
COMPUTERIZED MODEL FOR APHASIA ASSESSMENT, BASED ON KERTEZS TEST

Iliya Pendzhurov, Polina Mihova, Atanas Dashovski

Abstract: *Aphasia is an acquired communication disorder caused by brain damage that impairs a person's ability to understand, produce and use language. Furthermore, it is a multimodal disorder which includes additional neurological impairments such as apraxia of speech or dysarthria [Keshree et al, 2013]. Aphasia tests are used to classify and diagnose aphasia and they are needed for a standard classification of aphasia and to compare studies performed in different centers. The aim of this paper is to present an original authors solution, which performs a digital version of the Kertész test.*

Keywords: *aphasia, WAB, software solution*

Introduction

The Western Aphasia Battery is a comprehensive test of language function for individuals with aphasia and aged 18-89 years. Test administration time is 30-60 min, depending on the severity of the patient's aphasia and coexisting deficits (e.g., apraxia, dysarthria). As stated in the test manual, the aim of the WAB is to "evaluate the main clinical aspects of language function, content, fluency, auditory comprehension, repetition, naming, reading, writing, and calculations." The WAB is designed to test all language modalities: reading, writing, listening, speaking, and gestural communication. It also tests what Shewan and Kertesz originally referred to as "higher cortical functioning", including a block design subtest as well as Raven's Colored Progressive Matrices and tests of drawing, and calculation. The purpose of this paper is to present a new kind of solution - computer assisted testing for aphasia, which is quite new and unique for Bulgarian medical practice.

Material and methods

Aphasia test batteries have been used by clinicians to assess persons with aphasia (PWA) for nearly a century. As interest in aphasia rehabilitation grew between 1960 and 1982, and objective measures were needed to measure the effects of treatment, several test batteries were developed which have a widespread use globally. Among them are the Minnesota Test for Differential Diagnosis of Aphasia, the Porch Index of Communicative Ability, the Boston Diagnostic Aphasia Examination, and the Western Aphasia Battery. The Western Aphasia Battery provides the diagnostic goals of Minnesota Test for Differential Diagnosis of Aphasia. [Keshree et al, 2013]

The test of Kertész (WAB) is a tool for diagnosing subtypes aphasia, extent of damage aphasia and evaluating the results of treatment. The test is a comprehensive survey, providing an opportunity to involve highly structured observations in the process of diagnosis.

The test consists of two parts (language and executive) containing several subtests. The language part of the test gives coefficient of Aphasia (CA), covering as necessary for the classification of types of Aphasia by several sub tests. The test itself does not classify cases cross aphasia symptoms.

The second part contains tests for reading and writing (Display language factor), Praxis, drawing, stacking cubes, calculus and colored progressive matrices Raven, by which, in combination with results of the first part is derived factor of cognitive functioning KKF (aphasiology.pitt.edu/archive/00000795/01/14-07.pdf).

In frequent cases in clinical practice are those with mixed symptomatology. KKF helps to determine whether (and to what extent) the disturbances in other higher cortical functions, which in turn strongly supports the diagnosis in the presence of cross symptoms and an individual treatment plan for the patient.

On the other hand, information technologies – part of the eHealth era, are becoming more and more widely used in health care. The digitization of "medical paper flow" reduces the needed for storage resources and gives a positive impact to the efficiency of the entire workflow. After a research, we found out that at the Bulgarian market absents specialized solutions for speech therapy with integrated form for administration of the Kertész test.

According to the National Health Development Strategy 2008-2013 the following are outlined as key priorities:

- ✓ Providing health services on-line;
- ✓ Implementation of electronic health cards.
- ✓ Implementation of personal electronic health records.
- ✓ Implementation of integrated software applications for processing and sharing information in real time, including: electronic directions, recipes, expert findings, laboratory and diagnostic data, etc.
- ✓ Development of complex integration models, working with external applications and systems.
- ✓ Creation of hospital information systems for electronic medical records.
- ✓ Construction of the infrastructure required for the normal functioning of the healthcare system - networks that connect devices and other devices.
- ✓ Construction of appropriate infrastructure for the deployment of telemedicine applications.

eHealth, by definition, is a rapidly developing field where medical informatics, public health, supply of healthcare services and information using modern information and communication technologies interact. It features technology development to improve health services at local, regional and global levels.

The standard medical practice, as such, exists from the Hippocrates times - face to face contact with a suffering patient, personal experience to suggest accurate treatment and legitimacy to the laws in Bulgaria are just some of the advantages and established standards of practice. On the other hand, the paper documentation that is still the practice in our healthcare system, the possibility of intentional or accidental error, lack of sufficient practical experience in this particular case, show these are just some of the factors that present the current status of our system as old-fashioned, unsatisfactory and risky for the health of the patient.

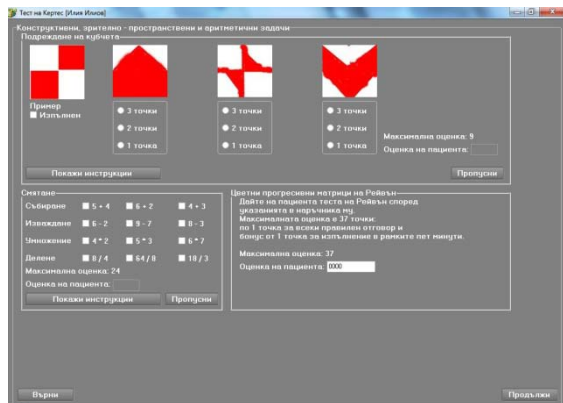
However, medical practice, based and ensured with PC and software technologies is facing many other problems that lead to fear and reluctance from consumption of new kinds of working models. It requires modern standards of employment, security for the patient by several expert opinions, prevention and minimization of the possibility of errors in the final diagnosis, the provision of care 7 days a week, 24 hours a day. Of course, the difficulties and obstacles in this scheme of work related to the willingness of medical experts, placed in a competitive regime, the lack of ethical and legal frameworks that limit abuses and skills required to work with information technology are only a few of the barriers to implement that service. At Table 1 we demonstrate the positive and negative factors for both standard medical practice and medical practice, assisted by software and hardware solutions.

Table 1 Comparative analysis between standard medical practice and assisted one by PC and software solutions

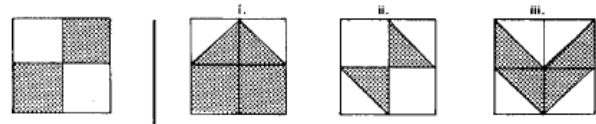
Standard medical practice		Medical practice assisted from PC and softwares	
For	Against	For	Against
tradition of medical practice		simultaneous operation of	costs for equipment
changing with the generations		several organizations	
tested in time – fixed and accepted as routine practice		simplified and standardized process	knowledge of electronic standards and requirements
paper does not require any technology	risk of information loss	improved health services	new public nature of the profession
face-to-face contact	expenditure of financial and time resources to	provision of care anytime,	problems with persuasiveness
	remote patients and their families	anywhere and by anyone	and reliability
subjective – the record is done by one author	possible errors	transfer of various data formats	Perceptions of staff to
	or omission		work with the new system
Law legitimacy	opportunity for abuse and manipulation of information	various forms of diagnostic techniques	competency requirements for more than narrow specialization
written responsibility, verified with personal signature	delay in time	consultation with multiple	competitive moment
		specialists together	
results of communication with patients	poor results of aging assets	Provision of care 24 hours at home	ongoing commitment
		education from a distance	Pricing - Who decides?
		in real time	
		human interaction - PC	PC equipment
		objectivity of opinions	ethical issues
		reduce professional isolation	Lack of political will to implement
		increased confidence by	Institutional will
		specialist	
		providing the best experts	prudence
		in the field	
		new working standards ,	lack of legal framework
		fast and efficient , information transfer	
		Real teamwork	

The presented here electronic health record is a client -server application and it requires connection to a MySQL Server database. In practice, the essential function of any system is to provide the user a convenient way to manage records in a database table .

The screens below (Figure 1 – Figure 2) demonstrate the digital representation of Kertesz paper's version, which is over 20 pages in non-digital format.



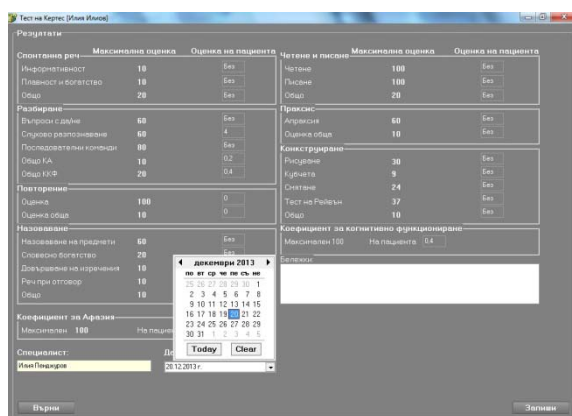
Place four blocks before the patient. Say "You see these blocks, they are all alike. On some sides, they are all red, on some all white, and on some, half red and half white. I am going to put the blocks together to make them look like this picture. Watch me first. Now, look at the picture and make one just like it with the blocks." Demonstrate how to do the example: moving slowly, then mix up the blocks and have the patient do it, using the same blocks. If he or she fails to do it in 90 seconds, mix up the blocks and have him or her try again. If the patient fails on the second attempt, go on and show the next picture. Mix up the blocks after each design. Except for the example, the patient is not shown how to do it or is given a second attempt. Score 3 points for correct design, completed in 60 seconds; score 2 points for correct design, with extra time allowed (2 minutes). Score 1 point for blocks put together.



Practice
Score 3 points for correct design within 60 seconds
Score 2 points for correct design with extra time
Score 1 point for 4 blocks put together

Figure 1. Screen "Moving blocks" from Kertesz test computerized model vs paper version

On Figure1 is presented a comparison between digital and paper version of Nonlinguistic Skills assessment, which are Drawing, Block Design and Calculation Praxis.



	Maximum	Patient's Subscores	Total For AQ
Spontaneous Speech			
Information Content	10		
Fluency	10		
Total	20		
Comprehension			
Yes/No Questions	60		
Auditory Word Recognition	60		
Sequential Commands	60		
Total	180		
(Divide By 20 For AQ)	10		
(Divide By 10 For CQ)	20		
Repetition	100		
Total	100		
(Divide By 10)	10		
Naming			
Object Naming	60		
Word Fluency	20		
Sentence Completion	10		
Responsive Speech	10		
Total	100		
(Divide By 10)	10		
Aphasia Quotient (AQ)			
(Add Totals And Multiply By 2 For AQ)			
Reading And Writing			
Reading	100		
Writing	100		
Total	200		
(Divide By 10)	20		
Praxis	60		
Total	10		
(Divide By 6)	10		

Figure 2. Screen Score sheet from Kertesz test computerized model vs paper model

On Figure 2 is demonstrated a comparison between digital and paper version of Spontaneous speech assessment, which are the Linguistic Skills most frequently Affected by Aphasia. It consists of the following parts: Content, Fluency, Auditory, Comprehension, Repetition and Naming, Reading, Writing.

Discussion

Computer technologies offer new avenues for treatment and expression for people with aphasia. Based on web browsing and searching for similar software solutions, we have found 55 products ([http://www.aphasiasoftwarefinder.org/spelling%20and%20writing?tid\[\]=31](http://www.aphasiasoftwarefinder.org/spelling%20and%20writing?tid[]=31)), containing different separate parts from the general Kertesz test, which would speech-language pathologists can use with clients with aphasia. They are compared by the following parameters: Results Recorded, Free Trial Tutorials, Personalized, Advice, Record Self, Easy To Use and Number of Exercises.

Also, we have found two other desktop solutions (PsychBook CMS and Therapy Notes), which are compared below.

The current project is designed to be easily integrated in our specialized Center for treatment of communication and emotionally-behavioral disorders in childhood, New Bulgarian University. It is first and at the moment the only electronic solution for Kertezs test for Bulgaria.

Organization and requirements of innovatory unit have to be secured and nucleus, namely "Patient Management", which provides complete patient record, ability to search, elaborate, investigate and archive records and data.

The proposed solution provides collected and processed information in a knowledge base that guarantees its customers the necessary statistical information, as well as copyright forms and methods of searching and numerous data references.

According to the task, they represent authors' model in identical to the paper copy, which operates daily in the laboratory. PsychBook CMS is an appropriate solution for a single practice with easy to use interface. Major business activities are Invoicing, Financial Statements, Planning graphic. Besides the administrative patients information in PsychBook CMS is integrated full patient's history, presented in usable form. The solution also performs the ability to prepare treatment plan.

PsychBook CMS is available in both versions for Macintosh and Windows operating systems. It uses local database, therefore it is not required internet connection.

Therapy Notes - Web based platform suitable for medium-sized venues. Support various positions with limited access makes it easy adaptable to the structure of the organization. There are well-integrated templates for guiding therapeutic documentation.

<i>Function</i>	<i>PsychBook CMS</i>	<i>Therapy Notes</i>	<i>Our project</i>
Multiuser	No	Yes	Yes
Export	No	Yes	Yes
Attachment of files	Yes	Yes	Yes
Schedule	Yes	Yes	No
Treatment plan	Yes	Yes	Yes
Investigation tools	No	No	No
Reports	Yes	Yes	No

Figure 3. Comparative analysis of Kertez test computerized models

Conclusion

Aphasia following an acquired neurological insult necessitates an in-depth evaluation of the primary and secondary language symptoms. Of all the tools available for aphasia diagnosis, the Western Aphasia Battery [Keshree et al, 2013] has proved to be one of the most comprehensive test batteries for describing the aphasia symptom complex. Several authors have pointed out the need for language-specific tools for the assessment of aphasia. Based on the presented analysis and the surrounding era of "e-" and mSolutions in medicine and healthcare, we can conclude that the author's solution is necessary tool for Bulgarian medical practice.

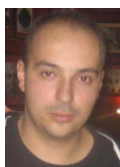
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