A Training Tool to support the management and diagnosis of Sjögren's syndrome

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ABSTRACT

Objective. *The objective of this work is to present a Training Tool designed to support healthcare professionals involved in the diagnosis and management of Sjögren's syndrome.*

Methods. *The Training Tool aims to fulfil the gap of targeted education by providing a structured protocol of training including state of the art guidelines and practices. For the development of the Training Tool, latest relevant technologies have been used to assure efficiency and usability. Core functionalities include training by a series of multimedia courses, testing during the learning process, and profiling for monitoring the progress. An iterative requirement analysis process was established involving a large number of clinical experts, with the objective to identify user's training needs.*

Results. *Comprehensive usability evaluation was performed by applying, an Unmoderated Remote Usability Test resulting to 97.2% Success Rate; and the well-established System Usability Scale, reaching a score of 90.4 which classifies the Training Tool as "A" graded-excellent.*

Conclusion. *The Training Tool offers open-online training of healthcare professionals involved in the diagnosis and management of Sjögren's syndrome, using a well-designed training protocol in highly usable manner. To our knowledge, this is the first such tool for Sjögren's syndrome.*

Introduction

Sjögren's syndrome (SS) can be difficult to diagnose, even for experts, because the signs and symptoms vary from person to person and can be similar to those caused by other diseases (1). Side effects of a number of medications also mimic some signs and symptoms of SS (2). Early identifying SS patients can be difficult, resulting in delayed therapy provision and sometimes complications. Moreover, healthcare providers are challenged to maintain their professional competence in an ever-changing environment characterised by a continuing evidence expansion. To this end, the developed Training Tool aims to fulfil the gap in the support of SS diagnosis and management (3), since to our knowledge it is the only open-Training Tool in the field. The protocol of training in terms of scientific material was conducted through an iterative manner with the clinical partners of the work. The Training Tool requires user credentials to enable full access and interaction, through a simple e-mail self-based registration process. It can be launched online following the address link "https://edu.harmonicss.eu".

Materials and methods

Training Tool implementation and core functionalities

For the implementation of the HarmonicSS Training Tool the Modular Object Dynamic Learning Environment (Moodle) (4) Learning Management System (LMS) was selected, jointly with the HTML5 Package (H5P) (5) authoring tool for delivering the content. Moodle is an open-source LMS developed on the pedagogical principles of Social Constructionist Pedagogy, a learner-oriented philosophy developed by Papert (6), and is based upon Piaget's theory of constructivism (7). H5P is an open source authoring tool, providing a wide range of interactive tasks for the web, highly flexible, with cross-platform compatibilities. The combination of these technologies makes the Training Tool a powerful solution, offering efficiency and interactivity, through an easy to manage by non-ICT experts

Human Computer Interaction (HCI) environment.

The core functionalities of the Training Tool relate to the training itself, the assessment of learning objectives, and the profiling of users. The software components responsible for this functionality are seamlessly interoperating with each other in the context of the learning process. Learning material is delivered to the users, with the use of state-of-the art guidelines and practices using real patients' data, in different multimedia ways such as text, image, and video. Each course in the Training Tool has a maximum duration of 15 minutes, to ensure minimum decline of learner's attention (8). Assessment of the learning objectives, in the form of questions and quizzes have been incorporated in the learning process to evaluate the earned knowledge, making the overall experience direct and interactive. A personalised user profile area is available for monitoring the progress of the user over time.

Table I. Courses of the training tool.

No.	Short course description
	Scientific material focused on non-experts of SS
1	**General aspects of the disease**
2	**Diagnostic approach of pSS**
3	**Clinical manifestations of pSS**
4	**Classification criteria of pSS**
5	**Advanced scientific lectures of pSS**, including 7 video lectures with embedded questions: • Introduction to SS • Clinical aspects of SS • Salivary gland morphology and functions • Oral manifestations of SS and role of AQP5 in the pathogenesis of the disease • Pathogenesis of SS: role of the epithelial cells • Mechanisms of saliva formation: involvement of aquaporin-5 • Treatment and prognosis of SS
6	**Major risk factors and features of stratification**
7	**Real cases of pSS patients** • Case 1: pSS of type II (low risk) • Case 2: pSS of type I (high risk)
	Scientific material focused on experts of SS
1	**Salivary gland ultrasonography** • Salivary gland ultrasonography (SGUS) • Real patient cases with SGUS images
2	**Salivary gland biopsies** • State of the art on salivary gland histopathology • Salivary gland biopsy - Diagnostic value of salivary gland biopsy - Use of biopsies in clinical trials • Need for consensus • Validation phase of additional items to include in revised histological criteria • Limitation of current measures for use in clinical trials • Biopsies as disease biomarkers

Advanced scientific material on Sjögren's syndrome

Detailed analysis of user requirements with respect to training needs revealed the fact that users should be categorised in different classes: a) Experts of SS, referred to as expert rheumatologists; and b) Non-experts of SS, who include non-experts rheumatologists and a variety of other clinical specialists that could come across with signs and symptoms of SS, *i.e.* general practitioners, pathologists, ophthalmologists, dentists, experts in oral medicine, neurologists and gynaecologists. As a result, the courses within the Training Tool have been structured according to the type of user to which they refer, as presented in Table I. Nevertheless, the Tool allows users to enrol themselves in any of the courses, irrespective of the category they belong to.

Usability evaluation

Following the development of the tool and prior to delivering the tool to end users, a thorough usability evaluation was performed. According to the ISO 9241-11:2018 standard (8) that focuses on the ergonomics of human-system interaction, usability is defined as "the extent to which a product or service can be used by specified users to achieve specified goals in a specified context of use, with effectiveness, efficiency and satisfaction." The Training Tool was developed in line with fundamental principles of user interface (UI) design, such as, the Jakob Nielsen's 10 usability heuristics for interaction design (9, 10). Nevertheless, usability testing is essential to complete a project's life cycle, not only for making sure that the system delivers its intended goals in a satisfactory manner, but also in order to check if the system meet user's expectations and that it matches to real-world use, to remove flaws, and to obtain user reactions and feedback. A typical usability testing pipeline includes: goal definition, script/scenarios conduction, users' recruitment, testing, and analysis of the results. Usability testing methodology has been chosen by combining the following parameters: a) Remote rather than in-person, b) Unmoderated rather than moderated, c) Assessment rather than explorative or comparative. Both quantitative (which describe metrics that represent the user's satisfaction launching the system) and qualitative (which are more behavioural oriented and describe insights, findings, and anecdotes about how participants use the system) data were gathered. Particularly, for the usability evaluation of the Training Tool an Unmoderated Remote Usability Test (URUT) was performed and the widely accepted and well established System Usability Scale (SUS) was applied (11). Twelve and thirteen participants completed the URUT and the SUS respectively.

The unmoderated remote usability testing (URUT) is a technique designed for measuring how satisfied a user is with the interface and operability of a system. It gives the opportunity for participants to work through tasks which represent scenarios of usage targeting

Table II. Task completion rates on unmoderated remote usability testing.

Scenario		1		2		3		4		5
Participants		**Task A**	**Task B**	**Task A**	**Task B**	**Task A**	**Task B**	**Task A**	**Task B**	Task A
Computer scientists	**1**	yes	yes	yes	yes	yes	yes	yes	yes	**yes**
	2	yes	yes	yes	yes	yes	yes	yes	yes	**yes**
	3	yes	yes	yes	yes	yes	yes	yes	yes	**yes**
	4	yes	yes	yes	yes	yes	yes	yes	yes	**yes**
	5	yes	yes	yes	yes	yes	yes	yes	yes	**yes**
	6	yes	no	yes	yes	yes	yes	yes	yes	**yes**
Healthcare professionals	**7**	yes	yes	yes	yes	yes	yes	yes	yes	**yes**
	8	yes	yes	yes	yes	yes	yes	yes	yes	**yes**
	9	yes	no	yes	no	yes	yes	yes	yes	**yes**
	10	yes	yes	yes	yes	yes	yes	yes	yes	**yes**
	11	yes	yes	yes	yes	yes	yes	yes	yes	**yes**
	12	yes	yes	yes	yes	yes	yes	yes	yes	**yes**
Success	**Mean 11.7**	**12**	**10**	**12**	**11**	**12**	**12**	**12**	**12**	12
Success rate (%)	**Mean 97.2**	**100**	**83.3**	**100**	**91.6**	**100**	**100**	**100**	**100**	100
Failure	**Mean 0.3**	**0**	**2**	**0**	**1**	**0**	**0**	**0**	**0**	0
Failure rate (%)	Mean 2.8	0	16.7	0	8.4	0	0	0	0	0

in specific goals by the comfort of their own environment without the need of a moderator to support the process. For the evaluation of the HarmonicSS Training Tool using the URUT technique an online form was developed which included five scenarios of use of the Training Tool, where each scenario included two different tasks that participants needed to undertake and were followed by three task-specific questions regarding their experience. The tasks covered the main functionalities of the tool and specifically: Course/ Enrolment, Tracking course progress/ Grades, Users settings, Links external/internal, and Navigation. After the completion of each task, participants were asked to feedback regarding their level of satisfaction and their statement of making changes in order to advance their experience, by grading on a 5-point rating scale (1-Strongly No, 2-No, 3-Neutral, 4-Yes, 5-Strongly Yes), in the following questions: a) "Did you find easy to complete the described task?", b) "Would you change something to make it easier?". Qualitative data were gathered, by asking the participants to reply in an open dialog box at the end of the test, regarding problems they experienced, comments/ recommendations, and their overall impression as more behavioural like data. Another quick and reliable tool for measuring the usability of the HarmonicSS Training Tool, is the System Usability Scale (SUS) (11). SUS offers reliable results on small sample sizes and can effectively differentiate between usable and unusable systems. In the context of evaluating the Training Tool using the SUS an online form was developed. SUS consists of a 10-item questionnaire, switching from positive statement to negative statement, where participants must feedback by grading on a 5-point rating scale from strongly agree to strongly disagree. Participants were instructed to either have a free launching experience on the Training Tool prior to the test, or to follow the tasks of the URUT in case they had not completed it.

Table III. Percent agreement and task ratings on URUT.

Scenario	Task	Easy completion of the task		Would change something in the training tool	
		PA	**TR**	**PA**	TR
1	**A**	91.7%	4.8	25%	**1.1**
1	**B**	83.4%	4.3		
2	**A**	100%	4.9	16.7%	**0.8**
2	**B**	83.4%	4		
3	**A**	100%	4.9	8.3%	**0.3**
3	**B**	100%	5		
4	**A**	100%	5	25%	**1**
4	**B**	91.7%	4.4		
5	**A**	100%	5	8.3%	**0.4**
Mean	94.5%	4.7	16.6%	0.72	

URUT: unmoderated remote usability testing; PA: percent agreement; TR: task rating.

Results

The Training Tool was evaluated for its usability by deploying two different online tests, the Unmoderated Remote Usability Test - URUT, and the System Usability Scale – SUS. Participants were recruited through an open call of HarmonicSS consortium members. Twelve participants completed the URUT of whom six were computer scientists and six were healthcare professionals. Thirteen participants com-

pleted the SUS of whom six were computer scientists and seven were healthcare professionals. It is evidenced and widely accepted that five participants suffice for usability testing (12). Thus, in the case of the Training Tool usability testing we can explore sufficient results from different groups of end users: computer scientists and healthcare providers who are the targeted end users.

For the URUT the following metrics were used to evaluate the usability of the Training Tool: success rate, failure rate, and satisfaction questionnaire. The success rate, also called the task completion rate, is considered to be the fundamental usability metric and it is closely interwoven with effectiveness. Once participants have completed the test, their responses are binary described with a positive statement or "1" value if the participant managed to complete the task and with a negative statement or "0" value if participant did not, as it is shown in Table II. The success rate is given by the proportion of the number of successfully completed tasks divided by the total number of tasks undertaken (equation 1) and respectively the failure rate by the number of uncompleted tasks divided by the total number of tasks undertaken (equations 2).

$$Success\ Rate = \frac{Number\ of\ Successfully\ Completed\ Tasks}{Total\ Number\ of\ Tasks\ undertaken} * 100\%. \quad (1)$$

$$Failure\ Rate = \frac{Number\ of\ Uncompleted\ Tasks}{Total\ Number\ of\ Tasks\ undertaken} * 100\%. \quad (2)$$

Results for the URUT have shown that the mean success rate was 97.2%, (Table II), while the mean failure rate was 2.79%. Based on an analysis of almost 1200 usability tasks, conducted by Sauro on 2011 (13), an average success rate was found to be 78%, way below the success rate of the Training Tool. Finally, in the open dialog box at the end of the URUT, participants commented in a more open behavioural manner, describing their overall impressions on the usage of the Training Tool and reporting tasks that did not manage to complete. The general sensation of the Training Tool experience was highly positive.

Subsequently, using the responses of the participants on the satisfaction questionnaire two widely used metrics were calculated, the percent agreement and the task rating. The percent agreement expresses the extent to which participants agreed with the statements in question and thus it is calculated as the percentage of the summation of the number of responses rated as "4 - agree" and "5 - strongly agree" divided by the total number of responses (equation 3). The Task Rating is calculated as the percentage of the summation of the values of the responses divided by the total number of responses. Finally, the mean values were calculated for the described metrics.

$$Percent\ Agreement = \frac{\begin{array}{c}Number\ of\ Responses\ rated\ as\ "4-agree" \\ + \\ Number\ of\ Responses\ rated\ as \\ "5-strongly\ agree"\end{array}}{Total\ Number\ of\ Responses} * 100\% \quad (3)$$

$$Task\ Rating = \frac{Sum\ of\ Responses'\ values}{Total\ Number\ of\ Responses} \quad (4)$$

The results based on the satisfaction questionnaire are presented in Table III. 94.5% of the participants found the completion of tasks easy, which is a highly positive statement for the Training Tool. The lowest rate of 83.4% regarding the easiness of completion were given for tasks on Scenario 1- Task B, and on Scenario 2- Task B, which, as earlier presented in Table II, were the only tasks that were not successfully completed by two and one participants, respectively. Regarding the question if participants would change something in the Training Tool to make the completion of tasks easier, 16.6% of participants replied that they would have something to change.

SUS has been a usability standard for some time, nevertheless the interpretation of SUS scoring is not a straightforward procedure. In order to convert the original scores from a scale of 0–40 to a 0–100 (which describes a percentile ranking and not a percentage) the following calculations must be performed: a) for each of the odd numbered questions, "1" is subtracted from the score, b) for each of the even numbered questions, their value is subtracted from "5", c) these new values are added up and produce a total, which is following multiplied by "2.5" to produce the final SUS score. The results based on the satisfaction questionnaire are presented in Table III. 94.5% of the participants found the completion of tasks easy, which is a highly positive statement for the Training Tool. The lowest rate of 83.4% regarding the easiness of completion were given for tasks on Scenario 1- Task B, and on Scenario 2- Task B, which, as earlier presented in Table II, were the only tasks that were not successfully completed by two and one participants, respectively. Regarding the question if participants would change something in the Training Tool to make the completion of tasks easier, 16.6% of participants replied that they would have something to change.

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A SUS score above 68 would be considered above average and anything below 68 is below average (14). Bangor *et al*. (15) have proposed an association of SUS score with grades, adjectives (bad, good, excellent, etc.) and acceptability of a system, according to which a SUS score above 80 is considered to represent an excellent system. Results for the SUS (Table IV) gave a total score of 88.7 which classifies the Training Tool as "A" graded-excellent. The SUS score would be even higher, reaching 93.6, if we exclude the grading of participant 13, who responded to almost all questions by giving the worst grades, something that does not go in line with the responses of all others participants (Table IV). Although the reasons for this bad grading are not clear, we believe based on a communication that we had, that it was due to the

Table IV. Overall responses on SUS questionnaire converted to SUS score.

		Overall responses on SUS questionnaire converted to SUS score																				
Participant		**Q. 1**		**Q. 2**		**Q. 3**		**Q. 4**		**Q. 5**		**Q. 6**		**Q. 7**		**Q. 8**		**Q. 9**		**Q. 10**		Total SUS score
Best score		**4**	**5**	**4**	**1**	**4**	**5**	**4**	**1**	**4**	**5**	**4**	**1**	**4**	**5**	**4**	**1**	**4**	**5**	**4**	**1**	100
Type of score***		**R R**	**S S**	**R R**	**S S**	**R R**	**S S**	**R R**	**S S**	**R R**	**S S**	**R R**	**S S**	**R R**	**S S**	**R R**	**S S**	**R R**	**S S**	**R R**	**S S**	S S
Computer scientists	**Par. 1**	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	100
	Par. 2	**4**	5	**4**	1	**3**	4	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	97.5
	Par. 3	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	100
	Par. 4	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	100
	Par. 5	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	100
	Par. 6	**3**	4	**4**	1	**3**	4	**4**	1	**3**	4	**4**	1	**4**	5	**4**	1	**3**	4	**4**	1	90
Healthcare professionals	**Par. 7**	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	100
	Par. 8	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	100
	Par. 9	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	100
	Par. 10	**3**	4	**4**	1	**3**	4	**4**	1	**2**	3	**2**	3	**2**	3	**2**	3	**3**	4	**3**	2	70
	Par. 11	**2**	3	**3**	2	**4**	5	**3**	2	**3**	4	**3**	2	**3**	4	**3**	2	**3**	4	**4**	1	77.5
	Par. 12	**3**	4	**4**	1	**4**	5	**4**	1	**3**	4	**4**	1	**4**	5	**4**	1	**4**	5	**4**	1	95
	Par. 13	**0**	1	**0**	5	**0**	1	**0**	5	**2**	3	**2**	3	**1**	2	**0**	5	**2**	3	**2**	3	22.5
SUS score only for computer scientists										**97.9**						**Total SUS score**						88.7
SUS score only for Healthcare Professionals & (SUS score healthcare professionals excluding participant 13)										80.7 (90.4)						Total SUS score excluding participant 13						93.6

***RR represent the raw responses of the participants in the5-point rating scale; SS represent the converted SUS score.

participant's lack of computer literacy (16, 17). The SUS score, for computer scientists alone was 97.9, while the SUS score for healthcare professionals was 80.7, and reaching 90.4 when participant 13 is excluded. Overall, it is clearly evidenced that the Training Tool offers high levels of usability.

Discussion

The HarmonicSS Training Tool is a well-structured tool that can be reliably used for supporting the training of healthcare professionals in the diagnosis and management of SS. An aspect to be considered is that the technology acceptance issue (18) could affect its usage in clinical practice as it happens with every new technology advancement that replaces the traditional one. Nevertheless, based on the highly positive results of the usability evaluation, we believe that it could be easily adopted in clinical practice. Another important aspect to consider, is the validity and update of the scientific material over time. It is the intention of the authors to keep the Training Tool, up to date with state-of-the art practice and guidelines.

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