Development of an educational research software with advisory role in the clinico-biochemical evaluation of hyponatremia

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Abstract

Background: The diagnosis of hyponatremia is not always easy due to the diversity of underlying disease states associated with the condition.
Objectives: The aim of the present study was to develop a novel, free, simple stand alone educational research software (ERS) to assist students of medicine and healthcare sciences in understanding the diagnostic evaluation of hyponatremia.
Materials and methods: The software was designed using: a) Microsoft Windows as operating system, b) C# .NET (4.0) as software component (plug-in), and c) C# (C Sharp) as (object-oriented) programming language. It can be distributed on Compact Disk (CD) and be run on any Personal Computer (PC) on Windows.
Results and discussion: The developed software-which we have called DHS (Delimaris Hyponatriemia Software) v.1.0- doesn't demand special skills and expertise in computers. When the user logs into the system, a default page becomes visible with data in Greek language. Its instructional advantages (reasoning for usage) include mobilizing the user's interest, encouraging remembrance of the necessary teaching material, supporting training guidance and evaluation, practice over the timetabled program, and skill estimation.
Conclusions: The free (ERS) could be a advantageous training tool in medical and healthcare education. Prospective work should center on additional assessment of its accuracy, its practicality on the teaching procedure and its approval by the healthcare students or professionals.

Keywords: plasma sodium, medical informatics**,** medical education, digital learning.

I. Introduction

Hyponatremia is defined as a decreased plasma Na^+ concentration (<136mmol/L). Its incidence is considered to be between 29 and 42% (Gross, 2008). Hyponatremia typically manifests itself clinically as nausea, generalized weakness, and mental confusion at values < 120 mmol/L, and severe mental impairment between 90 and 105 mmol/L (Burtis et al., 2012). It can occur with a decrease in total body Na^+ (hypovolemic hyponatremia), a near normal total body Na^+ (euvolemic hyponatremia), and an excess of total body Na^+ (hypervolemic hyponatremia) (Schrier & Bansal, 2008).
Despite frequently observed in hospitalized patients, the diagnosis and management of hyponatremia is neither easy nor optimal. This may be attributable to the diversity of underlying disease states associated with the condition. In practice, interpretation of clinico-biochemical findings is difficult due to a combination of the complex, multifactorial etiology encountered frequently (Mocan et al., 2016). The aim of the present study was to develop a novel, free, simple stand alone educational research software (ERS) to assist students of medicine and healthcare sciences in understanding the diagnostic evaluation of hyponatremia.

II. Materials and methods

System Design

The design of the system was initially done on paper with all the relevant stages and data processing outlined clearly. The mathematical algorithms were detailed in simple English language for easy of programming (Delimaris & Delimaris, 2014).
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Implementation

The minimum hardware requirements for the (ERS) is a Pentium 4 processor (Intel) or equivalent and 1 GB of random-access memory. The required operating system is Windows XP Service Pack SP 2 or later (Microsoft), and the required software component (plug-in) is C#. NET (4.0). Other computer requirements are: color graphics screen; hard disk drive; mouse; and CD ROM drive (Delimaris & Delimaris, 2014).

Development

Clinico-biochemical data for hyponatremia were collected from a clinical biochemistry textbook (Marshall et al., 2014) and further evaluated from Internet biomedical databases. Control commands were added using C# (C Sharp), an object-oriented programming language developed by Microsoft. The developed software can be distributed from one Personal Computer (PC) to another using a flash drive, a compact disk, or any portable medium (Delimaris & Delimaris, 2014).

Testing

Software testing was performed so as to determine and minimize faults that failed on execution. Before the (ERS) was released, we did several in-house tests, defect fixes and design updates. Then, we released the (ERS) for evaluation by users who were informed of its trial status. During this phase, users provided needful feedback and gave us a better understanding of how they were using the (ERS). Once in-house testing and evaluation from users (which represent internal and external views of the (ERS) respectively) was finished, we released (ERS) for educational research use (Delimaris & Delimaris, 2014).

III. Results and discussion

The developed software-which we have called DHS (Delimaris Hyponatriemia Software) v.1.0- doesn't demand special skills and expertise in computers. When the user logs into the system, a default page becomes visible with data in Greek language (Delimaris & Delimaris, 2014) (Figure 1, 2, 3).

The use of an educational software increases the active participation of students in the learning procedure, promotes discovery learning, creates a collaborative environment, and reduces learning time. It addresses the students' specificities by suggesting learning models with different rates of learning, while it offers new imaging capabilities of difficult concepts contributing to their better understanding (Theodoropoulos, 2009).
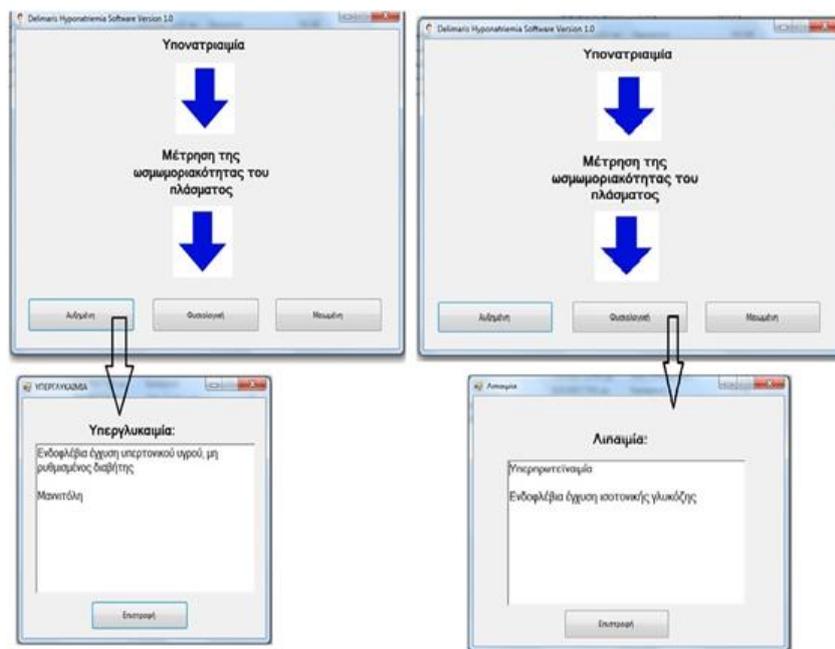
Figure 1. An example - illustration of the screen from the DHS v.1.0. When the user selects a button, the program performs a specific action. Just after the levels of plasma osmolality have been selected (high and normal levels) the system indicates the most common causes for hyponatriemia.
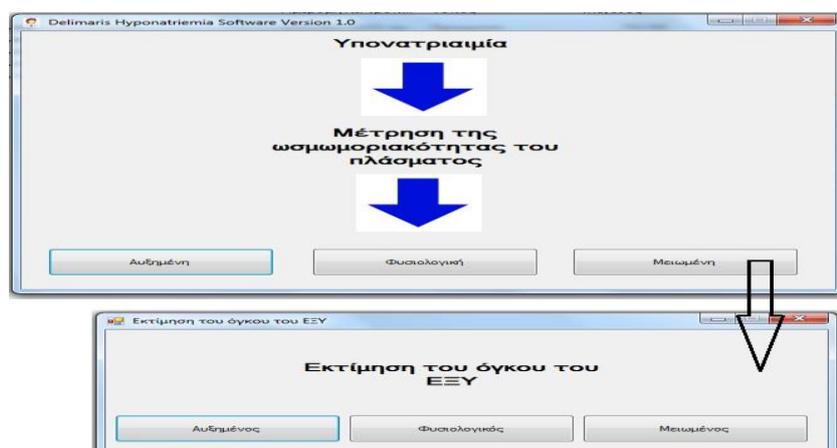
Figure 2. An illustration of the screen from the ERS that appears when the low levels of plasma osmolality have been selected. As results, the system indicates that an additional test (the volume of the extracellular fluid) must be estimated.

Using an educational software the teacher's role is not invalidated, but it becomes more complex and more demanding, as from the role of the information presenter passes to the potential role of the learning process coordinator. Moreover, when the teacher organizes a teaching activity using novel technologies he/she encourages the self-motivation and cooperation of the students, and acts more as advisor and mentor rather than as a speaker and presenter (Theodoropoulos, 2009).
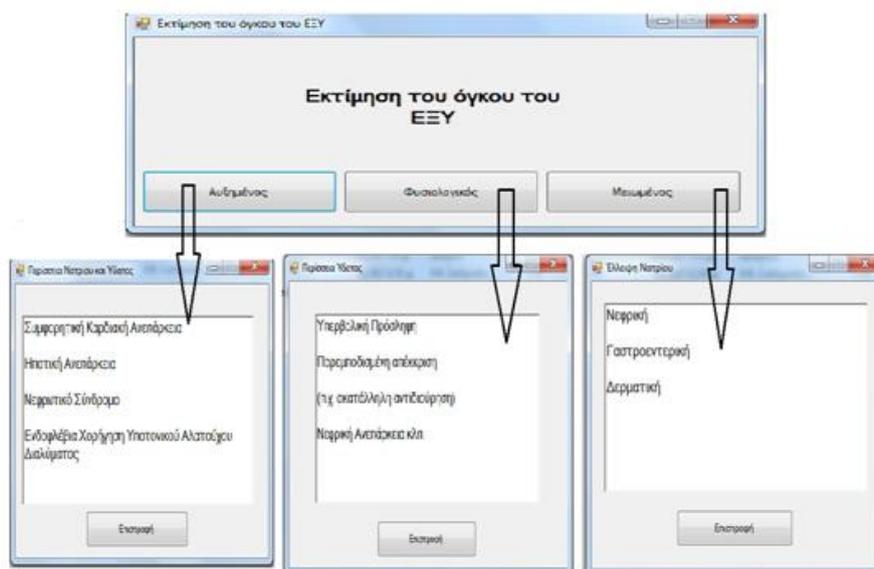
Figure 3. An illustration of the screen from the ERS that appears when the levels of the volume of the extracellular fluid have been selected (high, normal, and low levels, respectively). As results, the system provides the most common causes for hyponatriemia.

The instructional advantages of (ERS) include mobilizing the user's interest, encouraging remembrance of the necessary teaching material, supporting training guidance and evaluation, practice over the timetabled program, and skill estimation (Delimaris & Delimaris, 2014). When used properly, the computer can be an efficient learning resource, not only for the transfer of knowledge but also to help medical/healthcare students develop their problem-solving skills. Computer-aided learning is a very important learning support that warrants better concentration in healthcare education (Devitt & Palmer, 1998).

IV. Conclusions

The free (ERS) for understanding the diagnostic evaluation of hyponatremia could be a advantageous training tool in medical and healthcare education. Prospective work should center on additional assessment of its accuracy, its practicality on the teaching procedure and its approval by the healthcare students (in medicine, life sciences, medical technology, dietetics, etc.) or professionals.

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