

Screening and Evaluation Platform for Depression and Suicidality in Primary Healthcare

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Keywords: Web-based Platform, Decision Support, Screening, Healthcare, Depression, Suicide.

Abstract: This work presents a screening and evaluation platform for depression and suicidality that has been tested in the scope of primary healthcare. The main objective is to improve the efficiency and effectiveness of screening processes. A web-based, decision support platform was provided for qualified healthcare professionals. The platform provides several assessment tools for patient evaluation and monitoring of their treatment, along with follow up appointment management. A preliminary evaluation process was carried out to understand the health professional's satisfaction. This revealed there was general satisfaction with its integrated functions and all the provided methods of assessment. In conclusion, the project sustains the goal of improving the treatment outcomes for clinical depression by refining the screening methods and consequently increase the screening effectiveness and efficiency.

1 INTRODUCTION

Available data indicates that the time period elapsed between the first depressive episodes and the respective diagnose by a clinician is about 4 years (Almeida et al., 2013). Additional references (Farvolden, McBride, Bagby, & Ravitz, 2003) suggest that general practitioners fail to diagnose up to half of the cases of major depressive disorder or anxiety. On the other hand, depression is associated with suicide, medical illness and increased risk of accidental death (Fawcett, 1993).

Screening tools may help physicians and other health professionals in primary health care to timely recognize and adequately follow depressive disorder and suicidality cases. The Stop Depression project aims at aiding healthcare professionals in this task, in order to provide a better response to the previously identified weaknesses.

The StopDepression ("Stopdepression.pt," 2017) project (EEA GRANT 91SM3), supported by the EEA Grants Iceland, Liechtenstein and Norway, is a mental health project deployed in a primary care setting (ACeS – Agrupamento de Centros de Saúde do Porto Ocidental - Portugal). The main goal is to

improve the effectiveness of the means used for detecting depression and managing the risk of suicide. It's an initiative inspired by the stepped care model (Williams & Martinez, 2008) which has specific objectives: detecting depression in early stages, assessing suicide risk and improving the patient's treatment progress - based on web technologies - always considering the severity and symptomatology of each case.

To achieve these goals, a set of training sessions, complemented by computer-based tools were delivered to professionals. These have been applied to face-to-face appointments to systematically diagnose and thoroughly follow up the treatment of depression. This paper describes the main software pieces in the Stop Depression platform and how they orchestrate in a computer aided diagnosis and decision support solution.

2 RELATED WORK

In the last decades, several health organizations (e.g., United States Preventive Services Task Force [USPSTF], 2002, 2016; World Health Organization

(World Health Organization, 2012); National Institute for Health and Clinical Excellence [NICE], 2009), have been drawing attention to the importance of improving detection and management of mental-health problems such as depression.

One way to do this is by performing a systematic screening and assessment of mental-health problems in order to promote their adequate treatment (Siu et al., 2016).

In this context, web-based screening platforms are being developed and increasingly used for a variety of mental-health problems (including depression and suicidal risk) in various healthcare settings and populations across the world (Farvolden et al., 2003; Fothergill et al., 2013; Oromendia, Bonillo, & Molinuevo, 2015).

For instance, the Web-Based Depression and Anxiety Test (Farvolden et al., 2003) is a web-based self-report screening instrument that has been used in a rehabilitation centre in Toronto to effectively screen for major depressive disorder and a number of common anxiety disorders. Through this platform, the healthcare professional has access to a report that summarizes the person’s responses to several questions elaborated according to the DSM-IV criteria for these disorders (American Psychiatric Association, 2000), which contributes to the healthcare professional’s decision about the diagnostic and treatment of the patients (Farvolden et al., 2003).

Likewise, the Internet-based Behavioural Health Screen (BHS) is a screening instrument that has been developed by Diamond and colleagues (2010) to help detect mental health problems and suicidal risk in adolescents and young adults in a North-American primary care. This tool facilitates healthcare professionals the administration of several questionnaires, as well as its interpretation and integration (Diamond et al., 2010).

Also, the Integrating Mental and Physical Healthcare: Training and Research (Matcham et al., 2017) is a screening tool that has been used across two London National Health Service (NHS) Trusts to help detect depression, anxiety and the severity of nicotine dependence in patients with chronic conditions. This web-based platform helps not only the detection, but also the management of these mental-health disorders (Matcham et al., 2017).

A common trait among these platforms is that they help healthcare professionals to perform screening and diagnosis by integrating validated paper-based psychometric measures (e.g., PHQ-9; Kroenke, Spitzer, & Williams, 2001) that maintain good psychometric properties when adapted to web-based

versions (van Ballegooijen, Riper, Cuijpers, van Oppen, & Smit, 2016).

However, to our knowledge, although these platforms are extremely useful tools, the majority fails to provide healthcare professionals with case management support information which is essential for an effective approach to mental health care (O’Connor, Whitlock, Gaynes, & Beil, 2009).

In order to pursue this goal, we analysed requirements in the scope of the national context and proceeded to the development of a case management platform, which complements the ones previously developed (Rocha et al., 2012; Warmerdam et al., 2012) to support low intensity Internet-based interventions.

The Stop Depression’s key contributions are: 1) Integrating the screening and assessment of the severity of depression and suicidal risk; and 2) Providing healthcare professionals with suggestions and guidelines for specific interventions based on the assessment outcome, according to evidence-based guidelines preconized by NICE (2010).

3 DESCRIPTION OF THE PLATFORM COMPONENTS

The depression and suicidality evaluation platform records the systematic screening, evaluation and follow-up of patient’s depressive symptoms. This takes place during their appointments in the primary healthcare services. It includes a computer aided diagnosis and decision support module that leverages on the input from the remaining modules and its progress over time to suggest an appropriate course of action, based on a stepped care model. Figure 1 depicts the logical organization of the software modules that were developed to achieve these goals. The following subsections present a brief description of modules implemented in the context of this project.

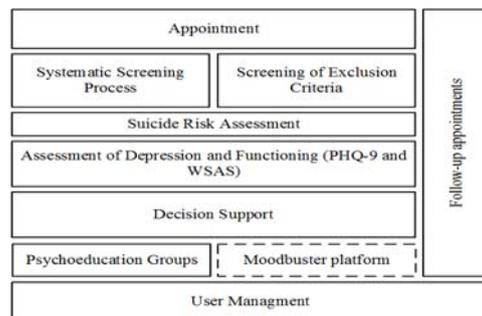


Figure 1: Stop Depression platform components.

3.1 User Management

Stop Depression is a pilot implementation project, therefore this platform is not yet integrated with SClinico (“spms.min-saude.pt,” 2017), the software used by most of the primary healthcare institutions in Portugal.

In order to deal with this challenge, the platform includes functionalities to manage multiple user profiles that are able to interact with different functionalities. These users include medical doctors and nurses which are able to screen and evaluate patients; and psychologists that deliver interventions to patients assigned to them.

From the technical point of view, an independent structure was created to hold the subset of health records related with the patient mental health. Aside from dealing with the necessary security issues by means of authentication and access control over a secure transport layer, particular attention was paid to privacy, therefore no information that can directly or indirectly identify the patient is ever stored.

3.2 Systematic Screening Process

Prior or during an appointment three straight questions are prompted. Answers to these questions are used to determine if a more thorough evaluation should follow. The goal is to quickly detect the presence of depression and eventual suicidal ideation.

3.3 Screening of Exclusion Criteria

This step narrows a particular disorder or ailments that prevents the participation of the patient in this study, such as heavily affected neurocognitive functions that compromise interpretation abilities, speech, social interactions and cognition. Psychotic disorders, including schizophrenia, also fall out of the spectrum of the study.

3.4 Suicide Risk Assessment

The goal of this process is to weight the factors that impact the patient’s suicide risk (Jacobs et al., 2003). The platform is able to draw an inference process to suggest a treatment course that may address the patient’s condition. It considers the patient’s immediate safety as an active measure for critical cases and suggests urgent procedures if needed.

3.5 Assessment of Depression and Functioning (PHQ-9 and WSAS)

The Patient Health Questionnaire (PHQ-9) assessment module is used to make a swift but thorough assessment of the severity of depression and has been validated for use in primary care services (Cameron, Crawford, Lawton, & Reid, 2008). The final score is computed by summing the value of every answer and indicates the degree of depression. This questionnaire can also be used to monitor the patient’s progress recurrently, in order to evaluate their progress.

Alongside PHQ-9, the patient fills in a questionnaire aimed at measuring the impairment of functioning. The Work and Social Adjustment Scale (WSAS) helps to determine conditions or disorders that may affect or deteriorate an individual’s abilities to execute or participate in certain standard day-to-day tasks (Mundt, Marks, Shear, & Greist, 2002). It is also used as supplement with PHQ-9 to evaluate the progress of the patient’s treatment.

3.6 Decision Support

Having completed the interview process, the platform will show to the interviewer the calculated risk within the suicide risk scale, which can be used as an aid for suicide risk assessment. In addition, and depending on the asserted risk, recommendations and instructions on how to proceed according to different degrees of severity are also suggested.

The platform evaluates the severity of depression based on a weighted analysis of the PHQ-9 and WSAS. It infers the degree of depression the patient might have, along with a recommendation on how the healthcare professional should proceed.

Any outcome presented in this section can’t be seen as a prognostic, but rather a result of a computer aided diagnostic tool, that can help the decision of a qualified healthcare professional. Several important dimensions not currently taken into account by the decision support module need to be considered when assessing depression degrees and suicide risks, such as, the patient’s current physical state, medical health history and other psychosocial grades (Williams & Martinez, 2008).

From the technical perspective it represents a classification problem. Health professionals have defined screening rules to rate the patient into disjoint groups. Said rules form the nodes of a decision-tree classifier (Silberschatz, Korth, & Sudarshan, 2011).

3.7 Follow-up Appointments

Healthcare professionals register appointments periodically, as a treatment monitoring process. This include the reassessment of the PHQ-9 and WSAS questionnaires, along with a re-evaluation of the risk of suicide when necessary. The goal of this module is to help determining the effectiveness of a treatment and how well a patient is adapting to it.

3.8 Psychoeducation Groups

Psychoeducation groups are a form of psychotherapy based on a shared therapeutic experience, which involves the presence of a therapist, the patient and other individuals working through similar ailments. Therefore, group therapy considers the interaction between group members as a vehicle of change (Whitfield, 2010), which might play an important role on the patient’s treatment progress.

The platform allows psychoeducation group administrators to manage and schedule different sessions, through the use of a calendar-like interface, enabling them to choose which schedule best fits the patient’s need.

3.9 Moodbuster Platform

When a patient is assigned to a computer based treatment, the system will generate credentials that allows the user to login on the moodbuster platform. The moodbuster is an innovative digital solution for the treatment of depression that is being used in a follow-up study in a blended care setting. This an Internet-based depression treatment that “is considered a promising clinical and cost-effective alternative to current routine depression treatment strategies such as face-to-face psychotherapy” (Kleiboer et al., 2016).

4 PLATFORM WORKFLOW

In the following section we expose the platform’s workflow, and how appointments progress during an interview with the patient. Figure 2 shows a synthesised flowchart of this process.

When a patient attends a medical appointment in the primary care, a healthcare professional checks for previous records in the screening and evaluation platform. If any is present, the professional is required to repeat the PHQ-9 and WSAS questionnaires (which may themselves trigger other instruments). On the other hand, in the case of a first appointment, the

following steps of the screening and evaluation workflow will happen.

The process begins with the systematic screening, which may lead to the conclusion that no symptoms of depression or suicide risk are present, then resuming to the standard medical appointment.

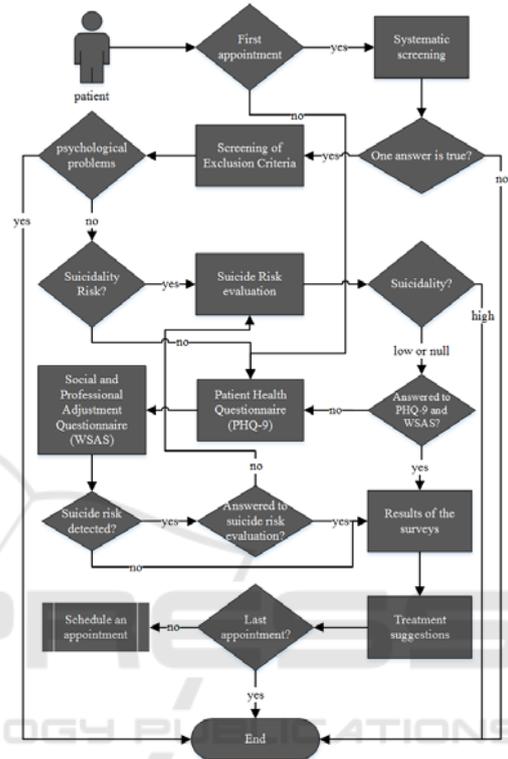


Figure 2 - Platform Workflow.

If the systematic screening yields a possible positive result for depression and suicide risk, the platform will guide the professional through a list of exclusion criteria. For instance: bipolar disorder, borderline personality disorder, obsessive-compulsive disorder, etc., including the suicide risk. When the professional recognizes that the patient presents one or more of these exclusion criteria, the professional will step the patient out of the study, while recording these results before resuming the medical appointment.

When excluded due to risk of suicide, the platform will point out the next steps based on the severity of that assessment.

If the patient does not meet any exclusion criteria, the results of PHQ-9 and WSAS instruments are used to determine the severity of depression and the next steps of its treatment. These steps also include the schedule of follow-up appointments to assess the progress of the patient’s mental health status.

In either case, the PHQ-9 includes a question to acknowledge the risk of suicide. If detected, the suicide risk is then reassessed in all subsequent appointments.

5 PRELIMINARY RESULTS

As a method for analysing user’s satisfaction, a preliminary evaluation was carried out from a group of 18 (eighteen) qualified health professionals answering a System Usability Scale (SUS) questionnaire (Brooke, 1996). This survey consists of ten ranked questions that provide a measurement of effectiveness, efficiency and satisfaction regarding the platform’s use. All participants have received training in using the platform.

Table 1: SUS results.

	a	b	c	d	e
Will use frequently	0%	0%	6%	28%	66%
Is complex	33%	39%	11%	17%	0%
Easy to use	0%	0%	6%	44%	50%
Need help to use	44%	33%	17%	0%	6%
Integrated functions	0%	0%	17%	33%	50%
Has inconsistencies	33%	56%	11%	0%	0%
Easy to learn	0%	0%	28%	39%	33%
Is complicated	66%	22%	6%	6%	0%
Felt confident	0%	0%	16%	56%	28%
Had a learning curve	28%	22%	28%	22%	0%
a- Disagree Completely; b- Disagree; c- Neither Agree nor Disagree; d- Agree; e- Agree Completely					

From the analysis of the collected data (Table 1), it can be determined that 72% of the users agree that the platform is easy to learn and 94% of them consider it easy to use.

Furthermore, most users disagree that the system had a steep learning curve. In terms of usability, 72% users disagree that the platform is complex and 88% disagree that it’s complicated.

A total of 89% of the users disagree that there are inconsistencies with the user interface.

Most users felt confident interacting with the platform, with 84% agreeing to this fact. This is further emphasized by users agreeing that they did not need help to use the platform, totalling 77%.

When it comes to integrated functions, 73% of the users were satisfied with the tools provided and the combined functionalities.

Finally, 94% of the users agreed that they would definitely use the system frequently.

6 CONCLUSIONS

Stop Depression project’s main goal is to improve clinical outcome when treating clinical depression. It does so by broadening the screening process, allowing early detection of depressive symptoms, and by refining the treatment course, providing tools for continuous monitoring of diagnosed patients.

This paper describes a state-of-the-art system for mental health screening and assessment in the Portuguese primary care, combining computer aided diagnostic tools, along with other mechanisms such as rule-based decision support (Abbasi & Kashiyarndi., 2006), to empower health professionals in determining the best treatment course and improve treatment adherence. New, low intensity interventions were made available in the scope of this pilot, with the platform having a determinant role in their implementation.

System usability surveys reveal that users were pleased with the use of the system during the Stop Depression clinical trials. Qualified users considered the platform to be straightforward and with a low learning curve, having felt confident while using it. Moreover, an extremely high percentage of users claimed that they would use the system frequently.

Although healthcare professionals seem to be generally satisfied with the platform, more research is currently undergoing to quantify the gains of using the system from the clinical perspective. Furthermore, extending the use of the system to other institutions, particularly in the primary health care, will likely require an impact analysis of its interoperation or integration with the platforms currently in use by the national health system.

ACKNOWLEDGEMENTS

This paper is financed by the ERDF – European Regional Development Fund through the Operational Programme for Competitiveness and Internationalisation - COMPETE 2020 Programme within project «POCI-01-0145-FEDER-006961», and by National Funds through the Portuguese funding agency, FCT - Fundação para a Ciência e a Tecnologia as part of project «UID/EEA/50014/2013».

REFERENCES

Abbasi, M. M., & Kashiyarndi., S. (2006). Clinical

- Decision Support Systems: A discussion on different methodologies used in Health Care. *Marlaedalen University Sweden*.
- Almeida, J. M. C., Xavier, M., Cardoso, G., Gonçalves Pereira, M., Gusmão, R., Corrêa, B., ... António, J. (2013). Estudo Epidemiológico Nacional de Saúde Mental 1º Relatório. *Faculdade de Ciências Médicas, Universidade Nova de Lisboa*.
- American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders*. Diagnostic and Statistical Manual of Mental Disorders 4th edition TR. <https://doi.org/10.1016/B978-1-4377-2242-0.00016-X>.
- Brooke, J. (1996). SUS - A quick and dirty usability scale. *Usability Evaluation in Industry*, 189(194), 4–7. <https://doi.org/10.1002/hbm.20701>.
- Cameron, I. M., Crawford, J. R., Lawton, K., & Reid, I. C. (2008). Psychometric comparison of PHQ-9 and HADS for measuring depression severity in primary care. *British Journal of General Practice*, 58(546), 32–36. <https://doi.org/10.3399/bjgp08X263794>.
- Diamond, G., Levy, S., Bevans, K. B., Fein, J. A., Wintersteen, M. B., Tien, A., & Creed, T. (2010). Development, Validation, and Utility of Internet-Based, Behavioral Health Screen for Adolescents. *Pediatrics*, 126(1).
- Farvolden, P., McBride, C., Bagby, R. M., & Ravitz, P. (2003). A Web-Based Screening Instrument for Depression and Anxiety Disorders in Primary Care. *Journal of Medical Internet Research*, 5(3), e23. <https://doi.org/10.2196/jmir.5.3.e23>.
- Fawcett, J. (1993). The morbidity and mortality of clinical depression. *International Clinical Psychopharmacology*, 8(4), 217–20. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/8277138>.
- Fothergill, K. E., Gadomski, A., Solomon, B. S., Olson, A. L., Gaffney, C. A., dosReis, S., & Wissow, L. S. (2013). Assessing the Impact of a Web-Based Comprehensive Somatic and Mental Health Screening Tool in Pediatric Primary Care. *Academic Pediatrics*, 13(4), 340–347. <https://doi.org/10.1016/j.acap.2013.04.005>.
- Jacobs, D. G., Ross Baldessarini, C. J., Conwell, Y., Fawcett, J. A., Horton, L., Meltzer, H., ... Simon, R. I. (2003). *Practice Guideline for the Assessment and Treatment of Patients With Suicidal Behaviors*.
- Kleiboer, A., Smit, J., Bosmans, J., Ruwaard, J., Andersson, G., Topooco, N., ... Riper, H. (2016). European COMPARative Effectiveness research on blended Depression treatment versus treatment-as-usual (E-COMPARED): study protocol for a randomized controlled, non-inferiority trial in eight European countries. *Trials*, 17(1), 387. <https://doi.org/10.1186/s13063-016-1511-1>.
- Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *Journal of General Internal Medicine*, 16(9), 606–13. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11556941>.
- Matcham, F., Carroll, A., Chung, N., Crawford, V., Galloway, J., Hames, A., ... Hotopf, M. (2017). Smoking and common mental disorders in patients with chronic conditions: An analysis of data collected via a web-based screening system. *General Hospital Psychiatry*, 45, 12–18. <https://doi.org/10.1016/j.genhosppsy.2016.11.006>.
- Mundt, J. C., Marks, I. M., Shear, M. K., & Greist, J. M. (2002). The Work and Social Adjustment Scale: a simple measure of impairment in functioning. *The British Journal of Psychiatry*, 180(5).
- O'Connor, E. A., Whitlock, E. P., Gaynes, B., & Beil, T. L. (2009). *Screening for Depression in Adults and Older Adults in Primary Care. Screening for Depression in Adults and Older Adults in Primary Care: An Updated Systematic Review*. Agency for Healthcare Research and Quality (US). Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/20722174>.
- Oromendia, P., Bonillo, A., & Molinuevo, B. (2015). Web-based screening for Panic Disorder: Validity of a single-item instrument. *Journal of Affective Disorders*, 180, 138–141. <https://doi.org/10.1016/j.jad.2015.03.061>.
- Rocha, A., Henriques, M. R., Lopes, J. C., Camacho, R., Klein, M., Modena, G., ... Warmerdam, L. (2012). ICT4Depression: Service oriented architecture applied to the treatment of depression. In *Proceedings - IEEE Symposium on Computer-Based Medical Systems*. <https://doi.org/10.1109/CBMS.2012.6266379>.
- Silberschatz, A., Korth, H. F., & Sudarshan, S. (2011). *Database System Concepts - 6th. ed. Database* (Vol. 4). <https://doi.org/10.1145/253671.253760>.
- Siu, A. L., Bibbins-Domingo, K., Grossman, D. C., Baumann, L. C., Davidson, K. W., Ebell, M., ... B. D. (2016). Screening for Depression in Adults. *JAMA*, 315(4), 380. <https://doi.org/10.1001/jama.2015.18392>.
- spms.min-saude.pt. (2017). Retrieved January 31, 2017, from <http://spms.min-saude.pt/product/sclinicocsp/>.
- Stopdepression.pt. (2017). Retrieved January 31, 2017, from <http://stopdepression.pt>.
- van Ballegooijen, W., Riper, H., Cuijpers, P., van Oppen, P., & Smit, J. H. (2016). Validation of online psychometric instruments for common mental health disorders: a systematic review. *BMC Psychiatry*, 16, 45. <https://doi.org/10.1186/s12888-016-0735-7>.
- Warmerdam, L., Riper, H., Klein, M., van den Ven, P., Rocha, A., Ricardo Henriques, M., ... Cuijpers, P. (2012). Innovative ICT solutions to improve treatment outcomes for depression: the ICT4Depression project. *Studies in Health Technology and Informatics*, 181, 339–343.
- Whitfield, G. (2010). Group cognitive-behavioural therapy for anxiety and depression. *Advances in Psychiatric Treatment*, 16(3).
- Williams, C., & Martinez, R. (2008). Increasing Access to CBT: Stepped Care and CBT Self-Help Models in Practice. *Behavioural and Cognitive Psychotherapy*, 36(6), 675. <https://doi.org/10.1017/S1352465808004864>.
- World Health Organization. (2012). DEPRESSION A Global Public Health Concern.