# Simulation Training Program of Pediatric Appropriate Technology Improves Knowledge for doctors and nurses in Zanzibar: A Quasi-experimental Study

**Li WANG**
Hunan Children's Hospital
**Qing-qing SONG**
Hunan Children's Hospital
**Li-hui ZHU** ( 877845375@qq.com )
Hunan Children's Hospital
**Xiang DING**
Hunan Children's Hospital
**Jun QIU**
Hunan Children's Hospital
**Shi-ying LIU**
Hunan Children's Hospital
**Xuan-dong WEI**
Hunan Children's Hospital
**You-you LIANG**
Huan Children's Hospital

**Research article**

**Keywords:** Simulation Training, Pediatric, Care, Zanzibar, Health foreign aid

**Posted Date:** April 27th, 2020

**DOI:** https://doi.org/10.21203/rs.3.rs-22657/v1

## Abstract

**Background:** Due to the limited human resource and medical materials, the mortality of children under-5 was high in Tanzania. Systematic and effective training programs for pediatric medical staffs are required. Thus, aim of this study was to describe and test a simulation training program of pediatric technology for doctors and nurses in Zanzibar.

**Methods**: A simulation training program of pediatric appropriated technology was designed and performed in this quasi-experimental study, in which pre-post self-reported of pediatric knowledge (scoring 0-100) of participants were calculated to analysis the effectiveness of this simulation training in Apr, 2018 and Oct, 2018. Correctly answering of items≥80% was considered to be a pass. Data were entered and analyzed in SPSS 22.0 software to test the hypothesis.

**Results:** 56 participants were finally included in this study with 27 doctors and 29

nurses. Pre and post test scores of pediatric knowledge were at mean 44.32 (SD 9.53) versus mean 82.11 (SD 11.06) respectively, $p<0.0001$. The most effective training domain was (pediatric life support) at 44(78.57). Passing rate of pediatric knowledge increased dramatically after training with p value less than 0.0001. Although there was a mild difference between doctors and nurses at scoring of pre-test ($p=0.048$), the training effect between them had no statistical differences ($p>0.05$).

**Conclusion**: The scenario simulation training course of pediatric appropriated technology could significantly improve pediatric knowledge for doctors and nurses in Zanzibar. It might be further promoted as one effective module of training in health foreign aid.


## Introduction

Children are the future of our human beings; thus, it is our priority to offer quality care for neonatal and children under-5 according to the United Nations Sustainable Development Goals (UNDP). As a systematic analysis by the Global Burden of Disease [1] published on Lancet 2017 stated that mortality of children under 5 years old was about 38.4 (34.5 to 43.1) per 1000 livebirth, while this data increase by 55.7 (48.2 to 65.3) per 1000 livebirth in Tanzania, means that the mortality of children under 5 years old being almost 1.5 times of the global health data. Pediatric health condition in these areas require more concern and effort. Leading cause of death in children under-5 years old in sub-Saharan Africa was pneumonia, diarrhea and intrapartum-related events [2]. Study on 247,976 deaths over a 10-year period in Tanzania found that Leading death of in-hospital patients were respiratory diseases (10.08%) and anemia (7.78%). Death among children under 5 years has shown an increasing trend in neonatal disorders by 128% [3]. Zanzibar belongs to Tanzania with a population of 1.3 million. Although the help babies breathy (HBB) training program and the Integrated Management of Childhood Illness (IMCI) Strategy for Children Under Five [4] has been performed across over hospitals of Tanzania[4-5]there is still high mortality rate of children in that country [5], The reason why this condition occurred in Zanzibar are due to its insufficient human resources and lack of medical facilities and equipment [6], thus leading to an urgent requirement for systematic and standardized appropriate pediatric care technology training of medical staffs, so as to improve children health and decrease mortality rate in children under 5 years old.

Medical Simulation Training began in 1960 with the clinical use of the Resusci-Anne model, it is worldwide spread since then [7]. Application of simulation training was mainly in surgical training[8-12], trauma education [13], emergency medical treatment [14], Neonatal Resuscitation Program(NRP) [15], Pediatric Life Support Training[16], nursing education[17-18] among residents, medical students, doctors, nurses and other medical staffs. Conducting of cased-based simulation training could dramatically improve the clinical skills of health care workers, positively influenced intern outlook and attitude, promote the prognosis and outcome of patients, enhance multidisciplinary team work and has economic benefits and economic effect advantages [19-25].

Thus, the aim of this study was to describe one appropriate pediatric technology simulation training program at two different islands of Zanzibar and to test its effectiveness while application in order to improve the ability of emergency response and treatment skills of pediatric doctors and nurses.

## Methods And Materials

### Study design

A quasi-experimental design was performed in this study, in which self-reported of pediatric knowledge score of participants were calculated to analyse the effectiveness of this simulation training program.

### Study setting

Hunan Children's Hospital was a tertiary hospital located in south central China with a total of 1200 beds and more than 2000 medical staffs only doctors and nurses. It is also the national pediatric foreign aid training base of Chinese Ministry of Commerce, has trained more than 1200 international trainees from more than 25 countries mainly from low-resource countries.

### Ethnic consideration

The study was approved by Hunan Children's Hospital ethics commission board, (approving number: HCHLL-208-03) and all written consent were signed by participants.

### Course participants

Pediatric medical staff who volunteered to attend this foreign aid training in two islands of Zanzibar in Apr, 2018 and Oct, 2018 were included in this study. Inclusion criteria were: a) Medical staff of pediatric departments, wards and hospitals in Zanzibar Island, with a total hospital beds over than 50; b) With an English medical education background; c) Obtaining a medical practice certificate; d) Volunteer to participate in this training course and sign the written informed consent; Exclusion criteria were: a)Temporary or un-formal employed staff; b) Residents or nurses who did not finish basic medical training; c) maternal or sick leave more than 1 month during this training year or attending other training program over than 1 months; d) failed to complete all training program; e) the completion rate of the knowledge questionnaire is less than 80% or there is a clear bias on the choices of all answers;

### Course design

**Pre-investigation in Zanzibar:** 5 pediatric specialists were sent to Zanzibar to conduct a pre-investigation by focus group interviewing with administration leaders of Zanzibar hospital in order to evaluate the current status of pediatric epidemiology in Zanzibar, and to know the main cause of death under 5 years old, common admitted disease and training requirements, then to determine the training methods based on local phenomenon. Results showing that the common diseases admitted in pediatric wards were pre-term, malnutrition, pneumonia and diarrhea in Zanzibar.

**Training team set up:** The training team consists of 10 medical doctors and nursing specialists with a title of deputy or above in one tertiary children's hospital, including 5 doctors and 5 nurses, with an English level of IELTS over than 6.5. 5 Medical doctors are responsible for preparation of courseware presentation according to pre-survey result, major in neonatal resuscitation, pediatric basic life support, pneumonia management, nutrition assessment and support, diarrhea and fluid therapy and prevention and control of hospital infection; 5 nurses are responsible for the preparation of training facilities and equipment and other translation task. 3 officers of the International Cooperation Department of children's Hospital is also equipped to assist and help in recruiting trainees, training venue layout, training implementation and other logistics support.

**Appropriate technical curriculum design:** The training course is based on the reference of 2017 Neonatal Resuscitation Program (NRP) case training program released by the Canadian Academy of Pediatrics, Pediatric Basic Life Support(PBLS) and Pediatric Advanced Life Support(PALS) of 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendation and "Integrated management of childhood illness (IMCI) strategy for children under five reviewed by the Cochrane database 2016 [26-29]. 6 topics/domains were included in the end, as Neonatal Resuscitation Programm (NRP), Pediatric Basic Life Support (PBLS), Pneumonia management, Fluid therapy, Nutrition assessment and support, and Prevention and control of hospital infection in pediatric wards. The training sites was set in the conference rooms of the central hospitals on the two islands of Zanzibar. Each training program lasts for five days, with 2 days of theory lectures and 3 days of simulation practice.

At the beginning of the training, the teacher will explain the theoretical course in presentation with all trainees in the conference room. A unified explanation of the six domains designed in advance are given, aiming to build a general theoretical framework for the students. Key contents including: I, How to determine and calculate children's fluid requirements, basic principles of diarrhea treatment in children; II, The importance of nutritional assessment for children and how to provide total parenteral nutrition support; III, how to diagnose pneumonia in children, standard treatment process and the main selection criteria of antibiotics; IV, prevention and control of hospital infection in pediatric wards and hand hygiene; V, Steps and implementation process of NRP; VI, PBLS flow-gram processes and key points.

At scenario simulation practice, whole conference room were divided into 5 arears, 5-6 Students and 2 teachers (1 doctor, 1 nurse) were distributed into isolated areas, with a teaching ratio of 2: 5-6, a set of operating tools (including: 1 table, 1 set of neonatal asphyxia resuscitation simulation model,1 set of pediatric basic life support simulation model, 1 set of pediatric venous indwelling model, related medical equipment and appliances). The training process is shown in Figure 1.

### Scenario simulation practice

Scenario simulation practice includes four steps: Case selection- Instructor-led technic teaching- Case analysis- Scenario procedure simulation.

Firstly, Case selection and design. Before the training, the experts of the training team would select some typical cases according to the training content, transcript cases, and compile the case information into a reminder case-card. Case selection criteria were children younger than 16 years old, length of hospitalization <2 weeks, without congenital disease or any other surgical requirements etc. Cases including changes in the illness condition who require basic life support, new admitted patients required neonatal pulmonary resuscitation, different types of children with pneumonia, diagnosed hospital infection, diarrhea and malnutrition. For each topic at least 4 cases were selected with a total of 30 case card were made. In the process of case selection, patient privacy should be taken into consideration, without true personal information appearing on the case card such as name, hospital number and family address. The case card would be distributed to the trainees before simulation practice, encourage them to analyze and make consideration about the cases in advance.

Then case information of case-card was interpreted by the teachers, and students were invited to try to propose specific clinical treatment plans and related clinical technical skills. Then teachers would summarize and analyze the case details, give and introduction and diagnosis of all involved diseases, offer standardized treatment plans and related skill procedures. The aim of this process was to help students focus on each individual characteristic, build one comprehensive diagnosis and treatment plan, Strengthen their sense of cooperation, critical thinking ability and comprehensive ability on disease diagnosis and treatment.

Secondly Instructor-led procedure teaching. The teachers will select cases that includes all procedures required for systematic teaching, emphasis on standard skill procedures and assessment indicators in the form of one-to-one procedure demonstration. The procedures including: Apgar scoring, newborn care, positive-pressure ventilation, endotracheal intubation and use of laryngeal mask, chest compression, administration of medications, placement of peripheral vein catheter and hand hygiene, and treatment plan determine.

Thirdly, Case analysis. The case information of case card was asked, and students were invited to try to propose specific clinical treatment plans and related clinical technical skills designed for the case. Summarize and analyze case details, introduction and diagnose of involved diseases, standardized treatment plans and related skill procedures. Focusing on each changing individual, which requires comprehensive diagnosis and treatment. Strengthen the teamwork awareness, problem thinking ability and comprehensive diagnosis and treatment ability of medical staff.

In the end, Scenario simulation practice. Participants would simulate the clinical treatment process in pairs, make treatment plans and perform clinical procedures according to the instructor/teacher who acts as the debriefing facilitator, judge if the trainees making correct judgements. If the judgments were correct, procedures would be carried out smoothly. If not, simulation stopped and the teacher would revise it correctly then guide the students in right way. They are going to work together as a team to follow the NRP and PBLS flow diagram. During simulation not only the case study was assessing but also the procedure learning was taught by giving one-on-one teaching method and detailed instructions. Trainees alternate roles and perform procedures one-by-one. The simulation training ends until all trainees have completed all procedures. On-the-spot correction and Q & A for the specific problems of students were conducted during the practice.

Throughout the scenario simulation process, participants are taught to evaluate and analyze cases while emphasizing continuous correction and improvement of the students' correct procedure skills. All skill procedure items are first taught to the students in a demonstration form, and then the students are instructed to rotate through repeated exercises until they have mastered all the essentials of the procedures.

### Study outcomes

Self-designed questionnaire of pediatric knowledge was distributed to test the score of all trainees' before and after training. Participants were asked to finish the questionnaire anonymously and independently. General characteristic of the trainees and pediatric knowledge were included in the questionnaire. The questionnaire was formulated by 10 pediatric specialists and was revised by three rounds of Delphi method.

Characteristics of trainees including gender, date of birth, occupation, education level, and working years; Pediatric knowledge questionnaire is a questionnaire that includes 50 multiple choice questions. Knowledges are about neonatal resuscitation; pediatric fluid therapy; nutrition support and evaluation; pneumonia management, pediatric basic life support and prevention and control of hospital infection in pediatric ward, contains a total of 50 questions, 2.0 points per each question, all questions are not weighted, with total score of 100. The higher score is, the better of pediatric knowledge is. A passing grade required answering 80% or more of items correctly [30].

### Statistical analysis

SPSS 22.0 software was used for data analysis. Quantitative data satisfying the normal distribution and homogeneity of variance were expressed by mean (standard deviation). Comparison between the two groups was performed by independent sample *t* test. The training effect was defined as the difference in scores of the pediatric knowledge questionnaire before and after training, and the paired sample *t* test was used for analysis. Qualitative data are expressed as percentages (%), and comparisons between groups are made by chi-square test. P value less than 0.05 is considered as statistically significant.

## Results

### Characteristic of participants

A total of 66 participants were recruited in this study, of which 5 did not meet the inclusion criteria, 2 refused to participate in the study, 3 failed to complete the entire training program, 56 students were finally included for data analysis. Of the 56 trainees, 40 were male and 27 were doctors. Only 3 doctors had master's degrees or higher. 5 midwives, 2 head nurses, and 3 department chiefs were also included; 51.79% of the trainees have worked in pediatric department for over than 3 years, and the average age of trainees is mean 33.75(SD 8.08) years old, min at 25 and max at 56. The pre-test score of pediatric knowledge between doctors and nurses has slightly difference (p=0.048), major in score of nutrition assessment and support (p=0.037). But there was no statistical difference shown on other groups as age, education level, working experience and gender (P <0.05), (Table 1 and Table 2).

### Effectiveness of training program

Pre-test score of Pediatric knowledge were relatively low with no one pass the knowledge of NRP, PBLS and full pediatric knowledge. The highest passing rate happed at the domain of fluid therapy knowledge with 41 participants pass accounts for 73.21%.

Post-test of pediatric knowledge was 82.11(11.06) with 41 passed and 15 failed. At this time point the highest passing rate was still at the knowledge of fluid therapy with 54(96.43), and then the knowledge of NRP and prevention and control of HI followed up at both 44(78.57), (Figure 3).

As for the training effect, we found that the most effective knowledge part was PBLS at 44(78.57), followed by prevention and control of HI at 39(69.64) and then NRP at 35(62.5). The worst effective knowledge part was knowledge of fluid therapy, but after our training the score of this part increased by 9.71(1.04) with only 2 failed. As pneumonia management, there was only score of 2.57(2.90) increased. Even with our training there was still almost half at 26(46.4) of participants did not pass the pneumonia management test.

Thus, is to say overall score of pediatric knowledge had increased dreamily, from mean 44.32 (SD 9.53) at pre-test to mean 82.11 (SD 11.06) at post-test, (p<0.001). Score of prevention and control of HI and PBLS have increased more than any other score of subscale knowledge at an increasing of 39(69.64) and 44(78.57) participants passed respectively. But all score of pediatric knowledge had been improved, with p value less than <0.00011, (Table 3). There were no statistical differences in the effect of training on demographic groups(p>0.05), (Table 4).

Table 1 Characteristic of participants

| Variables | | N (%) | Pre-test of PK | *t/F* | *p* |
|---|---|---|---|---|---|
| Gender | Male | 40(71.43) | 43.9(9.75) | -0.519 | 0.606 |
| | Female | 16(28.57) | 45.36(9.20) | | |
| Occupation | Nurse | 29(51.78) | 41.90(9.14) | -2.027 | 0.048 |
| | Doctor | 27(48.22) | 46.93(9.42) | | |
| Education level | Diploma | 30(53.57) | 44.3(9.26) | -0.018 | 0.986 |
| | BSc and above | 26(46.42) | 44.34(10.03) | | |
| Age(years) | <30 | 25(44.64) | 45.36(9.43) | 1.274 | 0.293 |
| | 30-40 | 19(33.92'.) | 41.21(7.84) | | |
| | 40-50 | 8(14.29) | 48.38(12.83) | | |
| | >50 | 4(7.14) | 44.5(9.434) | | |
| Working experience (years) | <3y | 27(48.21) | 44.93(9.35) | 0.295 | 0.829 |
| | 3-5y | 7(12.5) | 42(8.64) | | |
| | 5-10y | 14(25) | 45.29(12.09) | | |
| | >10y | 8(14.29) | 42.63(6.48) | | |

Notes PK= score of pediatric knowledge

Table 2. Pre-post score of pediatric knowledge varied in doctors and nurses

| | Nurses | | | Doctors | | | T1 | | T2 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pre-test | Post-test | Training effect | Pre-test | Post-test | Training effect | *T* | *P* | *t* | *p* |
| Total score | 41.90(9.14) | 81.66(11.98) | -39.76(15.56) | 46.93(9.42) | 82.59 (10.18) | -35.67(15.04) | -13.768 | <0.0001 | -12.322 | <0.0001 |
| Fluid therapy | 7.41 (1.80) | 9.59(1.24) | -2.17(2.30) | 7.89(1.37) | 9.85(0.77) | -1.96 (1.68) | -5.086 | <0.0001 | -6.089 | <0.0001 |
| Nutrition management | 7.79 (3.04) | 15.45(4.03) | -7.66(5.13) | 8.81 (3.73) | 15.78(3.73) | -6.96 (5.50) | -8.038 | <0.0001 | -6.576 | <0.0001 |
| Pneumonia management | 4.62 (2.68) | 7.24 (2.17) | -2.62 (2.78) | 4.74 (2.43) | 7.23(1.85) | -2.52(3.07) | -5.071 | <0.0001 | -4.265 | <0.0001 |
| PBLS | 4.14(2.67) | 16.34 (2.93) | -12.21(3.98) | 5.26(3.00) | 16.74 (2.01) | -11.48 (3.50) | -16.531 | <0.0001 | -17.093 | <0.0001 |
| NPR | 8.62 (2.88) | 16.83 (3.72) | -8.21(4.39) | 8.67(2.29) | 16.67(4.44) | -8(5.87) | -10.075 | <0.0001 | -7.081 | <0.0001 |
| Prevention and control of HI | 10.21(3.40) | 16.21(3.04) | -6(4.96) | 10.59 (3.50) | 16.30 2.700) | -5.70 (4.25) | -6.518 | <0.0001 | -6.973 | <0.0001 |

Notes: T1=paired sample *t* test of nurses between pre-test and post-test; T2= paired sample *t* test of doctors between pre-test and post-test;

T3=different sample *t* test of pre-test between nurses and doctors; T4= different sample *t* test of post-test between nurses and doctors

Table 3 Pre-post score of pediatric knowledge

| | Full mark | Pre-test | Post-test | Chang score | *t* | *P* |
|---|---|---|---|---|---|---|
| Total score | 100 | 44.32(9.53) | 82.11(11.06) | -37.79(14.50) | -19.501 | <0.0001 |
| Fluid therapy | 10 | 7.64(1.61) | 9.71(1.04) | -2.07(1.93) | -8.015 | <0.0001 |
| Nutrition management | 20 | 8.29(3.40) | 15.61(3.86) | -7.32(5.25) | -10.442 | <0.0001 |
| Pneumonia management | 10 | 4.68(2.54) | 7.25(2.00) | -2.57(2.90) | -6.641 | <0.0001 |
| PBLS | 20 | 4.68(2.86) | 16.54(2.52) | -11.86(3.73) | -23.763 | <0.0001 |
| NPR | 20 | 8.64(2.59) | 16.75(4.05) | -8.11(5.11) | -11.876 | <0.0001 |
| Prevention and control of HI | 20 | 10.39(3.42) | 16.25(2.86) | -5.86(4.59) | -9.549 | <0.0001 |

## Discussion

### Pediatric knowledge of doctors and nurses was not ideal in Zanzibar

As results demonstrated in our study, pre-test score of pediatric knowledge was not ideal, demonstrated that no one passed the pre-test. Study[30] on Essential Care for Every Baby (ECEB) training in rural Tanzania found that the pre-test pass rates of learners was about 66.7% (n=24) which was much better results than our pre-test. The reason why the results varies is due to their ECEB training was following on the success of help baby breathy (HBB) program launched in 2009 all over Tanzania, thus offer a better knowledge foundation of learners. As for our pre-test of pediatric knowledge contains major appropriate pediatric care technology, means no pre training except for medical school learning, making it difficult to choose the right answers and getting high score of the questionnaire. There was 5.9 million children under-5 died every year worldwide, the leading cause of death were pneumonia and diarrhea[2], most of these deaths occurred in South African countries, such as Sierra Leone, Tanzania, etc. The level of their pediatric care was relatively low as our previous study found [31-33] and make the score of fluid therapy had the biggest passing population in this study. Fakih and colleagues [6] pointed out that according to the minimum staffing requirements of Zanzibar, the human resources of the surveyed among 79 medical institutions were inadequate, qualified staffs including medical doctors, nurses and general surgeons were limited. These findings were consistent with our study. Since different medical background and differences distributed daily work between doctors and nurses, doctors preferred to prescribe feeding regimens while nurses notes feeding implementation and adverse reactions [34], leading higher pre-test score in doctors rather than nurse at the domain of nutrition assessment and support in our study, but training effect of all learners varied in groups had no statistic difference.

### Simulation training can improve pediatric knowledge of pediatric medical staffs in Zanzibar

In this study the adoption of simulation training program, evaluate the current actual case needs by case-card, so as to systematically manage the cases and build comprehensive medical strategy, which is in line with integrated medical ideas and methods.[27] Traditional instructor-led teaching method had inability to present complete clinical practical thinking in the minds of students,[35] All patients are particular, special and complex individual, they need to be consider as an integrated samples to treat and deal with. Thus, why our case-oriented scenario simulation address on the competent of training team as they act as the debriefing facilitator, the only one to take control of the whole program and the key to the success of this training course.

From the study we known that all the sub-domain of pediatric knowledge has improved dramatically. The most effective knowledge part was PBLS, as the same as schoolers thought that through thoughtful design of animations and interactive virtual patients as simulation training tool could further improves PBLS skill acquisition [15].

Improving the sense of hospital infection and applying simple measures can significantly improve the effectiveness and knowledge for prevention and control of HI, the research by song and her colleagues found that scenario simulation exercises can strengthen trainees' awareness of infectious disease protection and improve their comprehensive ability to transport patients [36].

As Study by Mildenberger, C. demonstrated that the use of scenario simulation training can increase the knowledge of neonatal asphyxia resuscitation of local midwives in Uganda and maintain a high level after 1 month [21]. Pneumonia is the leading course of death of children under-5 in sub-Saharan Africa,[2] even with our training, pass rate of this domain was still not ideal, that is because pneumonia management including not only the right antibiotic selection, but also reasonable airway management and appropriate technical support, such as oxygen inhalation, physiochemical treatment, respiratory support, etc. which are very complicated and delicate tasks, so the pneumonia management is very difficult and tough. thus, cannot be totally administered only by one training. Overall these relevant research results are lined with this case-oriented scenario simulation training program adopted in this study.

Therefore, the author believes that this case-oriented scenario simulation training is an effective training strategy and measure, which can promote the teamwork of multidisciplinary for intensive care unit teams[22, 37], improve the ability of emergency and crisis management [23], and improve the students' disease management and diagnosis skills, knowledge and confidence[7, 38-39]and had economic benefits and cost advantages[19] which can be promoted and popularized as effective health foreign aid training models.

### Limitations

Firstly, we adopted a self-reported questionnaire in this study, it has its only limitations as self-reported investigations, we cannot figure the truth out if participants try to hide the real opinions; Secondly, we only included the pre-pos- test score of the pediatric knowledge as our only outcomes to test our training effect, future study that including patients outcomes should be collected also in order to have one more objective and fair training effect evaluation. Thirdly,

the learners are those who volunteer to attend our study, so that there may be a selection bias exist; last but not the least, we did not have access to evaluate the score of pediatric knowledge care in long-term after our training, thus we do not know if our training effect can last for how long and how much.

## Conclusion

Our study demonstrated that simulation training is one mature strategy that can effectively improve the skills and knowledge of medical staffs. Application of integrated simulation training strategy of pediatric knowledge might offer an overview of daily task and help to response quickly while working for doctors and nurses. And future health foreign aid is more than just pure medical materials, facilities or resources but to offer technology and skills. Further study of pediatric appropriated technology training program could focus on the test of whether improving of care knowledge for children help to decrease the mortality of children under-5 or not.

## Abbreviations

UNDP: United Nations Sustainable Development Goals; HBB: help babies breathy; IMCI: Integrated Management of Childhood Illness; NRP: Neonatal Resuscitation Program; PBLS: Pediatric Basic Life Support; PALS: Pediatric Advanced Life Support; ECEB: Essential Care for Every Baby.

## Declarations

### Ethics approval and consent to participate

The study was approved by Hunan Children's Hospital ethics commission board, (approving number: HCHLL-2018-03) and all written consent were signed by participants.

### Consent for publication

Not applicable

### Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### Competing interests

The authors declare that they have no competing interests

### Funding

The study was partially supported by the China Hunan Provincial Science & Technology Department under grant 2018WK2062 and 2015WK3047. The funding body was not involved in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript.

### Authors' contributions

LW, QqS, LhZ were responsible for the study protocol and design of the study. JQ, XD, SyL and YyL contributed to the data acquisition. QqS, JQ, XdW performed the analysis. All authors were involved in the data interpretation. QqS, LW and Lhz drafted the first manuscript and substantively revised it. All authors, LW, QqS, LhZ, JQ, XD, SyI, XdW, YyL agreed both to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work.

### Acknowledgements

We would like to thank all members of the training team in their outstanding effort on the design and conduction of this training course. And we also want to thanks all case card patients and their families for the permission of using their cases as example. Finally, is to thank all participants for their valuable time and interested in our training course.

### Authors' information

Li-hui Zhu is vice president of Hunan Children's Hospital, professor of School of Nursing Hunan University of Chinese Medicine. Committee of the Group of Nursing, Society of Pediatrics, Chinese Medical Association.

Li Wang is chief of department of international affairs in Hunan Children's Hospital, assigned as the only one organizer in pediatric foreign aid training in China, devoted to establish academic exchange and cooperative platform that gather high quality medical resources, technical expertise, and health care experiences to benefit participants from different countries.

## References

1. Collaborators GBDM. Global, regional, and national under-5 mortality, adult mortality, age-specific mortality, and life expectancy, 1970-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 2017;390(10100):1084-150.

2. Liu L, Oza S, Hogan D, Chu Y, Perin J, Zhu J, et al. Global, regional, and national causes of under-5 mortality in 2000-15: an updated systematic analysis with implications for the Sustainable Development Goals. Lancet. 2016;388(10063):3027-35.
3. Mboera LEG, Rumisha SF, Lyimo EP, Chiduo MG, Mangu CD, Mremi IR, et al. Cause-specific mortality patterns among hospital deaths in Tanzania, 2006-2015. PloS one. 2018;13(10):e0205833.
4. Gera T, Shah D, Garner P, Richardson M, Sachdev HS. Integrated management of childhood illness (IMCI) strategy for children under five. Cochrane Database Syst Rev. 2016(6):CD010123-CD.
5. Isangula KG, Kassick ME, Kairuki AK, Meda RA, Thomas E, Temu A, et al. Provider experiences with the large-scale 'Helping Babies Breathe' training programme in Tanzania. Paediatr Int Child Health. 2018;38(1):46-52.
6. Fakih B, Nofly AAS, Ali AO, Mkopi A, Hassan A, Ali AM, et al. The status of maternal and newborn health care services in Zanzibar. BMC Pregnancy Childbirth. 2016;16(1):134.
7. Sperl-Hillen J, O'Connor PJ, Ekstrom HL, Rush WA, Asche SE, Fernandes OD, et al. Educating resident physicians using virtual case-based simulation improves diabetes management: a randomized controlled trial. Acad Med. 2014;89(12):1664-73.
8. Thomsen ASS, Subhi Y, Kiilgaard JF, la Cour M, Konge L. Update on simulation-based surgical training and assessment in ophthalmology: a systematic review. Ophthalmology. 2015;122(6):1111-30.e1.
9. Kamel M, Eltahawy EA, Warford R, Thrush CR, Noureldin YA. Simulation-based training in urology residency programmes in the USA: Results of a nationwide survey. Arab J Urol. 2018;16(4):446-52.
10. Gopal M, Skobodzinski AA, Sterbling HM, Rao SR, LaChapelle C, Suzuki K, et al. Bronchoscopy Simulation Training as a Tool in Medical School Education. Ann Thorac Surg. 2018;106(1):280-6.
11. Khan R, Plahouras J, Johnston BC, Scaffidi MA, Grover SC, Walsh CM. Virtual reality simulation training for health professions trainees in gastrointestinal endoscopy. Cochrane Database Syst Rev. 2018;8(8):CD008237-CD.
12. Dawe SR, Windsor JA, Broeders JAJL, Cregan PC, Hewett PJ, Maddern GJ. A systematic review of surgical skills transfer after simulation-based training: laparoscopic cholecystectomy and endoscopy. Ann Surg. 2014;259(2):236-48.
13. Park C, Grant J, Dumas R, Dultz L, Shoultz T, Scott DJ, et al. Does Simulation Work? Monthly Trauma Simulation and Procedural Training are Associated with Decreased Time to Intervention. J Trauma Acute Care Surg. 2019.
14. Wehbi NK, Wani R, Yang Y, Wilson F, Medcalf S, Monaghan B, et al. A needs assessment for simulation-based training of emergency medical providers in Nebraska, USA. Adv Simul (Lond). 2018;3:22.
15. Lehmann R, Lutz T, Helling-Bakki A, Kummer S, Huwendiek S, Bosse HM. Animation and interactivity facilitate acquisition of pediatric life support skills: a randomized controlled trial using virtual patients versus video instruction. BMC Med Educ. 2019;19(1):7.
16. Ades A, Lee HC. Update on simulation for the Neonatal Resuscitation Program. Semin Perinatol. 2016;40(7):447-54.
17. Kaldheim HKA, Bergland Å, Ølnes MA, Hofsø K, Dihle A, Creutzfeldt J, et al. Use of simulation-based learning among perioperative nurses and students: A scoping review. Nurse Educ Today. 2019;73:31-7.
18. Hegland PA, Aarlie H, Strømme H, Jamtvedt G. Simulation-based training for nurses: Systematic review and meta-analysis. Nurse Educ Today. 2017;54:6-20.
19. Groot-Jensen S, Kiessling A, Zethraeus N, Björnstedt-Bennermo M, Henriksson P. Cost-effectiveness of case-based training for primary care physicians in evidence-based medicine of patients with coronary heart disease. Eur J Prev Cardiol. 2016;23(4):420-7.
20. Poulsenª M, Friesgaard KD, Seidenfaden S, Paltved C, Nikolajsen L. Educational interventions to improve medical students' knowledge of acute pain management: a randomized study. Scand J Pain. 2019;19(3):619-22.
21. Mildenberger C, Ellis C, Lee K. Neonatal resuscitation training for midwives in Uganda: Strengthening skill and knowledge retention. Midwifery. 2017;50:36-41.
22. Pammi M, Dempsey EM, Ryan CA, Barrington KJ. Newborn Resuscitation Training Programmes Reduce Early Neonatal Mortality. Neonatology. 2016;110(3):210-24.
23. Fung L, Boet S, Bould MD, Qosa H, Perrier L, Tricco A, et al. Impact of crisis resource management simulation-based training for interprofessional and interdisciplinary teams: A systematic review. J Interprof Care. 2015;29(5):433-44.
24. Murphy M, Curtis K, McCloughen A. What is the impact of multidisciplinary team simulation training on team performance and efficiency of patient care? An integrative review. Australas Emerg Nurs J. 2016;19(1):44-53.
25. Bullard MJ, Fox SM, Wares CM, Heffner AC, Stephens C, Rossi L. Simulation-based interdisciplinary education improves intern attitudes and outlook toward colleagues in other disciplines. BMC Med Educ. 2019;19(1):276.
26. Finan E, Campbell DM, Aziz K, McNamara PJ. Update for Canadian NRP providers: A case-based review. Paediatr Child Health. 2017;22(6):351-6.
27. Gera T, Shah D, Garner P, Richardson M, Sachdev HS. Integrated management of childhood illness (IMCI) strategy for children under five. Cochrane Database Syst Rev. 2016(6):CD010123.
28. Atkins DL, de Caen AR, Berger S, Samson RA, Schexnayder SM, Joyner BL, et al. 2017 American Heart Association Focused Update on Pediatric Basic Life Support and Cardiopulmonary Resuscitation Quality: An Update to the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2018;137(1):e1-e6.
29. de Caen AR, Maconochie IK, Aickin R, Atkins DL, Biarent D, Guerguerian A-M, et al. Part 6: Pediatric Basic Life Support and Pediatric Advanced Life Support: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Circulation. 2015;132(16 Suppl 1):S177-S203.

30. Dol J, Campbell-Yeo M, Bulemela J, McMillan D, Abel Z, Nyamtema A, et al. Knowledge acquisition after Helping Babies Survive training in rural Tanzania. Int Health. 2019;11(2):136-42.
31. Zhu L-H, Sun J, Wang L, Ding X, Liang Y-y, Liu S-y. Most of these deaths occurred in South African countries, such as Sierra Leone, Tanzania, etc. The level of emergency treatment in these countries is relatively low. Nursing Research of China 2019;33(24):4318-20.
32. Ding X, Zhu L-H, He S-W, Wang L, Liang Y-y. Investigation on Knowledge of Appropriate Technology for Pediatric Emergency Department of Medical Staff in Sierra Leone Journal of Chinese Physician. 2018;20(10):1582-4.
33. Zhu L-H, Ding X, He S-W, Liang Y, Wang L. Theory and Practice Training Effect of Appropriate Pediatric Technology in Sierra Leone Journal of Clinical Research. 2018;35(12):2357-9.
34. Beck K, Mukantaganda A, Bayitondere S, Ndikuriyo R, Dushimirimana A, Bihibindi V, et al. Experience: developing an inpatient malnutrition checklist for children 6 to 59 months to improve WHO protocol adherence and facilitate quality improvement in a low-resource setting. Glob Health Action. 2018;11(1):1503785-.
35. Zhu L-h, Sun J, Wang L, Ding X, Liang Y-y, Liu S-y. Evaluation of foreign aid training effect of neonatal treatment technology on medical staffs in Zanzibar. Chinese Journal of Nursing Research. 2019;33(24):4318-20.
36. Song X-a, Tang H-m, Gu Mei-lei, Zhang H-y, Meng Y-h, Wen F, et al. Application Effect of Scenario Simulation Drilling in Transferring Ebola Patients Training by Medical Workers in Sierra Leone. Chinese Journal of Nursing Administration. 2015;15(8):547-8.
37. Frengley RW, Weller JM, Torrie J, Dzendrowskyj P, Yee B, Paul AM, et al. The effect of a simulation-based training intervention on the performance of established critical care unit teams. Crit Care Med. 2011;39(12):2605-11.
38. Mirza A, Winer J, Garber M, Makker K, Maraqa N, Alissa R. Primer in Patient Safety Concepts: Simulation Case-Based Training for Pediatric Residents and Fellows. MedEdPORTAL. 2018;14:10711-.
39. Huang Q, Huang X, Liu L, Lin Y, Long X, Li X. A case-oriented web-based training system for breast cancer diagnosis. Comput Methods Programs Biomed. 2018;156:73-83.

## Figures

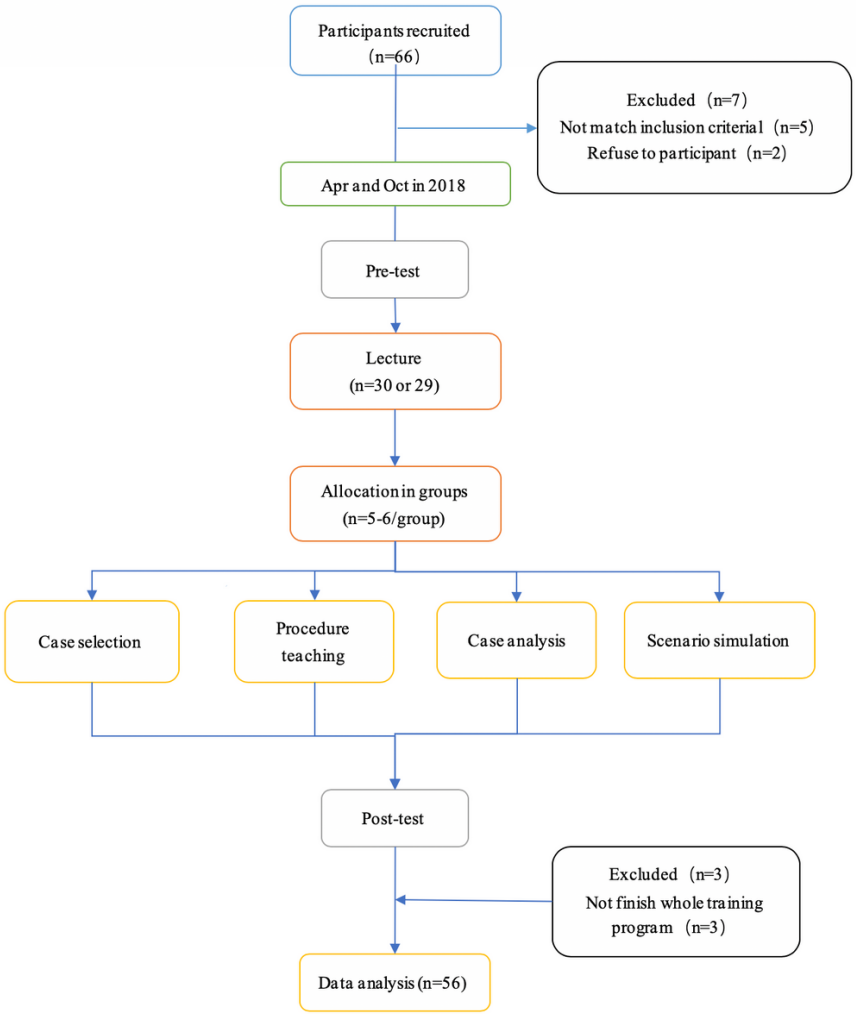


Figure 1

Stusy flowchart

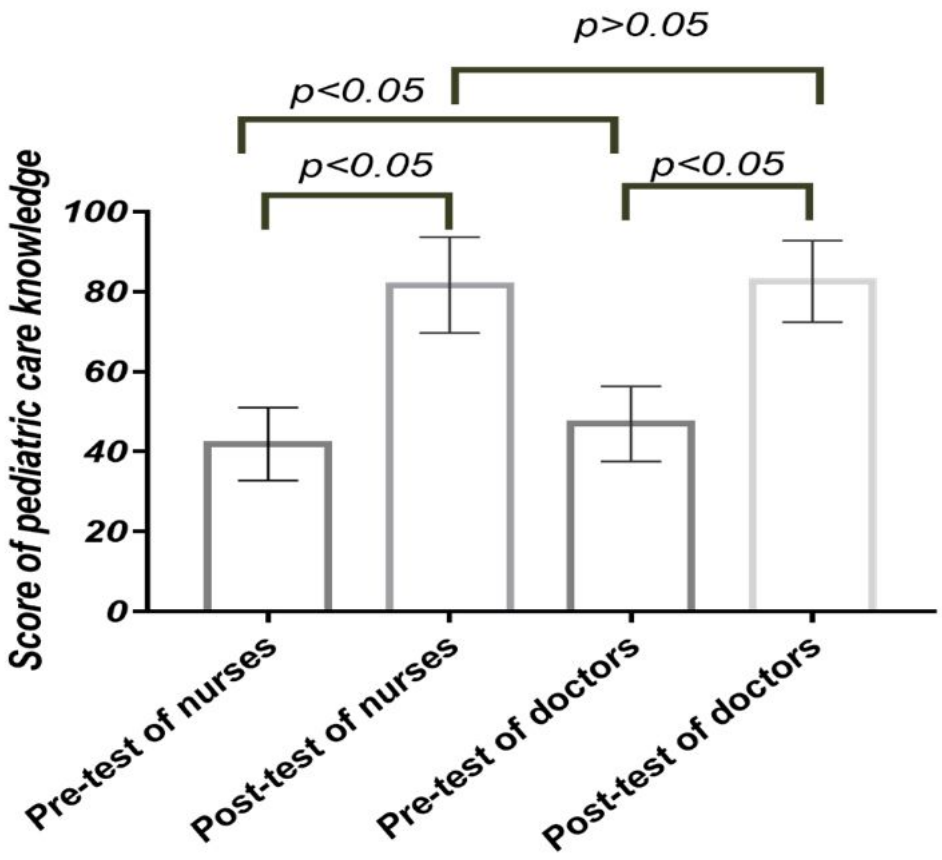


**Figure 2**

Pre-post pediatric knowledge varied in doctors and nurses

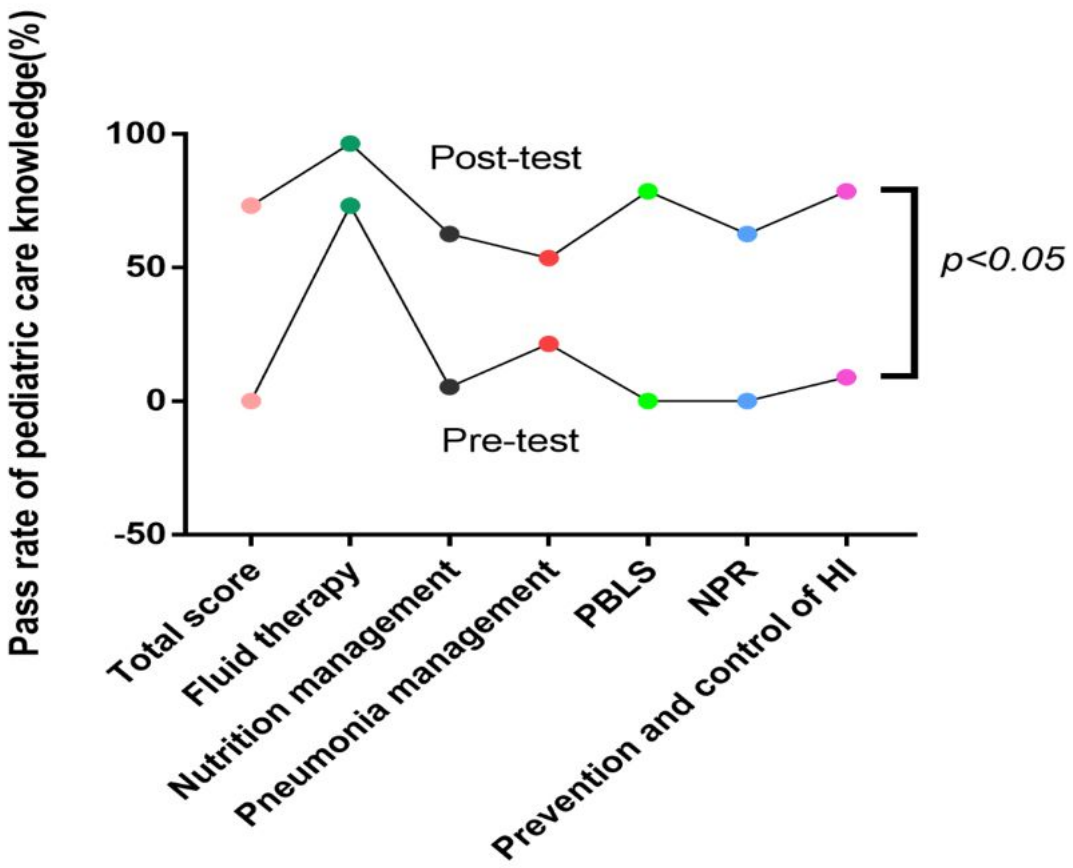


Figure 3

Passing rate of pediatric care knowledgy