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## ORIGINAL PAPER

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# HOW MANY REPETITIONS OF CHILD CARE SKILLS ARE REQUIRED FOR HEALTH WORKER STUDENTS TO ACHIEVE PROFICIENCY? LEARNING CURVE PATTERNS IN CHILD CARE SKILLS ACQUISITION

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## ABSTRACT

**Introduction:** The vulnerability of children under 5 years old requires paying more attention to the health of this group. In the Iranian health care system, health workers are the first line of human resources for health care in rural areas. Because most health workers begin working in conditions with minimal facilities, their clinical qualifications are crucial. The aim of this study was to determine the number of repetitions of child care skills, required for health worker students to achieve proficiency based on the learning curve. **Methods:** A time series research design was used. Participants in this study were first year health worker students enrolled in three health schools in 2011. Data were collected using a questionnaire consisting of demographic information and a checklist evaluating the health worker students' clinical skills proficiency for child care. Data were analyzed using SPSS version 16.0 software (SPSS Inc., Chicago, IL) using descriptive and inferential statistics including Kruskal-Wallis and Pearson correlation coefficient tests. **Results:** Learning curve patterns in child care skills acquisition showed that for less than 20 and between 20 to 29 times, the level of skill acquisition had an upward slope. Between 30- 39 the learning curve was descending, however the slope became ascending once more and then it leveled off (with change of less than 5%). **Conclusion:** It seems that 40 repetitions of child care skills are sufficient for health worker students to achieve proficiency. This suggests that time, resources and additional costs for training health worker students' trainees can be saved by this level of repetition.

**Key words:** Learning Curve, Health Worker, Child Care, Clinical Skills.

## 1. INTRODUCTION

Millennium Development Goals (eradication of poverty, reducing child mortality) would not be achievable without cost-effective interventions in health and nutrition. In the Islamic Republic of Iran, following the Alma Ata meeting in 1976, and after determining strategies for primary health care, a great revo-

lution occurred in the healthcare delivery system (1, 2). Now, the first level of primary health care (PHC) is provided by a set of healthcare houses and centers through multiple professional health workers and trained rural midwives (3).

PHC includes a range of healthcare services, of which maternal and child health are the most important. Today, govern-

ments are committed to providing access to healthcare services for all segments of society, especially vulnerable groups (such as women and children) (1). The vulnerability of children under 5 years old makes it necessary to pay special attention to this group, both in terms of access to health care and drugs prescription in times of sickness, as well as preventive health care for children (4). Child screenings are performed using a form designed for the purpose of determining child's general conditions including risk factors, growth, weight, head diameter, and the mother-child relationship (5, 6).

Improvement of the quality of child health care is one of the World Health Organization's (WHO) goals and to achieve this, different efforts should be made. Growth monitoring during pre-school ages (under 6 years) should be performed for all children once a month in the first year, every two months in the second year, every three months in the third year and once every six months thereafter, so that the growth curve is drawn regularly and any growth problems diagnosed immediately (1, 5-8). Also, it is generally acknowledged that children's needs during childhood are not limited only to providing physical care; rather children need all-encompassing care which includes their social, emotional, identity and intelligence growth. The high quality relationship between children and their parents, particularly with their mothers, plays an important role in the child's identity formation, social interactions and mental health development in the future. Thus, evaluation of the quality of the relationship between mother and child is one of the important issues for health care services (9, 10). In addition, due to the vulnerability of children less than 5 years of age, early identification and assessment of general warning or danger signs is important for providing appropriate and special care (6).

Providers of these services in rural areas are health centers and houses which are run by health workers. Health workers with minimal education and facilities provide services locally in the health houses for people, except for a few cases where patients are referred to doctors (1, 2, 11). In Iran's healthcare system, over 100,000 health care providers provide health services to 70 million people, of which 33 thousand are health workers. Health workers have played a basic role in the success of the PHC system for a long time. In the country's healthcare system, health workers are the front line of the workforce providing health care and treatment in villages. These workers are typically assigned to serve in the region of their own birthplace after passing a two-year period of theoretical and practical education. The health workers' service packages are based on the description of their organizational tasks including geographic population identification of the village, hygiene and family planning, integrated mothers health care, health education, infectious and noninfectious disease evaluation, vaccination, child care, occupational health, environmental health, and so on. In most rural areas, health houses are the only centers to provide health services (12-14). Health workers are employed after two years of theoretical and practical training in health house and they are responsible for work in various fields (15). The purpose of these educational courses is to train individuals to work as a health worker and to perform different tasks in this context. The main features of these courses should be exactly in accordance with predetermined educational goals.

The purpose of clinical teaching is to prepare the students to develop the competencies and professional skills in order

to guarantee the quality of care provided by them. Although the repetition of skills performance may be associated with an increased clinical competence, but very few studies have been conducted about the standards for the number of repetitions of doing a skill in which students achieve proficiency (16). To set an objective criterion which indicates the sufficient number of every skill repetitions, the level of proficiency of the skills can be determined for each of the skills which are called learning curve (17, 18).

The experience of researchers shows that the extensive tasks of health workers at health houses and the need to providing the desired services to rural society, limited facilities of health houses and cumbersome routes to most health houses greatly increases the need for health workers qualified in clinical skills to perform their tasks to the best way. Since health houses in the majority of rural areas are the only centers for providing health services, the health workers' mastery of educational contents has a direct effect on villagers, especially on the children under 5 years old of that community as a vulnerable group (15, 16). Therefore, the current study aims to evaluate the number of repetitions needed for health worker students to achieve proficiency in child care skills.

## 2. MATERIALS AND METHODS

The present study has been conducted using a time series research method, in which the observations or measurements is performed repeatedly during a set period (19). The research population included students enrolled in the first year of training courses for health workers in three health schools during the first educational semester (autumn and winter) in 2011-2012. Given that the health worker students were visiting these educational centers to take clinical training courses, and these centers were able to provide the suitable environment required for our research, these centers were selected as the research environment.

Using the census method all health worker students who were enrolled at the time of research and met the inclusion criteria were selected by researchers. These criteria include passing the child care course with satisfactory grade, the absence of any defects or diseases that would cause difficulty in performing child care skills and taking the course for the first time. Exclusion criteria included absence during the training course for more than 3 days and not being physically or psychologically ready (at the discretion of the instructor coworkers). Hence all 54 health worker students in the study were enrolled at the time of the study and therefore no one was excluded during the study. In order to prevent any interference with the routine educational activities of the center, students participating in the study were attending the school in groups of four, in the morning during a 15-week training period (except for holidays) at 11 health houses.

After institutional research committee approval and explaining the purpose of the study to the health worker students and obtaining their written informed consent, researcher began to collect the data in the target health houses. During the study period, the skill training was planned by the researcher and carried out by the learners and then after, their impact on the level of the skills gained by the students was measured. For data collection, the researchers made a questionnaire consisting of two parts. The first part included the health worker students' demographic characteristics such as age, the grade obtained in the theoretical child care course, the trainees' grade point aver-

age and the name of the training center. The second part was a checklist developed to measure the level of students' proficiency in performing child care skills. The evaluation of proficiency in child care skills included 4 relevant skills and sub skills. These 4 skills were selected based on their importance from the point of view of health provider experts' and included: the assessment of the child's general warning or danger sign with two sub skills, the assessment of child's weight status with three sub skills, the assessment of the child's height with three sub skills, and advice on interrelationships between mother and child.

The initial check list was prepared according to the latest resources available in health providers training courses and was reviewed in a meeting attended by six members of the health care instructors (20). The resulting check list was re-evaluated in a pilot study in a health workers school in 2011, and after making the necessary changes, it was prepared to be used in this study. Therefore, the validity of the data collection tool was approved through content validity (using the most recent books and articles, and opinions of experts, including specialists). The reliability of the check lists for measuring proficiency in clinical skills was verified by the observer agreement method ( $r = 0.9$ ).

Since traveling to the health houses, where the health worker students were working, was difficult due to the road problems, the researcher(s) referred to health houses once a week. Therefore performing the skills and evaluating expertise took place once a week during the 15 weeks of the training course. Each student recorded the number of repetitions of each child care skill, with the approval of the responsible health care provider in the relevant checklist. The researcher recorded on a learning curve the scores resulting from the checklist after each observation of skills practiced by students and with respect to the number of previous repetitions of the skills. The concept of a learning curve is a potentially powerful tool to determine an objective criterion that represents the sufficient number of repetitions of a given skill (18).

Learning curve theory was introduced in the nineteenth century as one of the important concepts of learning, and it is based on the fact that the time required for execution of an activity is decreased by its repetition. In fact, changes in the skill of a person with respect to the number of times performing a skill is called a learning curve. The curve is plotted in a coordinate system, so that on the horizontal axis the numbers of times performing the skill and on the vertical axis the competency of the learners is plotted (21, 22). The learning curve can be used for simple skills such as memorizing a word, intermediate skills

such as establishing an intravenous line and complex skills such as cystoscopy or other surgical procedures (17, 23-26).

Measuring the level of the skill was continued until a plateau in the learning curve was achieved or a proficiency level of 75 to 100 percent was reached. The criterion for supposing a smooth learning curve is a variation of less than 5% of the curve (17). In the situations that after the 15 weeks of the training course this criterion was not achieved, the evaluation of proficiency level should have been continued, however, all learners achieve the required proficiency before the end of training course.

Data were analyzed using SPSS version 16.0 software (SPSS Inc., Chicago, IL). Descriptive statistics were used to calculate the frequency and the mean and standard deviation. Comparison of the number of consecutive proficiency skills was performed by the Kruskal-Wallis test and plotting the learning curve for each skill. The Pearson correlation test was used to examine relationships between variables. A p-value of 0.05 or less was considered statistically significant.

### 3. FINDINGS

All participants in this study were women. The mean age was  $20.6 \pm 1.7$  and the minimum age was 18 and a maximum was 26 years old. Half of the participants ( $n=27$ ) were single and the other half were married. Most students in the study had a diploma in experimental science ( $n=36$ ), human science ( $n=12$ ), Technical-vocational ( $n=2$ ) and Mathematics ( $n=4$ ). The GPAs of health worker students were from 13.7 to 19.5, with an average of  $16.5 \pm 1.8$ .

The results of Kruskal-Wallis test (Table 1) showed that the average amount of child care proficiency in controlling infants less than 2 months old in terms of the general warning or danger sign, child weight status assessment and child's height status assessment had statistically significant changes ( $P_1=0.01$ ,  $P_2=0.005$ ,  $P_3=0.005$ ), but the average skill in counseling on the relationship between mother and child had no significant changes ( $P_4=0.1$ ).

The learning curve for skill proficiency of students in doing the selected child care skills shows that the average proficiency of the students was more than 85 percent. The change in skill levels for less than 20 repetitions and between 20 and 29 was less than 5%, but between 30 to 39 repetitions the change was more than 5% and the slope of the curve was downward (the level of expertise reduced). Through the next repetitions, the curve slope gained an upward trend again but its changes were less than 5% and therefore it is regarded as a straight line.

Number of doing the skill	Number of persons	Lever of proficiency (Mean $\pm$ SD)				Proficiency percent			
		First Skill	Second skill	Third skill	Fourth Skill	First skill	Second skill	Third skill	Fourth skill
Less than 20	12	18.7 $\pm$ 0.5	19.6 $\pm$ 0.5	19.2 $\pm$ 0.8	19.3 $\pm$ 0.7	93.5	98.1	96.3	96.6
29-20	4	18.2 $\pm$ 1.5	19.7 $\pm$ 0.5	19.6 $\pm$ 0.4	19.7 $\pm$ 0.5	91.2	98.7	98.3	98.7
39-30	9	17.2 $\pm$ 1.5	18.5 $\pm$ 1.0	18.0 $\pm$ 1.2	18.4 $\pm$ 1.1	86.3	92.5	90.0	92.2
49-40	20	17.7 $\pm$ 0.9	18.7 $\pm$ 0.8	18.4 $\pm$ 0.9	18.7 $\pm$ 1.0	88.9	93.6	92.2	93.5
59-50	4	5/0 $\pm$ 7/17	7/0 $\pm$ 2/18	7/0 $\pm$ 1/18	7/1 $\pm$ 5/18	7/88	2/96	8/90	5/92
70-60	5	17.0 $\pm$ 1.1	18.6 $\pm$ 1.02	18.2 $\pm$ 0.7	18.4 $\pm$ 2.6	85.0	93.3	91.3	92.0
Sum	54	17.8 $\pm$ 1.1	18.9 $\pm$ 0.9	18.6 $\pm$ 1.0	18.8 $\pm$ 1.2	89.4	94.6	93.0	94.1
Kruskal-Wallis test result, df = 5		P = 0.01	P = 0.005	P = 0.005	P = 0.1				
Chi-square						14.3	16.5	16.5	8.02

Table 1. Average level of proficiency in doing the skills of the child care according to the number of doing in health worker students

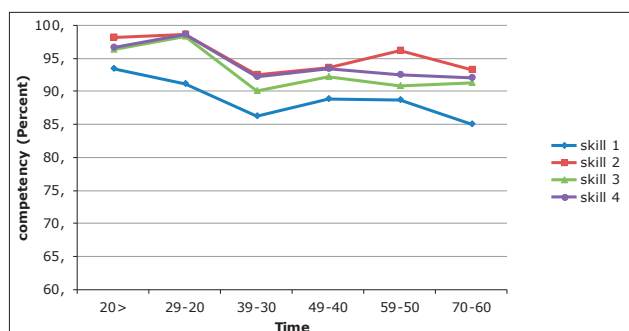


Figure 1. The learning curve to master the skills of the students doing 4 units of study in child care

The Pearson correlation coefficients showed that there was a direct relationship between the theory and clinical scores (total score of skills) of the students ( $P=0.000$ ,  $r=0.5$ ). This means that as the theoretical test score of the learner was higher; her clinical exam score was also greater.

#### 4. DISCUSSION

Learning is a relatively stable change in the behavior or personal potential which occurs as a result of enhanced training (16, 18). Through the learning curve, a standard for the number of repetitions of clinical skills can be generated. This is one of the first studies in which learning curves are used to determine the number of repetitions of child care skills by health worker students.

The learning curve of the child care skills in this study indicate that by less than 20 and from 20-29 repetitions of the skills, the gained level of proficiency had an upward slope, but then almost all the skills had downward slopes, and after 40 repetitions the curve considered straight line (with changes is less than 5%). These curve changes show that during the early repetitions of a skill, the increase in proficiency was greater, and it declined afterwards. Reduced levels of proficiency during consecutive repetitions can have many explanations. These include training intervals, learning environment and individual characteristics of the learners (17, 27). However, what seems to be the reason for the curve changes in the current study is a reduction of precision and focus in some details due to skill acquisition of the students, which is probably due to a false sense of confidence about the acquisition of sufficient skill and decreasing of the fear and stress of doing the skill. Benner also points to the subject of sense of mastery and proficiency in the early stages of skill acquisition (28). The results of studies that have been conducted by Son et al. (24), Burritt et al. (29) and Yung et al. (30) revealed that at the beginning of repetition of a clinical skill, there is an upward trend in the learning curve, but then the trend will either go downward or it becomes a straight line which is consistent with the result of the present study. The use of flat learning curve criteria for determining a standard is based on the idea that although the amount of proficiency increases in each repetition of a skill, its variation gradually reduces so that it almost becomes a straight line. Although after this stage there are changes in skillfulness, it is not significant. Clinical education is expensive, and the extensive work of trainers, shortcomings in human resources and standardized training are all problems in the context of education (31). With the use of a standard learning curve and a determined set of skills, it is possible to have both greater access to an effective clinical

education and cost savings. Instead of spending time on mastering a clinical skill which has already been acquired, time and effort can be put toward performing the skills that are not yet sufficiently acquired.

The results of this study have shown a significant correlation between students' theoretical and clinical scores, and this indicates that clinical performance is influenced by information and knowledge. An effective connection between education and clinical practice requires a two-way interaction between them, meaning that theoretical knowledge should be based on the realities of clinical practice and on the other side clinical performance should benefit from theoretical knowledge. This interaction guarantees proper functioning and development of the profession (32, 33). Training programs have a significant impact on the educational and practical success of learners. It has been stated that the application of theoretical concepts in practice is a major factor for acquiring professional skills in learners (34).

One of the limitations of this study was the absence of researcher (s) at the location of the studies on all training days because of the difficulties of traveling to these places. Therefore it was not possible to observe every time a skill that was practiced by the health worker students. Another limitation of the study was the lack of male trainees in the study, and therefore the impossibility of using the random sampling.

#### 5. CONCLUSION

The study showed that approximately 40 repetitions of a child care skill are sufficient for health workers' students for acceptable proficiency acquisition. However, the number of times that these skills are normally is practiced by health workers students is much greater than that. Therefore, by proper educational planning in this regard, resource wasting, which is a universal challenge in education, can be avoided. For this reason it is recommended that instead of practicing the skills in which proficiency has already been achieved, the current resources should be directed towards satisfying the new requirements of health workers in future.

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