



## Development of Verbal Expressive Skills Management Programme (VESMP) for Patients with Broca's Aphasia

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### ABSTRACT

**Introduction:** Disorders of communication, including aphasia (mainly post stroke) caused by the left hemisphere brain damage, is a major community health issue. The prevalence of aphasia after stroke is 25% in Pakistan in which Broca's aphasia is predominant in stroke patients who have anterior lesion in the frontal lobe of the left hemispheres. The verbal expressive skills management programme (VESMP) is the software which developed augmented management for patients to enhance verbal expressive skills for patients with severe Broca's aphasia from different geographic areas. Moreover, the software increases the independencies which are not observed in other traditional techniques. This study is the pathway for maintaining and improving the functional life of patients. **Objectives:** The main objective was to develop the verbal expressive skills management programme (VESMP) to enhance verbal expressive skills of patients with severe Broca's aphasia. **Methodology:** Initially a pilot study with eight cases is carried out. The non-probability purposive sampling technique was used to recruit the patients with severe aphasia who received therapy through VESMP programme on their smart phones. It contains seven domains: spontaneous speech, comprehension, naming, reading, writing, imitation, and automated speech. The programme was developed in Urdu language and its content was selected from grade three Urdu Punjab text books. The program was then updated with the help of guidance and feedback received from five experts of the relevant field. The patients scoring is recorded for each domain on basis of correct responses. The study was conducted in YUSRA general hospital and Pakistan Railway Hospital, Rawalpindi. The study includes patients that are 40+ years old, and have three months of post stroke with diagnosis of chronic Broca's Aphasias, patients with severe cognitive impairment were excluded from the study. The pre-and post score was recorded for each domain for the measurement of change. The treatment protocol for each patient lasts for 8 weeks that includes 4 VESMP sessions per week with each session being 30-45 minutes long. Data for each patient was analyzed based on their pre-and post-intervention scores. **Results:** The scores were computed in terms of mean and standard deviation. The pre-and post-scores of each patient compares separately through which remarkably improvement in all domains. The results also illustrate significant difference ( $p=0.05$ ) between the pre-and post-scores on each domain of the programme and show the vital improvement in verbal expressive skills of patients with severe Broca's aphasia. **Conclusion:** It is concluded from the results that the development of VESMP programme improved verbal expressive skills of patients with severe Broca's aphasia.

**Keywords:** Aphasia, Broca's aphasia, Verbal expressive skill management programme

### INTRODUCTION

Patients with Broca's aphasia have slow and labored speech with short utterance length and in severe cases no expressive skills at all. Aphasia persists as disability in 21% to 38% of stroke survivors. Internationally community incidence is 43/100,000/year, and prevalence is 3000 per million [1]. Aphasia is a language impairment which is due to damage of brain areas related to production of speech and understanding of language. The common reason behind aphasia is stroke that is either due to haemorrhage or ischemia i.e., lack of blood flow [2]. The prevalence of aphasia indicates that about 100,000 people have aphasia per year in the United States [3]. About 82.37% of stroke patients

suffer from speech disorder [4]. The patients of aphasia, as one kind of speech disorder, have a prevalence of 30.25% to 42.4% [5,6]. Large scale epidemiological studies are not available to determine the actual incidence of stroke in Pakistan. Estimated annual incidence is 250/100,000, translating to 350,000 new cases every year [7]. Aphasia has heavily influenced the life quality of patients and is one of the most important indicators to evaluate the patients' social outcomes [8].

It is calculated that about 21-38% of acute stroke patients suffer with aphasia. The incidence of the different types of aphasia includes Wernicke's 16%, anomic 25%, global 32%, Broca's 12%, transcortical motor 2%, transcortical sensory 7%, conduction 5% world widely [9].

Preliminary assessment takes place when symptoms become obvious in the acute state of neuro patients with aphasia. There are many standardized assessment tools through these speech and language pathologists assess the communication strengths and weaknesses, on assessment basis therapist make baseline and management plan for patients.

There are different speech therapies most of them are for verbal expressive skills as stimulation-response method and the Melodic Intonation Therapy (MIT) [10,11]. Other are like linguistic-oriented learning approaches, Still, other techniques such as Promoting Aphasics' Communicative Effectiveness (PACE) and the Response Elaboration Training (RET) Designed for Broca's aphasia patients to improve the length of verbal responses [12]. The constraint-induced aphasia therapy, CIAT is used to improve verbal abilities [13].

Computer-based aphasia therapy is appealing and the patient with severe Broca's Aphasia managed with computer-based training that was provided with a laptop installed program which show instant recovery with in sessions [14]. Patients showed positive effects through computer based therapy on sentences making, reading writing [15].

There is no scientific literature on the use of the VESMP software for rehabilitation of aphasia. Some studies find out effectiveness of computer programs for management [16]. A study based on computer therapy conducted on aphasic patients after five months of computer treatment, showed that a significant improvement on naming skills of the patients was achieved [17].

The VESMP software is for stroke survivors without access to intensive speech therapy services confirms that they can continue to recover on their own by using the tool. This study validates the importance of the work. Unfortunately, many people face barriers to accessing speech therapy due to time required to create change in the brain.

## MATERIALS AND METHODS

This article is part of a major study which aims to develop software to enhance spontaneous speech and comprehension for patients with severe Broca's thus improving their quality of life. The study underwent ethical approval procedures from authorized bodies. The purposive sampling was used to recruit the patients from various hospitals in Rawalpindi and Islamabad. To recruit the patients, the following criteria patients that are forty years old or more with post stroke having diagnosis of severe Broca's aphasia (within three months). Presence of cognitive impairment of any kind led to exclusion from the study. The researcher considered comprehends ability, affordability, comfort ability and familiarity with the software designed for the study purpose before implementation. The procedure began with an informed consent and information disclosure. The programme was designed with specific consideration to patients' level of education, affordability, familiarity, and comfortability with gadgets. Interactive programme was created in Urdu language for each participant and installed on their smart phones. The programme contains seven domains spontaneous speech and comprehension, naming, reading, writing, imitation, and automated speech. It also contains different daily functional statements e.g. *aap kaisay hain?* 20 to 30 words, phrases, and sentences according to the need of domain; Treatment stimuli consisted of images of objects along with auditory sounds and actions, cues and with person sounds like picture along word "*kaila*". In programme, the intelligibility of speech has been identified by patients and intelligible speech output has been recognized for individuals with aphasia and their caregivers through natural sounding. The voice output can operate by pressing the selected picture with his index finger. The VESMP was designed and implemented on eight aphasia patients with stroke who were eligible and willing to participate. The pre-and post-test scores were recorded for the measurement of change domains of VESMP. Participants received 1-8 weeks of therapy using software of two domains with different difficulty levels. The programme specifically included seven domains within the software comprising of eight 30-45 minutes sessions (4 days per week for total 8 weeks). The measurement will be taken at 0 week (baseline) after 8 weeks. Data was analyzed on basis of pre-and post-intervention score.

### Procedure development of VESMP

The programme is developed for the treatment of severe Broca's aphasia patients, targeting the personal vocabulary, and focusing on the patient's conversational needs. VESMP allow for individualized augmented management for patients from different geographic areas (Table 1). Moreover, the programme increases the independency which was not seen in other traditional techniques (Table 2). This study is the pathway for maintaining and improving functional expressive skills to achieve and maintain quality of life.

**Table 1 Disciplines of VESMP**

S. No.	Domain name	Description	Levels
1	Spontaneous Speech	Patient listen and read to the question and respond accordingly, can also see the answer written if not respond then hear it and then respond, all the scores are kept.	It has three difficulty levels these depend on cues patients use and its scoring according patient using cues and time of responses.
2	Comprehension	This domain divides in written and auditory comprehension and answer according that. It contains 6 different categories each Contained 20 to 30 words, phrases, and sentences according to the need of domain; Treatment stimuli consisted of images of objects along auditory sounds writing and actions. Each word had cueing methods for practicing the word, including the picture used in the probe, other images of the word, sounds of a person saying the word, as well as discrimination tasks. In this, patients are asked to touch the picture or word of the relevant thing	Level 1: Includes two options of same category
			Level II: It includes three options same category
			Level III: it includes three option of different categories
3	Naming	The pictures of daily functional things are presented in the order and ask the client to name each item. In word fluency portion, patient repeat the phrase and sentences of relevant picture. Then the action pictures show and the client have to describe the picture. There are cues: sound from which word start, then spelling form and then written form of picture name along auditory feedback	Level 1: Includes picture and just name them
			Level II: response in phrases and sentences
			Level III: narration of pictures
4	Reading	This domain contains simple Reading of functional items list, Symbol recognition, Number Matching, Word Identification, sentence completion Oral reading, Paragraph reading. Each has four option the patient clicks the statement which match the representative item from above. If wrong response then the option colour fades out.	Level 1: Characteristic of item match to picture
			Level II: response in Functional quality manners of item
			Level III: Patients have to answer the questions after reading paragraph
5	Writing	Ask the client to see picture and write the name. fill in blacks, copy the alphabets and make word related to given picture, spell the item which you see, spell what you hear the word. Write what is happening in the picture, each contain 10 alphabets if click hints option alphabets become less.	Level I: Easy
			Level II: medium
			Level III: Difficult
6	Repetitions	Ask the patient to repeat the words listed below contain different categories then record the responses. Hints related to that word are presented in form of written and auditory form.	Level I: Easy
			Level II: medium
			Level III: Difficult
7	Automated speech	Listen to the question and respond in sequence accordingly, can get help if require from the cues and scores are kept accordingly.	-

**Table 2 Patient treatment protocol**

Week	Domains	Time duration	Goals
1-2	Spontaneous speech	Session: 08	Patient listen and read the question and able to answer
		Duration: 30-45 mints	
3-4	Comprehension skills Contains six categories	Session: 08	Patients develop understanding of 20 to 30 words, phrases, and sentences along with visual images and can touch the command word.
		Duration: 30 each	
5-6	Naming skills Reading skills	Session: 08 Duration: 30 mints each	Can produce name of daily functional things and describe the pictures in phrases and sentences. The patients able to read of functional items list, Symbol recognition, Number Matching, Word Identification, sentence completion Oral reading, Paragraph reading.
		Session: 5 Duration: 30 mints each	
7	Writing skills.	Session: 04	Patients write the name of picture and fill in blacks, copy the alphabets, and make word related to given pic, spell the item which see and heard.
		Duration of session: 30	

8	Repetition Skills	Session: 04	Patient can repeat the words from different categories	
		Duration: 30 mints		
	Automated Speech	Session: 7		Listen to the question and respond in sequence.
		Duration: 30 mints		

## RESULTS

Descriptive statistics of score calculated in terms of mean and standard deviation. The paired sample t-test was used to compare pre-and post score of VESMP, which was statistically significant ( $p=0.05$ ). The results evidently indicate that the management of spontaneous speech and comprehension is more effective for patient's verbal expressive skills.

### Demographic variations among samples

According to demographic variations 50.0% people lie in the age range 40-50 while 50.0% of people are 51-60 years old. The mean age of sample is 49 years and 87% of participants are right handed while 12% are left handed.

Table 3 Pre-and post-treatment data

Pa-tient No.	Comprehension Total Score: 202		Spontaneous speech: Total Score: 22		Repetition Total: Score 78		Naming Total: Score: 188		Reading Total: Score 98		Writing Total Score: 48		Automated speech: Total Score: 40	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
1	138	186	6	16	10	42	34	96	30	62	25	38	10	20
2	160	190	0	18	8	56	40	102	20	68	20	40	8	24
3	96	188	5	16	12	60	30	88	18	36	16	38	12	34
4	98	150	8	16	10	62	22	98	28	60	20	42	13	32
5	96	184	6	20	22	70	38	86	40	86	10	32	16	36
6	96	184	6	18	22	58	58	98	28	60	20	38	12	32
7	98	150	5	16	20	66	78	154	40	88	30	46	12	36
8	138	160	6	14	26	70	98	168	50	80	20	38	11	34

The above Table 3 reveals the pre-and post-result of each patient on all domains of VESMP and showed drastic improvement on each domain.

Table 4 Domains of VESMP

Domains	Total patients	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	p
Spontaneous speech	8	5.12 $\pm$ 1.80	17.0 $\pm$ 1.85	0.001
Comprehension	8	1.11 $\pm$ 24.9	1.75 $\pm$ 17.38	0.001
Repetition	8	13.00 $\pm$ 4.40	60.5 $\pm$ 9.11	0.001
Naming	8	49.75 $\pm$ 26.28	1.11 $\pm$ 31.16	0.001
Reading	8	31.75 $\pm$ 10.81	70.00 $\pm$ 12.78	0.001
Writing	8	20.12 $\pm$ 5.86	39.00 $\pm$ 4.00	0.001
Automated speech	8	11.37 $\pm$ 2.56	31.50 $\pm$ 6.301	0.001

Table 4 illustrates the pre-test score and post test score of each patient for treatment data of VESMP. The result show significant difference which depicts that patients show remarkable improvement in their verbal expressive skills

## DISCUSSION

The main aim of study was to enhance the verbal expressive skills of patient with severe Broca's aphasia through using VESMP a mobile application. Moreover, the programme increases the patient's independencies which were not observed in other traditional techniques. The current study is the pathway for maintaining and improving functional life to achieve and maintain quality of life. The results of different studies revealed that home based practice on the iPad through these participants were able to self-teach and was maintained the improvement [18].

The present study reveals that pre-score of patients on comprehension domain was  $1.11 \pm 24.9$  and post-test core was

1.75 ± 17.38 which shows that patient comprehension skill enhances through the software. The other study results illustrate that computer based language therapy benefit the auditory comprehension and functional communication skills of patients with severe Broca's aphasia [19].

Present study showed significant result on the spontaneous speech one of domains of VESMP. The results clearly depict that through implication of software patients show drastic change in their speech production. The study on computerized reading treatment study that contains 29 tasks along with 8 levels, patients have to maintain performance. Results revealed the positive effect of this computer-provided intervention [20]. A randomized Computer-based aphasia therapy is conducted on patient with severe Broca's Aphasia that was provided with a laptop installed program which show instant recovery with in sessions on confrontation naming tasks [20].

The result of naming, reading and writings skills from present study illustrates that their p-value was 0.01 which is significant. One of related research showed that computer treatment for sentence construction, word finding, and reading and writing had a positive effect found that computer training has an additional effect: patients who received computer training in addition to their regular therapist-delivered therapy showed greater gains in linguistic functioning than patients who only received regular therapist-delivered therapy. This indicated that computer technology can be used to increase treatment intensity [21].

According to present study the mean and standard deviation for automated speech on pre-test score was 11.37 ± 2.56 and post-test was 31.50 ± 6.301, and p-value was 0.01, designate that participants are fluent in speech. More recently, research conducted a randomized controlled trial of computer therapy with people with chronic aphasia. After five months of computer treatment, individuals in the experimental group were found to have significantly improved on confrontation naming tasks in comparison with the control group [21].

### CONCLUSION

After the conduction and analysis of this study, it is concluded that the spontaneous speech, comprehension, reading writing, naming, repetition, and automated speech skills are improved in patients with severe Broca's aphasia using VESMP.

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