

Application of DOPS Checklists in Assessing the Skills of Emergency Bag Mask Ventilation and Endotracheal Tube Intubation

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ABSTRACT

Introduction: Checklist allows recording the presence/absence of each step which provides guidance to the user with the purpose to reduce error and harm in stressful conditions with adhering to best performance. Direct Observation of Procedural Skills (DOPS) was designed to evaluate practical skills under direct observation during procedure by teaching, learning & assessing and provides feedback to performer. Aim of our study was to develop checklists of Emergency Bag Mask Ventilation (BMV) and Emergency Endotracheal Tube (ETT) Intubation to enhance performer skills and contributing patient safety.

Methods: We performed among fellows and residents (n=42) which included literature reviews, webpages searching, expert group formation and consensus generating meetings. Initial checklists drafts were made through discussion on each step using Delphi method and final draft were made only after rating of 4 out of 5 by all the experts adapting mini-Delphi method. Regarding the content validity index, minimum 80% agreement was required to accept each step of a checklist.

Results: We developed checklists for Emergency BMV and ETT Insertion as shown below in Annex-1 and Annex-2 respectively and a pilot study was done. The mean age of the participants (n = 42) were 29.83 ± 3.09 years. Baseline score of the students before the lecture session and hands on workshop was lower for Annex-1 (17.07 ± 6.59 and 20.85 ± 8.16 respectively) when compared to the post session scores (35.19 ± 9.84 for Annex-1 and 35.76 ± 11.97 for Annex-2) but baseline scores were significantly higher in male ($P = 0.038$) among those who had performed procedures > 10 times ($P = 0.040$).

Conclusions: Implementation of the checklists was part of the effective assessment and contributed towards sustained improvement in patient health care in stressful emergency situation with less harm to the patients. On multivariate regression analysis, improvement in the scores (for both Emergency ETT Intubation and Emergency BMV) after training was not associated with age, sex, years after medical graduation or number of procedure performed previously.

INTRODUCTION

A checklist is composed of the list of actions which is arranged in

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a systematic manner and allows recording the presence or absence of each step or item listed in it. It also provide guidance to the user and act as verification during implementation to reduce the error in stressful conditions while adhering to the best practice.¹ The insertion of central venous catheter is one of the first published checklist in the medical field which helped significantly to decrease the infection rate (per 1000 catheter days from 2.7 at baseline to zero).²

The World Health Organization (WHO) team drew attention from airline industry to prepare the methodology for development of checklists in health care and reviewed lessons learned from the aviation, in checklist development of Surgical Safety and discussed the differences between aviation and medicine, which impacted the use of checklists in health care. Thus, WHO patient safety programme took an initiative to improve the safety of surgery around the world and developed a checklist if possible, should be practiced in all settings of surgery.³

Checklist use had been reported poorly as Fischer MO et al emphasized that checklists are scarcely used in French ICUs, despite recent evidence demonstrating its use can decrease morbidity and hospital stay. Human or computer prompting in simulation training for ICU teams could provide an effective approach for implementation.⁴ A metanalysis by Bergs J et al reported reduction in postoperative complications with adherence to aspects of care embedded in the WHO Surgical safety checklist (SSC).⁵ There are limited publications on checklists, especially in developing countries as Nepal. One of these methods, Direct Observation of Procedural Skills (DOPS) was designed to evaluate practical skills under direct observation during procedure and provide feedback to the performer. Observation was documented in the checklist and the trainee recorded objective based findings as a feedback thus helped trainees to improve their performance. Hence the implementation of this checklist will have positive influence on the didactic culture of academic institutions.⁶⁻⁹

Based on evidence of importance of using checklists, this study aims to develop checklists of Emergency Bag Mask Ventilation (Emergency BMV) and Emergency Endotracheal tube Intubation (Emergency ETT intubation) and to ob-

serve the performance. Our ambition was also to provide the revised checklists for health professionals in simple and familiar wordings and we believe its use will decrease human related errors, enhance the performer skills that contribute to patient safety.

METHOD

This is a quantitative, analytical, single centred study conducted in Chitwan Medical College Teaching Hospital (CMCTH), Nepal from January to November 2019. Ethical approval was given by Institutional Review Committee (IRC) of CMCTH (ref no.-CMC-IRC/076/077-012). Informed consent was taken from the study participants before starting the study and confidentiality was maintained.

This mixed method, quality improvement study included literature reviews, expert group of seven members and consensus generating meetings.¹⁰⁻¹⁹ Initial checklists drafts were prepared and discussed for both the checklists (BMV and ETT insertion). Each step was discussed and revised by experts using Delphi method five times through follow up emails. Each time every expert was asked to rate the step in 1-5 scale (1-strongly disagree, 2- disagree, 3-undecided, 4-agree, 5-strongly agree) through emails. Steps were considered for drafting checklist only after rating of 4 by all the experts. Meeting of the expert groups finalized the steps of both the checklists. Each checklist steps revised and finalized to 10 steps in sequence and each step has 5 boxes to rate the performance of study participants (poor, borderline, satisfactory, good and outstanding).²⁰⁻²²

Regarding the content validity index, only after rating of 4 (in 1-5 scale) i.e. minimum 80% agreement was required to accept each step of a checklist.¹⁰ After acceptance and finalization of the procedure steps by experts, a pilot test was performed for both Emergency BMV and Emergency ETT Intubation checklists separately. Postgraduate residents from different departments and first year fellows of pulmonary critical care medicine volunteered in this study (n=42). For each procedure all experts were provided with the checklist to observe and mark the appropriate box according to the observed performance on a mannequin. After that informative lecture session explaining all

the steps of both the checklists was delivered followed by hands-on workshop targeting the study population. After the session all the, participants were again asked to perform Emergency BMV and Emergency ETT Intubation in front of the experts. Thus, marking appropriate box for each step in both the checklists after observation was done. Performances of the study population before and after the lecture with hands-on workshop were than analysed.

ANNEX-1

Emergency bag mask ventilation for dops teaching, learning & assessment

Years after medical graduation: 1 [] 2 [] 3 [] 4 [] ≥5 []

Number of times procedure performed previously: 0-5 [] 6-10 [] 11-20 [] >21 []

Dops Rating Scale	Poor	Borderline	Satisfactory	Good	Outstanding
1	"Head- Tilt/ Chin- Lift" or "Jaw Thrust" maneuver *				
2	Swift oral cavity inspection and suctioning as required				
3	Choosing correct size mask with assembling bag				
4	Holding and sealing the mask appropriately with non-dominant hand with bagging by other hand (if no appropriate personnel around) **				
5	Holding and sealing the mask appropriately with 2 hands with supervision of bag mask ventilation done by others				
6	Holding and sealing the mask appropriately with 2 hands with supervision of bag mask ventilation done by others				
7	Holding and sealing the mask appropriately with 2 hands with supervision of bag mask ventilation done by others				
8	Holding and sealing the mask appropriately with 2 hands with supervision of bag mask ventilation done by others				
9	Holding and sealing the mask appropriately with 2 hands with supervision of bag mask ventilation done by others				
10	Holding and sealing the mask appropriately with 2 hands with supervision of bag mask ventilation done by others				

*Jaw Thrust maneuver for the suspected cervical injury patients.

** For creation of good seal, apply downward pressure on the mask with thumb and index fingers and to open the airway pull the patient's jaw up with 3rd, 4th and 5th fingers.

ANNEX-2

Emergency endotracheal tube intubation for dops teaching, learning & assessment

Years after medical graduation: 1 [] 2 [] 3 [] 4 [] ≥5 []

Number of times procedure performed previously: 0-5 [] 6-10 [] 11-20 [] >21 []

Dops Rating Scale	Poor	Borderline	Satisfactory	Good	Outstanding
1	Bag Mask ventilation with 100% O ₂ for 3 to 5 min if possible & call help if situation appears difficult to handle				
2	Ordering intubation set & asking to check appropriate ET tube size				
3	Rechecking instruments & Premedication				
4	Positioning supine, head on small pillow, tilted head backwards (sniffing position) *				
5	Laryngoscopy** with neuromuscular blocking agent as required				
6	ET Intubation with concavity plane of ETT horizontally, maintaining the laryngoscope in the position till the black marker line of ETT at the levels of the vocal cords (ETT cuff well inside the vocal cords)***				
7	Inflating the cuff to achieve air seal & fixing the ETT appropriately in reference to incisors				
8	If intubation is not possible within 30 seconds, Bag Mask Ventilation with 100% O ₂ and call for help if re-intubation appears difficult				
9	Re-intubation and confirmation				
10	If difficulty, back to Bag Mask Ventilation and call for help				

* With suspected cervical spine injury intubation should be performed without flexion & extension with an assistant stabilizing the head & neck in a neutral position.

** After opening the mouth with right hand fingers, insert the blade with the left hand from the right side of the mouth pushing the tongue to the left. If secretions are present, apply suction. Next place the tip of the laryngoscope blade in the depression between the base of the tongue and the epiglottis (in infants and small children, insert the blade beyond the epiglottis, using straight blade laryngoscope). Then to expose the larynx, lift the laryngoscope vertically upwards to the ceiling in the direction of the laryngoscope handle without levering the laryngoscope on the front top teeth.

***If required, may ask the assistant to apply cricoid pressure to help visualization of the vocal cords.

RESULTS

We developed separate checklists for Emergency Bag and Mask ventilation and Emergency Endotracheal tube Insertion as below in the annex-1 and annex-2 respectively.

Total 42 trainees were enrolled in the study. The mean age of the participants was 29.83 ± 3.09 years, with 34 males (81.0 %) and 8 females (19.0%). Checklists of Emergency BMV and Emergency ETT Intubation by DOPS Teaching, Learning & Assessment steps had acceptable internal consistency as demonstrated by Cronbach's alpha (0.669 and 0.598 respectively).

The baseline scores were significantly higher in male students ($P = 0.038$) and also in the students those who had performed similar procedures > 10 times ($P = 0.040$). However, the scores were not associated with years of training ($P = 0.06$) as shown in Table 1 and Table 2 respectively.

Table: 1 Years after medical graduation

Years after medical graduation	Frequency	Percentage (%)
1 year	6	14.3
2 years	11	26.2
3 years	10	23.8
4 years	6	14.3

Table: 2 Number of procedures done by the trainee

Number of procedures done	Frequency	Percentage (%)
0-5	14	33.3
6-10	8	19.0
11-20	11	26.2
>21	9	21.4

Baseline Emergency BMV scores were not associated with any of the afore-mentioned categories. Step no. 7 (Each bag compression / ventilation over 1 second) in Emergency ETT Intubation and step no. 4 (Holding and sealing the mask appropriately with non-dominant hand with bagging by other hand) in Emergency BMV had the least correlations with other items of the questionnaire.

Baseline score of the students before the lecture session and hands on workshop was lower for Emergency ETT Intubation and Emergency BMV (17.07 ± 6.59 and 20.85 ± 8.16) when compared to the post session scores (35.19 ± 9.84 and 35.76 ± 11.97) respectively as shown in table 3.

Table: 3 Impact of training on the students

Variables	Pre-training scores	Post-training scores	P-value
Emergency ETT intubation	17.07 ± 6.59	35.19 ± 9.84	0.000*
Emergency BMV	20.85 ± 8.16	35.76 ± 11.97	0.000*

On multivariate regression analysis, improvement in the scores (for both Emergency ETT Intubation and Emergency BMV) after training was not associated with age, sex, years after medical graduation or number of procedure performed previously.

DISCUSSION

42 residents and fellows were enrolled in the study, checklists of Emergency BMV and Emergency ETT Intubation by DOPS Teaching, Learning & Assessment steps were accepted as demonstrated by Cronbach's alpha (Cronbach's alpha= 0.669 and 0.598 respectively). The checklist being important tool in error management, contributed significantly in reductions of costly mistakes and improving overall outcomes, which helped to improve the delivery of patient care.¹ A metanalysis done by Bergs J et al was conducted to evaluate the effect

of the WHO SSC on complications, surgical-site infection (SSI) and mortality. Risk ratios for any complication, mortality and SSI were 0.59 (95 per cent confidence interval 0.47 to 0.74), 0.77 (0.60 to 0.98) and 0.57 (0.41 to 0.79) respectively and had strong correlation among significant decrease in postoperative complications and adherence to aspects of care embedded in the checklist ($Q = 0.82$; $P = 0.042$) and reduction in postoperative complications with adherence to aspects of care embedded in the WHO (SSC).⁵ In our study baseline scores were in the students those who had performed similar procedures > 10 times ($P = 0.040$) were not associated with years of training ($P = 0.06$). Similarly study done by Christoph Profanter et al showed that, in first month there was a statistically significant difference ($p < 0.05$) in performance of 95% positive objective structured clinical examination (OSCE) items in the DOPS-group versus 88% in the tutor group among 193 students who carried out in 756 OSCE, 209 (27.6%) via DOPS and 547 (72.3%) tutor-group.⁶ Alejandro E Delfino et al study, content validity of DOPS was established through interviews suggested by twelve domains and consensus survey, which were included in the final version as the Content Validity Index (CVI) and kappa values as 0.9 and 0.8, respectively. It stated that intubation procedure to be assessed with DOPS at least six times to obtain a G coefficient of 0.80.²³ In our study, baseline score before the lecture session and hands on workshop was lower for Emergency ETT Intubation and Emergency BMV (17.07 ± 6.59 and 20.85 ± 8.16) compared to the post session scores (35.19 ± 9.84 and 35.76 ± 11.97). Similarly, Keith Siau et al performed DOPS assessments in endoscopy among trainees ($n = 1300$) with ≤ 100 lifetime procedures which revealed that new DOPS was associated with greater utilization of the lowest score (2.4 % vs. 0.9 %; $P < 0.001$), broader range of scores, and a reduction in competent scores (60.8 % vs. 86.9 %; $P < 0.001$).⁸

Thus, Erfani Khanghahi M et al study states that DOPS tests can be applied as a valuable and effective evaluation method in medical education. The important strengths were: providing feedback, promoting independence and practical skills during assessment. However, stressful evaluation, time limitation for participants, and bias between assessors were major drawbacks.

Positive impacts of DOPS method on improving student performance were noted.⁷

Limitations: Our study was single center, observational with small study group, though it was a quality improvement study.

CONCLUSION

Implementation of the checklists was part of the effective assessment and contributed towards sustained improvement in patient health care in stressful emergency situation with less harm to the patients. On multivariate regression analysis, improvement in the scores (for both Emergency ETT Intubation and Emergency BMV) after training was not associated with age, sex, years after medical graduation or number of procedure performed previously.

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