provide feedback concerning their learning<sup>(18)</sup>. Users can verify the answers of each exercise proposed in this VLE and obtain their percentage of right answers.

There is literature in the field highlighting that the inclusion of videos in education evokes an immediate response from users. Such a reaction may be determinant in motivating users to engage in a given task<sup>(16)</sup>.

Based on guidelines for the development of virtual learning environments, some nurses and professors from the nursing field have taken the initiative to construct such environments.

The author of a VLE addressing the teaching of physiology in a nursing teaching diploma program highlights that, with the use of this type of technology, students have a supply of different learning styles available for given content in multiple formats and sequences, and are able to choose the most convenient one<sup>(19)</sup>.

Researchers who developed a VLE for a vocational nursing program encouraged educators and students to navigate through the large supply of possibilities of information and to work with the knowledge available whether through the internet or existing technological means, not only to aid the teaching-learning process but also to develop future professionals, especially in the nursing field<sup>(12)</sup>.

We highlight that the development of a VLE is a strategy that still needs to be better developed and requires further studies to validate methodologies and educational strategies specific to nursing<sup>(20)</sup>.

The VLE addressing "Management of Adverse Events in Nursing Services" will undergo technical and content evaluation to be used in the continuing education of nurses.

## Conclusion

Given the results found for the proposed objectives, we conclude that the search for knowledge within the subject of Adverse Events reveals how to produce quality and safe nursing care for professionals and also that the use of a new educational technology such as a VLE is an innovative strategy and a change of paradigm in the qualification of professionals in health institutions.

The development of a virtual learning environment addressing the management of adverse events approaching the themes of pressure ulcers, medication errors, phlebitis, falls, and loss of nasogastric probes will contribute to sensitizing nurses in relation to the types of events, risk factors, classification, and incidence of such events.

It is worth noting that the pedagogical reference grounded in information processing theory, as well as the methodology using the model Computer Assisted Instruction for developing programs proved to be appropriate for the development of this study.

This study's objective was achieved and the VLE entitled "Management of Adverse Events in Nursing Services" can be fully consulted at: <<http://www.eerp.usp.br/nepien/eventosadversos>>. The development of this environment still requires significant work because there is a need to deepen the theme both in the pedagogical aspects and in relation to technical resources.

The limitations found in the development of this study are related to a lack of illustrative material and videos depicting adverse events. Additionally, the cost of producing online educational material is high, and may restrict initiatives to create such materials in the field of nursing.

The authors will in the future proceed with the technical and content evaluation of the VLE "Management of Adverse Events in Nursing Services," aiming to use this educational material in the continuing education of nurses in health institutions.

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