Virtual Internet Patient Simulation: paving the way from sound pedagogical design to popularity

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VIPS: What, Why and When?

"Computers are useless. They can only give you answers." (Pablo Picasso)
Virtual Internet Patient Simulation (VIPS) is a computer-based training system that allows medical educators (self-proclaimed or otherwise) to build virtual patients capable to take part in Web-based simulated consultations that challenge the learner's clinical reasoning and decision-making skills. Recognising the primary importance of managing the context of uncertainty inherent to ambulatory medicine, VIPS focuses on *the question***s** one may ask and *the decisions* one has to make during a consultation, rather than on *the answers* that describe symptoms, conditions and treatments [1].

In other words, VIPS neglects the descriptive paradigm (ie systematic medical history, physical examination and investigations) in favour of the operational paradigm (ie what information is useful in the present context to make the right decisions). Few medical educators would argue against such an approach. In fact, with regards to clinical reasoning, the theoretical and practical foundations of VIPS are similar to those underlying live standardised patient (SP) programs, whose benefits are well documented [2]. Moreover, initial studies have indeed shown that VIPS holds the promise of effective learning [3] and high learner satisfaction [4].

The VIPS prototype was initially released as a combined Internet/stand alone application in 1999, using the best software technologies available at that time (Java Applet and Visual Basic) [5]. Over the next four years, the prototype underwent numerous evaluations, tests and revisions, culminating in the release of the current industry-grade version. As of today, some 50 VIPS cases have been created, both for continuing medical education (CME) and undergraduate formal education, catering to different target learners, in four different languages, operating in different contexts, often within the framework of pilot projects each with its own specific features.

This paper briefly presents the main original features of VIPS and the first lessons learned from our attempts to render the system popular among different users.

Anatomy of a VIPS consultation

"Anatomy is destiny" – Sigmund Freud
To the uninitiated that expect a virtual patient with convincing multimedia-rich, three-dimensional features that simulate a real human being, the first encounter with a VIPS patient will certainly be a disappointment. A VIPS patient is merely represented by a small photograph and a few sentences describing the chief complaint. As for the VIPS consultation itself, it consists of a user-defined series of inputs (questions or decisions) and software-generated outputs (patient answers or outcomes).

However, working up a VIPS case is much more realistic than what meets the eye. Just like in a real consultation, the learner must actively seek answers from the patient: no unsolicited information is ever communicated to the learner. The absence of any type of hints is probably the single most important feature of VIPS that sets it apart from most case-based educational resources on the Web. This feature is also essential to elicit unbiased clinical reasoning, which is (at least) a two-stage process: the first stage is the choice of the appropriate questions that need to be asked and the second stage is the correct interpretation of the answers that are obtained [1].

History taking

The requirement for VIPS to provide information only in response to user inquiries posed a specific technical problem when the software was initially developed; during the history taking phase of the consultation, the program had to recognise all reasonable questions that the user would formulate in free text format. A priori, this problem could have been solved by implementing a (never identified) sophisticated mechanism relying on some medical "knowledge" transferred to the program or by finding a simpler solution.

This second option was chosen and successfully implemented. It relies on developing a set of keywords, or more precisely key strings of char-

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Figure 1. *The left-sided panel of the VIPS consultation window which illustrates a typical result of the matching mechanism between user input (free text format) and items available in the case database.*

acters linked by Boolean operators that are used to match the user's input to the available questions in the case database.

Consider the following question one may ask a patient: "Have you had this problem before?". There are a number of ways to ask this question and thus several corresponding matching strings of characters: *probl, before, past, prior, first time, recur, repetiti,* etc. Finding the right combination of strings may appear complex at first. However, because the vocabulary is relatively controlled and perfect specificity and sensitivity are not absolutely necessary, an acceptable combination is reached in a reasonable period of time through several cycles of testing (figure 1). Importantly, such type of indexing is only done once for every new question that is added during new case creation. Existing questions, along with their matching strings, are integrated into new cases automatically.

Physical examination and laboratory tests

Compared to oral questions, the physical examination phase is implemented in a much simpler manner. The patient's body is represented by a series of static two-dimensional drawings. Each drawing is implemented as an image map and each active image polygon has an associated set of examination tools or methods. For example a drawing representing the patient's face has two "eye" polygons with the appropriate examination methods (ophthalmoscope, visual acuity, palpation, etc.). The type and number of images, the active polygons and the examination tools are all specified in the case database and can thus be easily changed depending on case specifics.

Laboratory tests are implemented as a hierarchy of lists of individual tests, which take into account the actual time needed to obtain the result. For example, a white blood cell count is a quick test and the result is available immediately, while the result of a haemoculture will only become available during the next consultation. Such time dependency, while relatively unsophisticated, is an important feature of the simulator, because it forces the user to make decisions like in the real world, in the *context of uncertainty*, without necessarily having all the answers to his or her questions.

Decisions and performance evaluation

Decisions in VIPS are defined as either diagnostic actions (e.g. radiology) or therapeutic actions (treatment or referral) that can have immediate or delayed outcomes. Ending the consultation (without setting another appointment) is a special decision that leads to the evaluation phase: all items chosen by the learner are scored and the entire database of all possible user inputs/virtual patient outputs (approximately 1500 for internal medicine cases) is made available for exploration.

From a pedagogical point of view, the key feature in the VIPS evaluation is to establish an explicit link between a question or decision chosen by the learner during the consultation *(Reflection-in-action)* with validated, relevant knowledge from the literature ***(Reflection-on-action)***. This two stage process complies with Donald A. Schön's theory of the "Reflective Practitioner" [6], a canonical reference among educators in healthcare and other professional domains.

At the end of a VIPS session, the user may request a certificate of completion for any of the consultations that he or she has previously completed.

VIPS: what's under the hood?

Structure is more important than content in the transmission of information – Abbie Hoffman

As a software product, VIPS is comprised of four distinct components:

VIPS Virtual Patients

A single VIPS patient is defined by a database of author-rated physician questions and patient responses, diagnostic or therapeutic actions and patient outcomes. All pertinent items are linked to author comments and local or distant medical knowledge references in HTML format.

VIPS patient databases are built and maintained with Microsoft Access, but all data are serialised prior to the compilation of any given VIPS case and subsequent publication on the Internet. Such serialisation insures easy storage and transport across broad and narrow-band Internet connections and optimises overall performance.

The VIPS Simulator

The VIPS simulator is a 100% Java server application modelled with the Unified Modelling Language (UML), facilitating any type of customisation and upgrading. This component allows any user with an Internet connection and an Internet Browser to carry out virtual consultations. A stand-alone version for off-line use is currently under development.

The VIPS Web server

The current VIPS web server (Apache/Tomcat/MySQL) includes all the necessary utilities to publish and maintain VIPS cases, manage registered users, requests for certificates, statistics and other back-office functions.

The VIPS case editor

A case editor is available for potential authors interested in creating their own cases. Our experience has shown that the architecture and the methodology of the VIPS patient database allow rapid creation of new cases, providing that the learning objectives and the case scenario are well defined by the author. Very often, defining a quality learning objective proves to be the rate-limiting step.

VIPS: different uses and different opinions

People can have many different kinds of pleasure. The real one is that for which they will forsake the others. – Marcel Proust

Careful instructional design, proven didactic value, innovative technology, quality content and official accreditation are all futile accomplishments if in the end, the product is not adopted by the intended users. As many creators of e-learning products have discovered, the pathway to popularity is anything but a straight highway.

Because VIPS is ultimately only a tool for managing virtual consultations, it can operate in a number of different contexts. Our current experience with different VIPS implementations does provide two main clues as to what may render the system popular or not.

Synchronous, multiple user VIPS sessions in a live setting

Unsurprisingly, off all channels of delivery, a workshop-like context where several users carry out VIPS consultations in the presence of a moderator prove to be the most rewarding. With very few exceptions (individuals that simply dislike computers), the participants appear very enthusiastic about VIPS and the opportunity to use this tool in the future. VIPS software characteristics (user interface and ergonomics) in particular, are perfectly adequate.

Interestingly, workshops organized for potential VIPS authors are particularly well received. The principal learning objective of such workshops is to learn what it takes to become a VIPS author. Because the approach is patient-centric, it sheds a unifying, strongly pragmatic light on notions that are often taught as disparate topics: evidence-based medicine, intelligent use of PubMed and other medical search engines, critical appraisal of retrieved information, reflective practice in medicine, etc.

Asynchronous, individual, distant VIPS sessions

A small number of VIPS cases are freely accessible on the VIPS website upon rapid registration. The context is thus identical to that of any number of e-learning offerings found on the Internet that have no "push" component. The results are somewhat surprising: while new user registration is an ongoing, uninterrupted process, requests for CME certificates (offered free of charge) are

extremely rare. Moreover, the majority of users carry out one single test consultation and fail to return to the web site. At the same time limited feedback obtained from users is usually positive, although certain users complain about the complexity of the user interface and a feeling of being "left without any guidance" in the middle of a consultation.

Conclusion

The value of an idea lies in the using of it. – Thomas A. Edison

While VIPS can be used in a number of different settings (workshops, isolated online CME, bundling with other educational material, performance profiling, undergraduate education, etc.), we believe it is most useful in two situations:

– As a means to expose learners in a harmless and pedagogically stimulating manner to errors known to have significant impact in medical practice.

– As a means to train and test clinical reasoning and decision making processes. It may in fact elegantly complement live SP encounters, which may then focus primarily on other crucial aspects of a medical consultation (communication and physical examination skills).

The issue of popularity is of course critical. Based on our experience, we hypothesise that VIPS is a good illustration of how a quality educational product can fail to engage learners when it is offered as pure "e-learning", and yet clearly satisfy users when used in a "blended learning" format.

At this stage of VIPS development it may be interesting to substantiate this hypothesis with real data. To this aim, we have created a short survey on our website for those readers who wish to discover VIPS for themselves and help us pave the way to popularity.

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