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RESEARCH ARTICLE

Respiratory Virus Transmission during Orthopaedic Surgery in Low and Middle Income Countries: A Survey of Knowledge and Clinical Practices

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ABSTRACT

Background: Orthopaedic surgeons, by virtue of the surgical tools they use, are very at high risk to contract respiratory viruses. This study sought to investigate orthopaedic surgeons' knowledge, beliefs and practices on the use of personal protective equipment (PPE).

Methods: Using a self-administered survey, investigators collected data from orthopaedic surgeons in a middle-income nation. Data collection occurred over a two month period and statistical analyses were performed using SPSS version 20.0

Results: Data from 45 orthopaedic surgeons (70% response rate) were analysed. Although 73% of doctors had received some training on the use of PPE, 40% were dissatisfied because the information was ambiguous. Unfortunately, 18% of orthopaedic doctors did not recognise that power tools used during surgery generated virus-carrying aerosols and 36% erroneously believed that pulsatile lavage reduced the risk of viral transmission. Of all respondents, 78% were dissatisfied the PPE supplied by their hospitals, with the scarcity in the operating theatre achieving statistical significance. This prompted >75% of doctors to purchase PPE for their personal use in the public hospitals.

Conclusion: Our study uncovered beliefs and practices which are not supported by scientific evidence and may contribute to a higher risk of infection. Future research should prioritize infection control training that reflects the unique roles and responsibilities of different categories of staff within the healthcare system.

INTRODUCTION:

Healthcare workers are at high risk of contracting respiratory viruses at work by virtue of their increased levels of exposure.^{1,2,3} Orthopaedic surgeons are particularly vulnerable due to aerosolization that occurs with the use of power tools.^{4,5} Therefore, it is important for orthopaedic surgeons to be familiar with the proper use of personal protective equipment (PPE) as a part of their risk-reduction strategies against respiratory viruses.

It is a reasonable expectation that healthcare institutions should educate their employees in safe practice, and provide a safety equipment to ensure a safe working environment.⁶⁻⁷ This, however, is not an area that receives much attention in most orthopaedic surgical departments, especially in low and middle income countries (LMICs) where PPE may not be universally available.^{5,8} Audits of institutional safety standards and healthcare worker practices are important exercises in order to determine whether a healthcare facility meets the minimum expected standard to foster safe working environments.⁹

The aim of this study was to investigate the knowledge, beliefs and practices on PPE use by orthopaedic surgeons in a LMIC in the Eastern Caribbean. The data gleaned from this study would be valuable to inform future public health strategies in the face of evolving health challenges. This becomes especially important in light of the recent global pandemic with the respiratory virus, COVID-19.

METHODS:

This study was performed in Trinidad & Tobago, a twin island nation in the Eastern Caribbean with a population of 1.45 million persons.⁴ The government of Trinidad &

Tobago provides free health care for all legal residents through a network of public facilities. Five of these public facilities have orthopaedic surgery departments that employ doctors at various levels, ranging from consultant/attending surgeons to newly graduated interns.⁴ The facilities are also attached to a regional university that provides post-graduate level training to orthopaedic surgical residents.¹⁰ The Campus Research Ethics Committee of the University of the West Indies gave approval (CREC-SA.0400/06/202) for the investigators to carry out a questionnaire study across the five facilities in this setting.

The investigators in this study developed a 20-item survey after a broad literature review. The questionnaire was pilot tested to ensure that the scope was adequately captured. Content validity ensured clarity of the questions and face validity was conducted by the primary author who is an experienced orthopaedic surgeon. The questionnaire is included as appendix 1 and was divided into three sections: The first section sought information on respondent demographics including level of experience and presence of comorbidities; the second section consisted of questions related to institutional practice; and the third section explored participants' knowledge of safety procedures as it relates to the use of common instruments and devices during orthopaedic surgery.

To be eligible for inclusion in this study, participants were required to be medical doctors with a minimum of six months experience in orthopaedic surgical practice at a major public hospital in Trinidad & Tobago. Exclusion criteria included non-physician healthcare workers in orthopaedics and doctors who had less than six-months experience in orthopaedics.

The self-administered questionnaire was distributed electronically to all eligible orthopaedic surgeons in the five major hospitals. Data collection took place over a two-month period from May 1 to June 30, 2020. Any doctors who did not return the questionnaire within 30 days was sent an email reminder.

An independent researcher transferred all the collected data to an Excel spreadsheet. Descriptive statistics were generated using SPSS version 20.0 The Pearson's chi-squared test was used to compare qualitative data, with statistical significance set at $p < 0.05$.

RESULTS:

The electronic questionnaire was distributed to 64 eligible doctors in Trinidad & Tobago across five major public hospitals. A total of 45 (70%) participants responded to the questionnaire. The mean age was 35 years (Range 25-58; Standard Deviation ± 8.4) and the majority were male (76%, 34/45). The study sample comprised 8 (17.8%) attending / consultant grade orthopaedic surgeons, 9 (20%) registrar / PGY3-5 grade, and 28

(62.2%) house officers / PGY1-2 grade staff. Interestingly, 20% of all doctors surveyed reported having at least one comorbidity that would place them at increased risk of complications should they develop a respiratory illness.

Knowledge:

As it relates to physician knowledge, 37 (82%) of doctors were aware of their hospital's protocols for PPE use, and 33 (73%) had received training in the use of PPE during the pandemic. However, 18 (40%) were dissatisfied with this training because they felt that the information was ambiguous, a finding that was consistent among the different hospitals ($p=0.3013$).

The most surprising aspect of the study related to the participants' knowledge of safety recommendations and protocols for PPE use. For example, 18% of doctors in orthopaedics did not recognise that power tools used during surgery generated virus-carrying aerosols and 36% erroneously believed that pulsatile lavage reduced the risk of viral transmission. The remaining participants' responses are outlined in Table 1.

Table 1: Orthopaedic surgeons' Knowledge on PPE Recommendations

Parameter	Hosp A (n = 15)	Hosp B (n=10)	Hosp C (n=11)	Hosp D (n=2)	Hosp E (n=7)	Mean (n= 45)	P
Is a N95 respirator mask required when using power tools during orthopaedic surgery?							
Yes	11(73.3%)	8 (80%)	9 (81.8%)	2 (100%)	7 (100%)	82%	0.5933
No	4 (26.7%)	2 9205)	2 (18.2%)	0 (0%)	0 (0%)	18%	
Does double-masking (N95 + surgical mask) offer additional protection against respiratory viruses during orthopaedic procedures?							
Yes	4 (26.7%)	4 (40%)	5 (45.5%)	1 (50%)	1 (14.3%)	33%	0.6233
No	11(73.3%)	6 (60%)	6 (54.5%)	1 (50%)	6 (85.7%)	67%	

Table 1: Orthopaedic surgeons' Knowledge on PPE Recommendations							
Parameter	Hosp A (n = 15)	Hosp B (n=10)	Hosp C (n=11)	Hosp D (n=2)	Hosp E (n=7)	Mean (n= 45)	P
Does pulsatile lavage reduce the risk of viral transmission during orthopaedic procedures?							
Yes	7 (46.7%)	4 (40%)	3 (27.3%)	1 (50%)	1 (14.3%)	36%	0.5939
No	8 (53.3%)	6 (60%)	8 (72.7%)	1 (50%)	6 (85.7%)	64%	
Are N95 respirator masks recommended for use in the outpatient clinic?							
Yes	11 (73.3%)	9 (90%)	8 (72.7%)	2 (100%)	6 (85.7%)	80%	0.7299
No	4 (26.7%)	1 (10%)	3 (27.3%)	0 (0%)	1 (14.3%)	20%	
Key: Hosp = hospital; A- Eric Williams Medical Sciences Complex; B- Port of Spain General Hospital; C- San Fernando General Hospital; D- Scarborough General Hospital; E- Sangre Grande Hospital							

Practice:

When the questionnaire sought information on clinical practice, doctors in orthopaedics were generally dissatisfied with the quality of PPE supplied by their hospitals (77.8% vs 22.2%; p=0.3487) although the questionnaire

was unable to discern the exact reasons for their dissatisfaction. Orthopaedic surgeons were also dissatisfied with the supply and availability of PPE in their hospitals, with the reported scarcity in the operating theatre achieving statistical significance (Table 2).

Table 2: Orthopaedic surgeons' opinions on the PPE supply in their hospital							
Parameter	Hosp A (n = 15)	Hosp B (n=10)	Hosp C (n=11)	Hosp D (n=2)	Hosp E (n=7)	Mean (n= 45)	P
The quality of PPE supplied met international standards							
Yes	1 (6.7%)	1 (10%)	5 (45.5%)	1 (50%)	2 (28.6%)	10 (22.2%)	0.3487
No	14 (93.4%)	9 (90%)	6 (54.5%)	1 (50%)	5 (71.4%)	35 (77.8%)	
The supply of PPE was adequate in outpatient clinic							
Yes	5 (33.3%)	2 (20%)	4 (36.3%)	0	1 (14.3)	12 (26.7%)	0.6675
No	10 (66.7%)	8 (80%)	7 (63.7%)	2 (100%)	6 (85.7%)	33 (73.3%)	
The supply of PPE was adequate in operating theatre							
Yes	10 (66.7%)	0	5 (45.4%)	2 (100%)	1 (14.3%)	18 (40%)	0.0028
No	5 (33.3%)	10 (100%)	6 (54.5%)	0	6 (85.7%)	27 (60%)	
Key: PPE = Personal protective equipment; Hosp = hospital; A- Eric Williams Medical Sciences Complex; B- Port of Spain General Hospital; C- San Fernando General Hospital; D- Scarborough General Hospital; E- Sangre Grande Hospital							

The overall frustration with obtaining safety equipment prompted >75% of doctors to purchase PPE for their personal

use in the public hospitals. The most commonly purchased items are displayed in Figure 1.

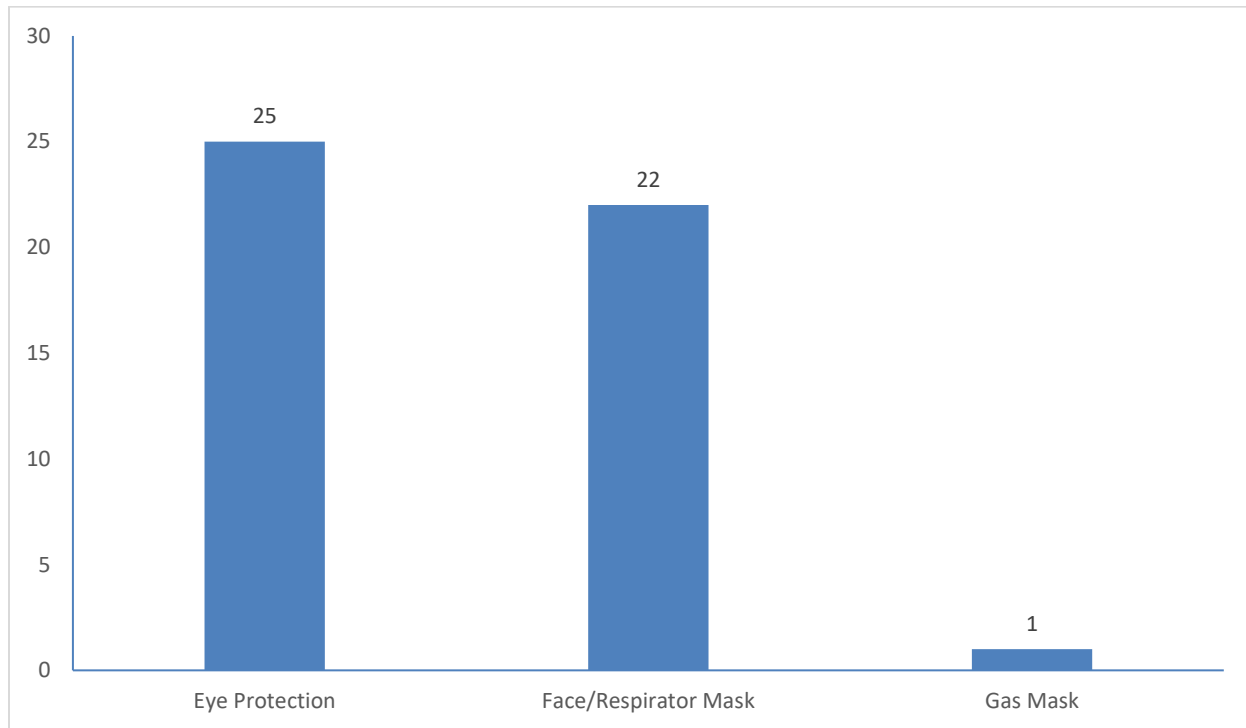


Figure 1: Most commonly purchased supplemental pieces of personal protective equipment

DISCUSSION:

During the recent COVID-19 global pandemic, it was estimated that healthcare workers accounted for up to 13% of confirmed cases.^{2,3} Therefore, many changes in practice and protocols were rapidly implemented in an attempt to reduce healthcare workers' risk of contracting the respiratory virus.¹¹ Orthopaedic surgeons were among the highest-risk group of healthcare workers due to the nature of their work. One published report revealed that 20.7% of orthopaedic surgeons across eight hospitals in Wuhan contracted COVID-19, with a documented transmissibility rate of 25%.¹² This finding is particularly significant in LMICs, where the relatively small orthopaedic workforce is especially vulnerable to the consequences of uncontrolled viral spread.

An important method to reduce the impact of respiratory viruses is infection control training. However, to be effective the training should be practical and persuasive. To illustrate this, Almohammed et al.¹³ demonstrated that with training and strict enforcement of infection control measures, they were able to achieve a zero infection-rate in their facility. One of their strong recommendations was mandatory training programmes for healthcare workers, with specific, clear and directed recommendations.⁹ It was disappointing, therefore, that 27% of doctors in our study did not receive infection control training at their hospital. An even more alarming finding was that nearly half (49%) of those who did undergo training deemed it ineffective, as the information was generic and tailored for a broad

audience of healthcare workers. Considering the high-risk nature of orthopaedic surgery this highlights a significant and dangerous gap in healthcare education. Our constructive criticism is that future training should focus on the unique risks associated with orthopaedic surgery and deliver specific recommendations for risk reduction in orthopaedics.

While it is agreed that healthcare workers are at an increased risk of contracting respiratory viruses than the general population,¹⁴⁻¹⁶ a more controversial point is their role in virus transmission. In the latter stages of the COVID-19 pandemic, some researchers documented that staff-to-staff transmission was responsible for up to 79% of confirmed cases.^{17,18} It has also been clearly documented that healthcare workers in high-risk departments within hospitals have a greater chance of infection compared with other healthcare workers in that facility.⁹ These findings support the hypothesis that healthcare workers were an important vector for viral spread, likely due to unsafe practices particularly in high-risk clinical areas.¹⁸ This strengthens our recommendation that public health policy makers should take this into account and deliver tailored training in orthopaedics and other high-risk specialties.

It is generally agreed that PPE is a critical weapon in the fight to control viral transmission and also to prevent morbidity and mortality for healthcare workers at greater risk of contracting respiratory viruses.¹ The premise is that PPE must be effective, should be made available for healthcare worker use, and should be accompanied by clear guidelines on their use. Therefore, we believe that it was reasonable for healthcare workers to expect that guidance documents would be

available for PPE use.¹⁹ However, many doctors in orthopaedics reported that institutional guidance for PPE use was vague. A similar effect was seen in two prior reports from the Caribbean that documented the challenges faced by hospitals to procure and preserve PPE supplies.^{4,5} This is supported by our finding that 89% of doctors in orthopaedics independently sourced supplemental PPE for personal use because they were dissatisfied with the supply by their institution. It is important to understand that the practices of PPE use by individual doctors in orthopaedics was largely driven by their understanding of information (or misinformation). This is a critical detail that has remained largely unexamined in surgical literature.

Orthopaedic surgery involving power tools and pulsatile lavage are aerosol generating procedures (AGPs) which increase the risk of respiratory viral transmission.^{20,21} One study demonstrated that aerosol generating procedures during spinal and hip arthroplasty contaminated a wide field, affecting all members of the surgical and anaesthetic teams.^{22,23} Similar levels of contamination were observed with the use of pulsatile lavage.¹⁹ We were, therefore, surprised to discover that 18% of doctors were unaware of the role that AGPs play in viral transmission and 36% believed that pulsatile lavage reduced the risk of viral infection.

It is firmly established in the literature that surgical masks are not effective in protecting against aerosols <3µm, making respirator masks such as the filtering face piece (FFP) 2/3 or N95 mandatory during AGPs.²⁴ So it was alarming to discover that 18% of doctors in our setting were unaware of these recommendations. There were several other misconceptions that

were exposed by our study. For example, 33% of doctors falsely believed that double masking provided additional protection from aerosol transmission, and 20% used a respirator mask in the outpatient clinic, contrary to a strong World Health Organization (WHO) recommendation that only a surgical mask is required in that setting.²⁵ Such beliefs put into practice would have misused critical PPE and increased the risk of viral transmission while further depleting scarce resources.

It is recognized that lack of knowledge inadequate infection control training, scarcity of PPE, and suboptimal PPE use are some of the factors that may increase the spread of respiratory viruses in orthopaedics.²⁶⁻²⁹ It is therefore imperative that we learn from the pandemic experience to inform future public health strategies in the face of evolving health challenges.

LIMITATIONS

We acknowledge that our study is limited by the small sample size and narrow scope, which prevents generalizability. However, it is the first study from the Caribbean aimed at understanding the level of knowledge and practice among orthopaedic staff. Despite its small sample size is represents 70% of the entire orthopaedic workforce in Trinidad and Tobago. In addition by including junior doctors, who often conduct the daily running of a unit, we sought to obtain a more real-life view of practices which may occur without the explicit knowledge of the consultant. Practices which may have had undesirable effects.

CONCLUSION:

Orthopaedic doctors are exposed to a higher risk of respiratory virus infection by virtue of

the type of operations routinely performed. Our study uncovered beliefs and practices which are not supported by scientific evidence and may contribute to a higher risk of infection. Future research should prioritize infection control training that reflects the unique roles and responsibilities of different categories of staff within the healthcare system.

Conflicts of Interest:

There are no disclosures for any of the authors that may represent conflicts of interest

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