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Influence of Spaced Repetition Intervention on Knowledge Retention among Community Health Promoters

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Abstract

Purpose: To establish knowledge retention (KR) baseline levels from the entry training community health promoters (CHPs) received in diverse years since 2006 in Nyandarua County, Kenya. Moreover, to determine the influence of spaced repetition (SR) intervention on knowledge retention.

Materials and Methods: Quasi experimental design through pre and post intervention tests were used and the sample (n=348) was calculated through Yamane (1967) formula at 95% confidence interval. Tests' measured KR and the use of mobile phone short message service (SMS) happened to the respondents once per week in 12 weeks after the pre intervention and before the post intervention test. The 4 key messages from the CHP training manual were relayed interchangeably, each 3 times in total. Both tests used competence based curriculum (CBC) rubrics; exceeding expectation (EE), approaching expectation (AE), meeting expectation (ME) and below expectation (BE).

Findings: With a response rate of 92% (n= 320), at pre intervention 82.2% (n=263) had BE KR which is 0-49% score and only 0.6% (n=2) had EE with a mean of 1.21 (30.25%) out of scale of 4. At post intervention the mean was 2.49 (62.25%), an improvement ratio of 2.1. The BE fell to 35.3% (n=113) and EE increased to 33.4% (n=107) at post intervention. SR was statistically significant on knowledge retention according to the Wilcoxon signed rank test results (Z = -11.919, p = 0.000).

Implications to Theory, Practice and Policy: Results confirmed the multi-store memory theory that some knowledge 'decays' before entering the long term memory but on several reminders knowledge can resurface; a further confirmation of the forgetting curve that information is forgotten over time if not reviewed. Results mean that training CHPs once without subsequent knowledge reinforcement may have less significant effects. Going forward, county government of Nyandarua should organize periodical training refreshment programs for CHPs.

Keywords: *Health, Training*
JEL Codes: I18, I26

INTRODUCTION

To equip community health promoters (CHPs), training them is of paramount importance as a way of knowledge management (KM) which entails knowledge gathering, retention and dissemination. Effectiveness of a training can be measured by the level of the training knowledge they have retained (Fiorini, 2022).

When CHPs are well-trained and supported by a continuing education (CE) as a knowledge reinforcement has capacity to improve community health outcomes. Knowledge reinforcement is an intervention to elevate knowledge retention (Dewah and Mutula, 2020; Shankar et al., 2019). Spaced repetition which is a reiteration of a particular information at certain time intervals in order to enhance its rememberance works against the forgetting curve (Stack, 2021).

Problem Statement

Knowledge gaps for CHPs still exist because evaluation for community health training programs is lacking which leads to inadequate evidence on the efficiency and effectiveness of the executed trainings (Agarwal et al., 2019). Almost two thirds, n=*2,391 (*63.2%) of CHPs recruited since 2006 in the County government of Nyandarua have dropped out, leaving only, n=1,392 (36.8%) who are the focus of this study. Kufe et. al. (2019) asserts that retention of healthcare workers (HCWs) in service also depends on their training. Studies on technology application among the CHPs are scanty in this era when the whole world is turning to technological solutions (Yadav, Dabas, Malik & Singh, 2021).

Literature Review

Health services have been in existence for more than 50 years at the community level and undergoing changes over time. CHPs are the main human resource for health (HRH) for community health. They have addressed very many health inequalities at the community leading to improved healthcare especially in low and middle-income countries-LMICs. However, community health is still burdened with staff gaps. Globally, the number of CHPs fall short by 1 million and yet the available ones lack the desired training (Brooks, 2019).

Besides training CHPs, their knowledge retention from what has been trained is key and appertains to complex and multiple processes. Knowledge retention in the brain is preceded by a mere sensory input or information which undergoes a filter network. Unnecessary information is cast-off and the contrary undergoes an organization into patterns. It then moves to the sensory memory, short term memory and finally to the long term memory where it resides forever. The human brain heeds to exceptional information which makes information with novelty get more retention in the brain. To prevent forgetfulness information is consolidated into a memory from hippocampus to the cortex in the brain after such an information is severally repeated or rehearsed (Richards, 2022). The training manual for CHVs' training organizes their training into modules which are incrementally applied from basic to technical segments in a single one continuum training, mostly at the recruitment and entry points. It does not however provide a possibility for refresher or knowledge reinforcement opportunities after that initial training like spaced repetition which is likely to render forgetfulness of what was trained rapid and immense (MoH, 2018)

In a South African study Plowright (2018) found out that short training interventions contribute to superior knowledge retention while Quadri et al. (2021) realized in India a knowledge retention increase at the end of a human health resource for health (HRH) training even though it declined towards the 12th month. Draiko et. al. (2019) also found such an increase in South Sudan where before training the knowledge retention was 42.5% but rose to 97% after training. Similarly, a Sub Saharan African study posted an improvement ration of 1.4 while

neurobiologists from the University of California agreed that some knowledge memories and the recall speed are strengthened by repetition (Ameh et. al., 2016) which also confirms the argument by Bridge (2022) that repetitions in learning improves the long term memory knowledge retention by 35%.

On the other hand, Richards (2022) indicates that multiple repetitions have the potential to bore to an extent of causing a brain mode similar to the "screen saver" in the computer. This is closer to the findings by Wong (2020), Meltzer (2021) and Lavery (2023) that only the first words are remembered instead of whole statements as far as the primacy effect theory is concerned.

FAO (2021) had indicated that training initiatives can rely more on technology known to posses great return on investments (RoI) today unlike it was before perhaps why Nyambura and Sabuni (2021) emphasizes the importance of technological investments now that Stack (2021) found out that on average perons with mobile phones check it as many times as 150 daily.

Kenyans (91%) who own a mobile phone are more than the rest of Sub-Saharan Africa (Kibuacha, 2021 and Namunwa, 2019). All (100%) Zambian human resource for health (HRH) were found to own mobile phones and amongst them 98% had SMS capabilities. All (100%) Kenyan healthcare workers own mobile phones and are said to regularly communicate with patients through SMS (Zurovac et. al. 2018). Under universal health coverage (UHC) mobile phones can be of great use. SMS option can make better the African medical and public health systems (Brown and Nieminen, 2017). According to Bastawrous and Armstrong (2019), mobile phone in healthcare is an evolution and a new space of possibilities.

According to the derring effect, Emamzadeh (2022) noted that making mistakes and correcting them improves the memory in the brain which makes it suggestive that pre and post intervention tests are likely to increase the knowledge retention expontially whenever applied. Edapp (2022) also postulated that whenever questions are used as a training strategy, learners are more motivated to learn and their knowledge retention increases higher when Ballard, et. al. (2018) asserts that assessing health knowledge and competencies among HRH is important. At the same time, Sonowski (2018) has a view that tests with a grading system can effectively measure the learning goals if at all those goals are available. Additionally, Kuehn (2022) pointed that pre- intervention tests are diagnostic in nature as much as they are a basis for tracking a trainee's progress in knowledge retention.

SMS and the mobile phone technology interventions are likely to influence the HRH behavior in tackling universal health coverage (UHC) challenges according to Brown and Nieminen (2017). Mobile phones have the capacity to revolutionize CHPs' as well. In support of this, Amref (2016) had realized that the CHPs' basic training almost and permanently marked the end to their health training and therefore unveiled the mHealth solution in 13 (28%) of the Kenyan counties which gave a tremendous improvement in knowledge retention and application improvement. Ninety-nine percent of the Narok HRH registered a better job performance after receiving a training (Momanyi et. al., 2015). Mobile phones are an opportunity that is unique among CHPs in the sense that whenever used it has enabled them to have access to healthcare information. A western Kenya study plainly indicated that CHPs were able to use most of the available mobile phones for SMS and that paper based methods were found to be more laborious yet the same has not been used to train or to reinforce their knowledge (Nandasamba, 2024).

The general memory process theory identifies the cognitive processes of memory which are encoding, storage and retrieval. Encoding is the reception of information (sensory input) which is converted in readiness for storage and the information may be visual, acoustic or semantic. The memory capacity of the brain entails the quantity of information stored and the duration it

is stored. The sensory memory store is large but stores information for a brief duration. This is contrary to the long term memory which has unlimited storage duration and storage capacity from where information retrieval happens everytime the information is needed in the future (McLeod, 2021).

The "learning pyramid," demonstrates that knowledge retention depends on the knowledge delivery methodologies where active teaching provides higher retention as opposed to passive approaches. Group discussions which is an example of an active approach are known to contribute to 50% knowledge retention and practice 75%. Teaching effects 90% knowledge retention, lecture 5%, reading (10%), audio visual (20%) and demonstration (20%). Learners retain more knowledge and also experience better content understanding if they write hand notes during training unlike those who store notes in digital devices. More teaching methods when blended can improve the learning pyramid approach. Besides, micro learning where a large learning content is split into smaller chunks and spread over a period of time has also been effective in contributing to knowledge retention (Colman, 2020).

Memory problems may be reflections of the brain structure and its function in relation to age as well. To deal with forgetfulness, several strategies need to be put into play. More learning make the brain more active and therefore stronger to store information. The brain cells become active to retain more information when challenged. Coincidentally, more knowledge is retained when learning engages more senses (Harvard Medical School, 2020).

Theoretical Review

According to the multi-store memory theory, part of knowledge "decays" before heading to the long term memory where it is stored for a lifetime. When the knowledge risking a decay is rehearsed, the expected decay is stopped. Proponents find this theory an enabler for theory expansion but the opponents dislike its oversimplification. This theory has been confirmed by other theories and in whatever may seem to expand it the "primacy theory" postulates that the mind is mostly able to remember only the first words in a sentence or from a piece of information and therefore repetition is not really the major component. Critics also suggest that there are many more types of recalls without explanations beyond the multi- store memory theory (Moses, 2019).

Conceptual Framework

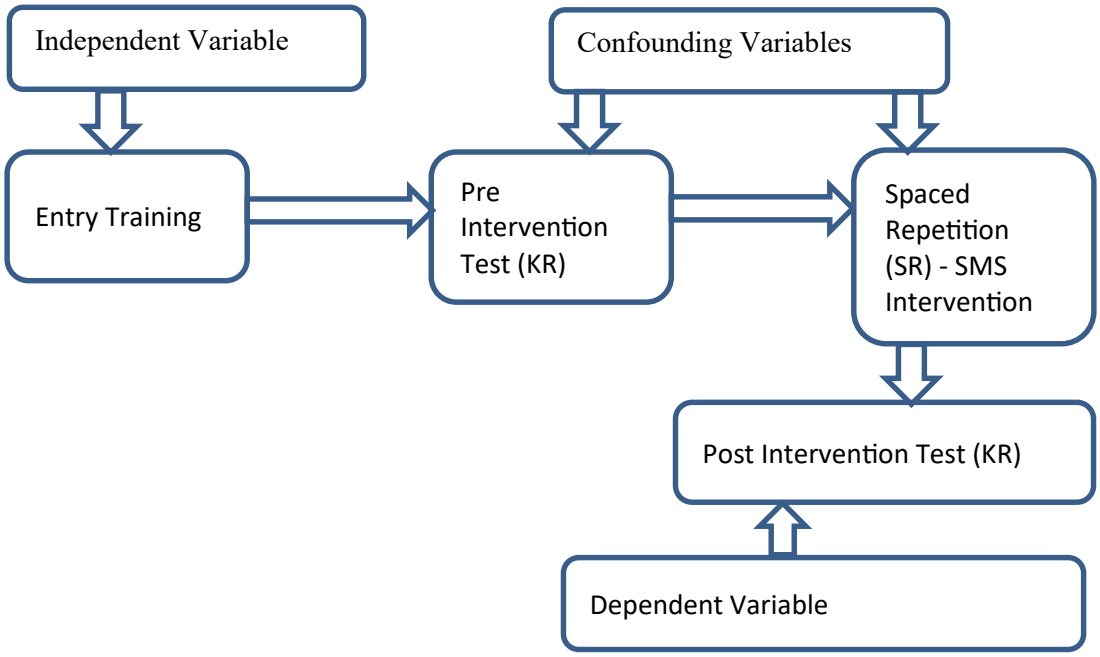

Figure 1: Conceptual Framework

Research Gaps

Would the knowledge retention increase further if spaced repetition went beyond three months that it happened?
Why was there a drop of knowledge retention among 5% (n= 16) of the respondents and no change in more than a third, 36.6% (n= 117) in the post intervention test yet all of them were under the same treatment?
Why was the level of knowledge retention at approaching expectation almost the same in both the pre intervention and post intervention test even after spaced repetition intervention?
What is the association between knowledge retention and high CHPs' dropouts?
What is the relationship between knowledge retention and the CHPs work performance?

MATERIAL AND METHODS

Study Design: Quasi experimental.

Study Location: Nyandarua County, Kenya.

Population: Study population were all the CHPs (36.8%) in the service (n= 1,390) of the County government of Nyandarua.

Sample and sampling techniques: Sample size (n=348) was calculated through Yamane (1967) formula at 95% confidence interval. Community health units (CHUs) were randomly selected from all the 25 wards in the county and another one from each of the five subcounties to back up data, all totaling to 30 community health units (CHUs).

Data Collection: Every CHP from the randomly selected CHUs who came for the monthly meeting during data collection and had a mobile phone for the relaying of the SMS (spaced repetition) was interviewed. Baseline knowledge retention was collected through a pre intervention test and 4 key messages from the CHP training manual were relayed interchangeably; one message per week for 12 weeks to the respondents which ended with a post intervention test for measuring the change in knowledge retention.

Statistical Analysis: Data was verified, cleaned, coded and computed through SPSS package for descriptive and inferential analysis using Wilcoxon signed rank test.

FINDINGS

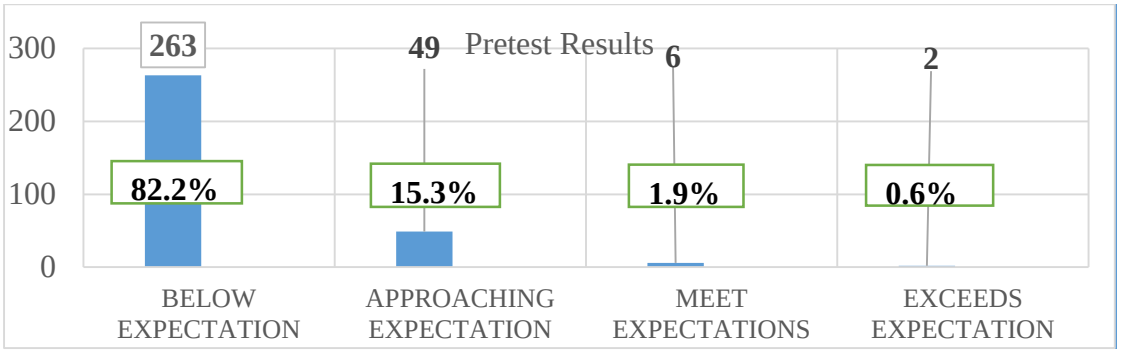

Figure 2: Pre-Intervention Test Results

Figure 2 above indicates that majority (n= 263; 82.2%) of respondents' knowledge retention was below expectation (0- 49%).

Table 1: Mean of Pre- Intervention Test Results

Parameter	N	Mean	Min.	Max.	Median	Std. Dev.
Pre-test	320	1.21	1	4	1.00	.491
%	92	30.25				

Table 1 above shows that the mean knowledge retention for the respondents was 1.21 (Below expectation).

Table 2: Mean of Pre Intervention and Post Intervention Test Results

Parameter	N	Mean	Min.	Max.	Median	Std. Dev.
Pre- test	320	1.21	1	4	1.00	.491
Average		1.85	1		2	1.384
Post- test	320	2.49	1	4	3.00	1.278

Table 2 above indicates that the mean score rose from below expectation (BE) of 1.21 (30.25%) to approaching expectation (AE) of 2.49 (62.25%) after the three months' (12 weeks) of spaced repetition (SMS).

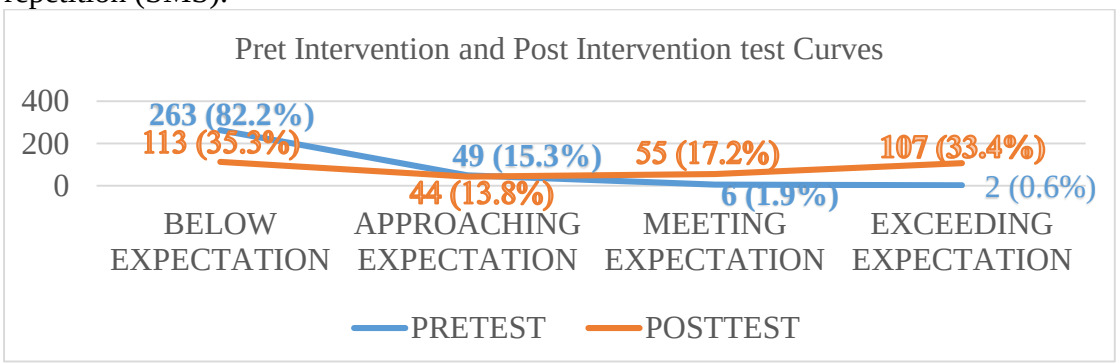

Figure 3: Pre- Intervention and Post- Intervention Curves

Figure 3 above indicates the broadening knowledge retention gaps at the extreme ends, an intersection and a lag phase at the approaching expectations (AE) point in the middle.

Table 3: The Change between Pre- Intervention and Post- Intervention Tests

	Mean (M)	Gap	% Increase	% Difference	Improvement Ratio
Pre-Intervention	1.21 (30.25%)				
	1.85 (47.25%)	1.28 (30%)	106	52	2.1
Post-Intervention	2.49 (62.25%)				

Table 3 above indicates that 106% was the percentage increase with an improvement ratio of 2.1 and a percentage difference of 52%.

Table 4: Wilcoxon Signed Ranks Test Results

Ranks				
		N	**Mean Rank**	**Sum of Ranks**
Post Intervention Test	Negative Ranks	16[a] (5%)	31.19	499.00
Pre Intervention Test	Positive Ranks	187[b] (58.4%)	107.55	20004.00
	Ties	117[c] (36.6%)		
	Total	320 (100%)		
a. Posttest < Pretest; b. Posttest > Pretest; c. Posttest= Pretest				

Table 4 indicates that 5% (n= 16) respondents had higher Pre- intervention than post-intervention test scores after the spaced repetition (SMS). However, 186 (58.4%) had higher scores after SMS while 117 (36.6%) had no change.

Table 5: Wilcoxon Signed Ranks Test Statistics

Test Statistics[a]	
	Post-test Pre-test Grade
Z	-11.919[b]
Asymp. Sig. (2-tailed)	.000
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

Table 5 above shows a statistically significant change between the pre and post intervention tests. The asymp. Sig. (2-tailed) p-value (p= 0.000) was Z = -11.919, p = 0.000 which was a statistically significant change.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Majority of CHPs had a below expectation (0-49%) knowledge retention and;
Training CHPs once without subsequent knowledge reinforcement programs may have less significant effects;
Spaced repetition had a significant influence on knowledge retention among the CHPs.

Recommendations

The county government of Nyandarua, Kenya should organize periodical training refreshment programs akin to spaced repetition to help the CHPs retain the knowledge they receive from their trainings.

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Conflict of Interest

I declare that I have no conflict of interests as far as this work is concerned.

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