ORIGINAL ARTICLE

Fogging of Protective Eyewear in Intensive Care Unit and a Comparative Study of Techniques to Reduce It

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Abstract

Background: Fogging of protective eyewear (PEW) can hinder routine work in the intensive care unit (ICU). The prevalence of fogging impairing vision (FIV) and the technique that reduces fogging have not been evaluated previously.

Methods: After donning personal protective equipment (PPE) with an N95 mask, the healthcare workers (HCWs) sequentially tried plain PEW, soap-coated PEW, PEW worn at a distance over the PPE hood, and the use of tape over a mask. The vision (distant and near) was checked before wearing PEW and with each technique. The prevalence of fogging and FIV, that is, change in vision in either eye was estimated and compared among various techniques. Mixed-effects logistic regression was used to analyze factors affecting fogging and to compare techniques. Room temperature, room humidity, and lens temperature were measured during the study.

Results: A total of 125 HCWs participated (151 observations) and the prevalence of FIV was 66.7%. The fogging of PEW, as well as the extent of PEW fogging, was least with soap coating followed by a mask with tape and goggles worn at a distance. The FIV was significantly lesser only with the mask with tape with an odds ratio (OR) [confidence interval CI)] of 0.45 (0.25–0.82). The prevalence of fogging while at work in the COVID ICU was 38%.

Conclusion: The prevalence of FIV is 66%. Application of tape over the mask can avoid disturbances in vision best. Soap coating of the PEW and PEW worn at distance from the eyes are potential alternatives.

Keywords: Fogging, Fogging impairing vision, Protective eyewear, Soap coating.

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Highlights

- The prevalence of PEW fogging is high in acute healthcare settings.
- Application of tape over the mask, using soap-coated PEW, and wearing the PEW as far from the eyes are simple; cost-effective methods to reduce fogging.
- Applying tape over the mask best prevents vision-affecting fogging.

Introduction

The use of PEW as part of PPE is recommended by the WHO in the setting of highly infectious diseases such as Ebola and Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Fogging of PEW has been an underrated and underreported problem, especially in the recent COVID pandemic. Fogging, that is, misting of PEW can hinder lifesaving procedures, delay the carrying out of routine patient care, and reduce work efficiency.[1] Fogging is due to a change in temperature and humidity which causes moisture to condense on the cooler surface of the PEW.[2] The temperature at which the water vapor condenses into water is referred to as the dew point. Condensation is proportional to the differences between the lens and exhaled air temperatures. The air trapped between the lens and the person's face is a warm humid microenvironment conducive fogging to occur.

There are a few techniques described which can reduce fogging including modification in wearing a surgical mask such as a double mask, knotting the ear loop, and using antifog spray or lenses.[3,4] Studies on fogging have been either experimental or in non-healthcare industry settings.[5] Few clinical studies have tried antifog sprays and their alternatives such as baby shampoo, Hibiscrub, chlorhexidine solution, etc. to prevent fogging.[6–9] Studies on PEW fogging and techniques to reduce it are limited. The actual prevalence of fogging in a COVID-related healthcare environment remains unknown. This study planned to estimate the prevalence

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of PEW fogging with PPE in the recent COVID ICU pandemic and identify the method that could reduce fogging the most with various modifications of PPE and PEW.

Methodology

Study Design

Analytical cross-sectional study: The study was performed on HCWs working in the ICU caring for SARS-CoV-2 patients, in a tertiary care university hospital. Institutional Ethics Committee approval (165/2020 Institutional Ethics Committee) and written informed consent from all the participants were taken. The study was registered in the Clinical Trial Registry of India (CTRI/2020/07/026664). The study was performed for a period of 2 months (from July 2020 to September 2020).

Primary objective: To find the prevalence of PEW fogging that causes impairment of vision in a healthcare setting

Secondary objective: To identify the method least associated with fogging with completely donned PPE.

The study was done in the donning room adjacent to the ICU taking care for patients with SARS CoV2 (COVID ICU). The investigators tested the HCW's baseline visual acuity [both bear vision (NV): Jaeger chart; distant vision (DV): Snellen's chart] without PEW and prescription spectacles (if applicable). After donning the PPE, the HCWs were asked to wear PEWs and try out each of the techniques mentioned below. Reference technique (N95 mask with PEW), soap-coated PEW, PEW worn at a distance, and tape over a mask. See Table 1 for details.

They were observed for a maximal period of 2 minutes for each technique. Each technique was followed by adequate washout time to allow the lens to return to a normal (unfogged) state. The presence/absence of fogging, time to appearance and disappearance of fogging, and extent of fogging (surface area of lens involved with fogging) were documented. For the extent of fogging, the independent observer documented the quadrants of the lens which had fogged. The lens was divided into four quadrants by two perpendicular imaginary lines crossing at the center of each lens and the quadrants involved were shaded in the case record form (Supplementary Fig. S1). The extent of fogging was determined depending on the proportion of quadrants fogged. Each quadrant was given a score of 0–3 (zero, ≤25%, 25–50%, >50% lens quadrant fogged, respectively) which was then added to form a cumulative score. The extent of fogging was represented quantitatively as no fogging (zero), mild (scores 1–6; 1–25%), moderate (scores 7–12; 26–50%), severe (scores 13–18; 51–75%), very severe (scores 19–24; 76–100%), the values derived from the cumulative score. In addition to this, all HCWs were assessed for degree of vision impairment by using near and far vision charts for visual acuity for each technique.

The HCWs then proceeded to enter the COVID ICU for their regular duty shift, using any technique or combination of techniques, of their choice. The investigators also did a follow-up check for the prevalence of fogging within the COVID ICU. The HCW was observed for presence and the extent of fogging, 30–60 mins after they entered the COVID ICU, and their near vision was also captured using the Jaegers chart. The COVID ICU temperature and humidity were separately captured.

The temperature and relative humidity of donning room was recorded. The temperature of the PEW lens was measured using a handheld non-contact digital thermometer device (Medek Model MDI901, Shenzhen Medek Biomedical Co., Ltd.) using the surface mode at end of the reference technique. The temperature and humidity of the donning room were measured by digital thermo/hygrometer (HTC^{TM} Digital Thermo/Hygrometer, 288 ATM; HTC Instrument). Fogging was defined as any misting of PEW lens and FIV was defined as the "Presence of fogging" AND "Decrease in visual acuity" in either eye as compared to baseline while reading near or/and distant vision charts" OR "Change in head posture while trying to read Snellen's and Jaegers charts." See Supplementary Material for details.

Statistical Analysis

Data were expressed as percentages for categorical variables, and mean [standard deviation (SD)] or median [interquartile range (IQR)] for continuous data as appropriate. The comparison of two proportions was performed using the Chi-squared test or Fisher's exact test and the comparison of means were performed by paired or independent sample *t*-test as appropriate.

Mixed-effects logistic regression models were used to identify factors that affected fogging, especially as the observations were performed on the same HCW and each HCW contributed more than one set of observations. The factors that are clinically important, or known to influence fogging: Type of technique, room temperature, room humidity, the dew point of the room, mask type, leak around the mask, etc. were used as explanatory variables, and fogging was the dependent variable in the predictive model. A backward stepwise elimination technique was used. The OR was calculated to compare the predictors.

Mixed-effects ordinal logistic regression was also performed with the extent of fogging and bi-ocular visual impairment (distant and near vision) as an ordinal dependent variable. Considering the possible correlation among the quadrants of the lens, that is, the fogging in one quadrant may influence the other quadrant, factor analysis was performed to get an un correlated fogging score and to reduce the dimensions. Mixed-effects linear regression was performed with factor scores to find factors associated with the extent of fogging.

McNemar's test was performed to compare fogging prevalence between first and second participation in a subset of participants to examine the reliability of the observations; $p < 0.05$ was considered statistically significant. All analyses were performed using Stata (Stata Corp. 2015. Stata Statistical Software: Release 14, StataCorp LP, College Station, TX, USA).

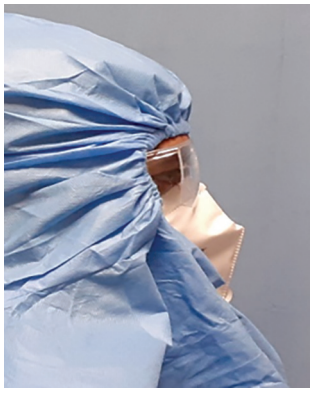
Results

The study was performed on 125 HCWs and 151 observations were done. A total of 26 HCW participated twice in the study, albeit on different days. Among 125 HCW, 37 were doctors, 57 were staff nurses 14 were physiotherapists and 17 belonged to other allied specialties (nursing aides, dialysis technicians, etc.). The mean (SD) donning room temperature, humidity, and lens temperatures where the observations were performed was 22.32 ± 0.7°C and 75.8 ± 2.8 gm/m^3, 26.35 ± 1.54°C, respectively.

The prevalence of fogging was 91% ($n = 113$) and the prevalence of FIV was 66.7% ($n = 82$) (Fig. 1). A total of 51.8% had difficulty reading and 60.2% had a change in visual acuity (both NV and DV) Table 2.

Protective eyewear fogging, as well as the extent of PEW fogging, was least with soap coating followed by mask with tape and goggle worn at a distance compared to the reference technique. See Table 3 and Supplementary Table S1. None of the

Table 1: Description of techniques and definitions

Techniques	*Description*	*Photography of techniques and comments*
Reference technique N95 mask with PEW	The PEW is worn close to the eyes inside the PPE hood. There is no space between the PEW and forehead (i.e. close to eyes)	 Reference technique
Soap-coated PEW N95 mask and PEW coated with soap and then air dried	A small drop of Microshield 4% chlorhexidine gluconate was placed and spread over the surface of the lens of PEW on both sides and left aside to air dry (not washed with water). The soap-coated PEW was prepared by the study investigators, undue care was taken to uniformly coat with the same thickness. The PEW with excessive coatings was not used.	 Like the reference technique, but with soap-coated PEW (not shown).
PEW worn at a distance N95 mask and the PEW worn over PPE hood	The PEW is worn over the PPE hood to increase the distance between the subject's eyes and the lens of the PEW. This forms a gap that helps the gas to escape without encountering the lens.	 A small gap is formed between the patient forehead/eye and the PEW.
Tape over mask N95 mask with tape to seal the upper edge	A tape (micropore) is applied at the upper edge of the mask in a bid to avoid air leaks and to improve the seal.	 Tape is applied across the entire upper border of the mask. Tape

PEW, protective eyewear; PPE, personal protective equipment

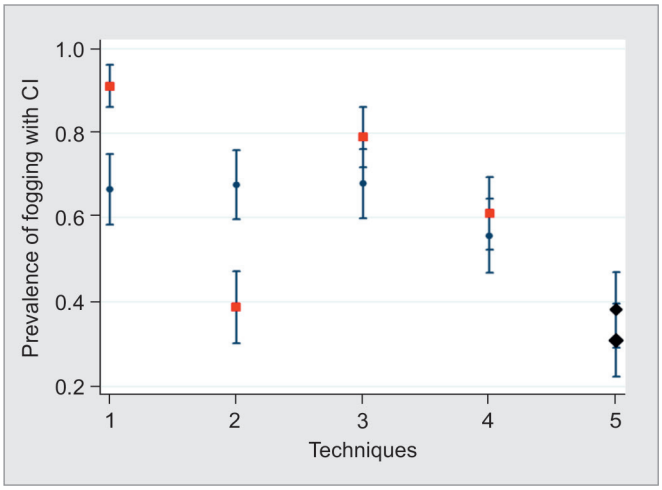


Fig. 1: Prevalence of fogging with various techniques. Data represented as percentage with 95% confidence intervals. Red square – Prevalence of fogging; blue circle – Prevalence of fogging impairing vision; the small diamond represents – Prevalence of fogging while at work i.e., inside COVID ICU; the large diamond represents, Prevalence of vision-impairing fogging while at work. Techniques 1 – plain PEW, 2 – soap coated PEW, 3 – PEW worn at a distance over PPE hood, 4 – use of tape over mask and 5 – inside COVID ICU while at work

Table 2: Comparison of PEW fogging among various study techniques*

Parameters	*Plain PEWs (Reference technique) n (%)*	*Soap-coated PEWs n (%)*	*PEWs worn at a distance n (%)*	*Tape over the mask n (%)*
Prevalence of fogging ($n = 125$)	113 (91.13)	48 (38.71)	98 (79.03)	75 (60.98)
Prevalence of FIV	82 (66.67)	84 (67.74)	85 (68)	69 (55.65)
Difficulty reading[a]	59 (51.75)	67 (55.37)	54 (46.55)	41 (34.75)
Time of appearance of fogging in seconds, median (IQR)	3 (2–6)	9 (3–20)	5 (3–20)	9 (4–27)
Frequency of fogging disappearance at 2 minutes[b]	6	1	2	1
Change in vision[c]	74 (60.16)	79 (64.2)	77 (61.6)	64 (51.61)
Presence of blurring	4 (3.42)	53 (43.80)	3 (2.59)	0
Quadrants/extent of fogging[d]				
• No fogging	11 (8.87)	76 (61.29)	26 (20.97)	48 (39.02)
• Mild	30 (24.19)	29 (23.39)	35 (28.23)	31 (25.20)
• Moderate	32 (25.81)	12 (9.68)	38 (30.65)	26 (21.14)
• Severe	18 (14.52)	3 (2.42)	16 (12.9)	10 (8.13)
• Very severe fogging	33 (26.61)	4 (3.23)	9 (7.26)	8 (6.50)

*The analysis is performed on 125 subjects and in the first observation. [a]Change in head or body posture while trying to read Snellen's and Jaeger's charts. [b]Instances where fogging did not disappear even at 2 minutes. [c]Change in either distant or near vision in either or both eyes. [d]The percentage of lens fogged.

Table 3: Factors associated with the extent of fogging of PEW*

S. No.	*Parameter*	*OR*	*p-value*	*CI*
Factors associated with fogging of PEW				
1.	Soap-coated PEW	0.04	<0.001	0.02–0.08
2.	PEW worn at a distance	0.32	0.002	0.16–0.65
3.	Tape over Mask	0.13	<0.001	0.06–0.25
Factors associated with the extent of PEW fogging				
1.	Soap-coated PEW	0.04	<0.001	0.02–0.08
2.	PEW worn at a distance	0.30	0.002	0.2–0.47
3.	Tape-over mask	0.14	<0.001	0.09–0.22

*Mixed-effects logistic regression for parameters associated with fogging (binary outcome). Mixed-effects ordinal logistic regression for parameters associated with the extent of fogging (ordinal no fogging; mild–very severe fogging). Comparison to the reference technique, that is, plain PEW. Apart from techniques, none of the factors predicted fogging or the extent of fogging. CI, 95% confidence interval; PEW, protective eyewear

factors predicted fogging or the extent of fogging apart from the techniques. See Table 3. The FIV was significantly lesser only with the mask with tape with an OR (CI) of 0.45 (0.25–0.82). See Supplementary Table S2. The increased extent of fogging was associated with a greater frequency of change in vision. See Supplementary Table S3.

Few participants reported blurring of vision with soap-coated PEW compared to other techniques which was also recorded and analyzed.

Blurring of vision with soap-coated goggles was reported by 53 (43.8%) HCWs. The prevalence of fogging among all four techniques was comparable for HCW who participated more than once (Supplementary Table S4).

The majority of HCW preferred the combination of wearing the PEW at distance from the eyes and a tape-over mask (71, 57.7%) while working inside the COVID ICU. The prevalence of fogging while at work in COVID ICU was 38%, ($n = 43$) and the prevalence of FIV in the COVID ICU is 30.9% ($n = 34$), both irrespective of the combination of methods or techniques used. The COVID ICU temperature (21.17 ± 0.8°C; $p < 0.001$), lens temperature (24.97 ± 1.16°C; $p < 0.001$) was significantly lower, and humidity was 80.37 ± 2.26 gm/m^3; $p < 0.001$ – significantly higher compared to the donning room.

Discussion

The prevalence of FIV in this study with fully donned PPE is 66.6%. The prevalence, as well as the extent of fogging, is least with soap-coated PEW and FIV is least with applying tape over the mask. Applying tape over the mask reduces the fogging of PEW with the least effect on vision. A combination of techniques may reduce the fogging of PEW further.

This is the first study, to the best of our knowledge, to estimate the prevalence of fogging and to compare various techniques to reduce fogging in an acute healthcare setting especially in the ICU. Higher FIV has been reported during intubations done in the operating room.[10,11] Yao et al.[10] reported a high occurrence of FIV during intubation despite using antifogging measures. These studies objectives were not to study fogging or the factors affecting it. In contrast, this study was conducted in a PPE donning room with the environment closely simulated to the ICU, while noting the room's temperature and humidity.

Factors affecting Fogging of PEW

Fogging of PEW happens because of condensation which occurs when the temperature of the object (PEW in our case) is at or below the dew point (the temperature at which the water vapor condenses to form water) of the surrounding air. Fogging is known to increase in the presence of higher surrounding temperatures or physical exertion by the subject[5] as shown in experimental settings. In contrast to experimental studies, in our case, the lens/PEW is exposed to room air and/or exhaled air. The exhaled air encounters the PEW either due to improper fit of the face mask or preferential exit of air upward while wearing a mask. The average temperature of exhaled air is around 31–34°C and humidity around 66–76% as shown in the study by Mansour et al. done on healthy volunteers.[12] Therefore, the dew point of the exhaled air will be higher favoring fogging. In this study none of the environmental factors, that is, temperature, humidity, or dew point of room predicted the occurrence of fogging as seen in the mixed-effects logistic regression analysis. This could be due to the fact that the environment temperature was more or less constant without any drastic change and fogging was likely due to exhaled air coming in contact with PEW in contrast to studies done in experimental environments.[5]

Comparison of Techniques to reduce Fogging of PEWs

The prevalence of fogging with the other techniques was significantly less compared to the baseline technique ($p < 0.001$). The soap coating, similar to antifogging sprays or baby shampoo, acts as a surfactant and is an effective way to reduce fogging.[6,7,13,14] Applying tape over the upper edge of the mask helps to reduce the air leak toward the PEW by ensuring a tight seal. Use of the tape has also been described by Bhardwaj et al. to reduce fogging in a operating room (OR) setting.[15] Similarly, wearing the PEW far from the eyes helps in allowing the air to escape through the gap between the PEW and face. A PEW close to the subject's face or a tightly fitted PEW can create a constant warm humid microenvironment that can not only increase fogging but also prolong the fogging experience. Although the PEWs were worn at a distance, they were placed outside the PPE hood creating a small gap between eyes and PEW but ensuring a good fit (See photographs in Table 1). This "distance" in real life may not compromise safety as it prevents eye contamination against splashes and droplets.

In this study, we found lesser fogging while at work (38%) compared to the donning room. Whether the lesser prevalence is because HCW used a combination of various techniques (e.g., wearing goggles at distance and tape over mask – a combination of techniques 3 and 4, respectively) or due to lower room temperature needs to be considered. We identified the least FIV with tape over the mask. The other three techniques had a similar prevalence of FIV. This could be due to the lesser extent of fogging with tape over the mask compared to other techniques. Vision change (both distant and near) was greater with a higher extent of fogging. Less than 25% quadrant involvement with fogging was associated with no change in vision and more than 75% quadrant involvement was associated with more frequent change in vision (Supplementary Table S1). In the case of soap-coated PEW, many HCWs reported some blurring of vision as compared to other techniques ($p < 0.001$) which would have affected the vision and led to more difficulty reading and in turn increased prevalence of FIV. This could be one of the major drawbacks of using soap-coated PEW. Blurring may be prevented by mild coating or coating on one side or washing it water followed by gentle wiping. This needs further testing.

The strengths of the study are, that this is the first study conducted in an acute healthcare setting that looked at the prevalence of PEW fogging and compare simple techniques to reduce it. In this study, we chose to use three simple and cost-effective methods that can be used even in resource-limited settings. We attempted to evaluate environmental factors and their role in the occurrence of fogging of PEW and tried to compare techniques in an environment similar to that of the ICU. Lastly, we have shown the prevalence of fogging was the same among all techniques when the study was repeated in a few subjects adding strength to the study. The main limitation would be not using antifogging solutions as a comparative technique to decrease fogging, as this is extensively described in the literature. We decided to omit it as it isn't cost-effective and may not be freely available to use in all healthcare setting. All the techniques were studied in the same HCW at a given time and occasionally repeated on HCW, but on different days. Having done

this, we believe that each subject acts as their own comparator, thus nullifying the unknown and anatomical factors that may influence fogging. Lastly, it is a single-center study performed in a donning room rather than the COVID ICU itself, which was our area of interest.

Conclusion

The prevalence of FIV is 66%. Application of tape over the mask can avoid disturbances in vision best even if fogging does occur. Soap coating of the PEW and wearing the PEW as far from eyes are potential alternatives. A combination of the above techniques may reduce further fogging but needs further evaluation in future studies.

Supplementary Material

The supplementary figure and supplementary tables are available online on the website of https://ww.ijccm.com.

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References

1. Yuli Hu, Lan Wang, Fang Fang. Prevention of fogging of protective eyewear for medical staff during the COVID-19 pandemic. J Emerg Nurs 2020;46(5):564–546. DOI: 10.1016/j.jen.2020.05.003.
2. Schurr MO, Kunert W, Arezzo A, Buess G. The role and future of endoscopic imaging systems. Endoscopy 1999;31(7):557–562. DOI: 10.1055/s-1999-52.
3. Malik SS, Malik SS. A simple method to prevent spectacle lenses misting up on wearing a face mask. Ann R Coll Surg Engl 2011; 93(2):168. DOI: 10.1308/rcsann.2011.93.2.168b.
4. Reed MJ. Preventing fogging of spectacles whilst wearing a protective face-mask. J R Coll Surg Edinb 2001;46:377. PMID: 11768580.
5. Crebolder JM, Sloan RB. Determining the effects of eyewear fogging on visual task performance. Appl Ergon 2004;35(4):371–381. DOI: 10.1016/j.apergo.2004.02.005.
6. Chainansamit S, Piromchai P, Anantpinijwatna I, Kasemsiri P, Thanaviratananich S. Baby shampoo versus commercial anti-fogging solution to prevent fogging during nasal endoscopy: A randomized double-blinded, matched-pair, equivalent trial. J Med Assoc Thai 2015;98(Suppl. 7):S128–S131.
7. Piromchai P, Kasemsiri P, Thanaviratananich S. Alternative agents to prevent fogging in head and neck endoscopy. Clin Med Insights Ear Nose Throat 2011;4:1–4. DOI: 10.4137/CMENT.S6597.
8. Manning TG, Perera M, Christidis D, Kinnear N, McGrath S, O'Beirne R, et al. Visual occlusion during minimally invasive surgery: A contemporary review of methods to reduce laparoscopic and robotic lens fogging and other sources of optical loss. J Endourol 2017;31(4):327–333. DOI: 10.1089/end.2016.0839.
9. Song T, Lee DH. A randomized Comparison of laparoscopic LEns defogging using Anti-fog solution, waRm saline, and chlorhexidine solution (CLEAR). Surg Endosc 2020;34(2):940–945. DOI: 10.1007/s00464-019-06852-5.
10. Yao W, Wang T, Jiang B, Gao F, Wang L, Zheng H, et al. Emergency tracheal intubation in 202 patients with COVID-19 in Wuhan, China: Lessons learnt and international expert recommendations. Br J Anaesth 2020;125(1):e28–e37. DOI: 10.1016/j.bja.2020.03.026.
11. Cook TM, El-Boghdadly K, McGuire B, McNarry AF, Patel A, Higgs A. Consensus guidelines for managing the airway in patients with COVID-19: Guidelines from the Difficult Airway Society, the Association of Anaesthetists the Intensive Care Society, the Faculty of Intensive Care Medicine and the Royal College of Anaesthetist. Anaesthesia 2020;75(6):785–799. DOI: 10.1111/anae.15054.
12. Mansour E, Vishinkin R, Rihet S, Saliba W, Fish F, Sarfati P, et al. Measurement of temperature and relative humidity in exhaled breath. Sens Actuators B Chem 2020;304:127371. DOI: 10.1016/j.snb.2019.127371.
13. Madan M, Malhotra N, Gupta N, Ish S, Ish P. Fogging of goggles in PPE during COVID-19 pandemic. A practical problem with multiple possible solutions. 2020;88(6):636–637. DOI: 10.5603/ARM.a2020.0164.
14. Palvia V, Gonzalez AJH, Vigh RS, Anasti JN. A randomized controlled trial comparing laparoscopic lens defogging techniques through simulation model. Gynecol Minim Invasive Ther 2018;7(4):156–160. DOI: 10.4103/GMIT.GMIT_39_18.
15. Bhardwaj A, Sharma C, A Rajan MB. Simple solutions for the fogging of spectacles when wearing surgical masks. J Am Acad Dermatol 2021;85(4):e237–e238. DOI: 10.1016/j.jaad.2020.08.041.