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How do we optimise operator safety during dermatological surgery?

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Introduction

The turn of the decade has brought with it the era of the mask. Conceived in 1897 by Johann Mikulicz, the surgical mask has been fundamental in enhancing the safety of surgeon and patient[1]. But it is not enough. The SARS-CoV-2 pandemic has revealed inadequacies in transmission prevention[2]. This is especially concerning in dermatological surgery[3], where operators are in close proximity to patients' oral and nasal mucosa and are exposed to airborne and liquid secretions. Additionally, operators are at risk from sharps injury, chemical irritation, electrocautery plumes, musculoskeletal injury, bloodborne infections and stress. This essay will discuss and posit implementations to improve operator safety, and consider their efficacy and practicality.

Hazards

Data suggests rates of needlestick injury are highest amongst dermatologists[4], with 1 in 20 Mohs surgeons also reporting occupational exposure to bloodborne infections[5]. More worrying is the report that 90% of Mohs surgeons suffer some degree of musculoskeletal dysfunction[6]. Moreover, hazards amalgamate to increase risk, e.g. stress from busy lists can hamper mental health and lead to operator injury (e.g. needlestick). A non-exhaustive list of hazards is presented in Table 1.

Stress, needlestick injury, contact with infectious mediums and musculoskeletal issues represent common hazards faced by dermatological surgeons. Dermatological surgery poses a significant risk of morbidity to the operator which, in turn, negatively impacts patient care[7]. Severe outcomes of hazards include: shortened surgical career, extended leave and chronic morbidity. Current preventative measures have some impact but there are inconsistencies in implementation between hospitals and surgeons[8].

Category	*Hazard*	*Approximate Prevalence in Dermatological Surgeons (%)*	*Current Preventative Solutions*
Biological	Infection – bloodborne	5[5] (exposure only, infection rates are close to 0%[9†])	Double gloving, vaccination, access to post-exposure prophylaxis or immunoglobulins[9]
	Infection – smoke and airborne	9[10‡]	Respirator mask use, positive pressure environment, pre-op screening for respiratory illness
	Infection – other fluid exposure	66.4[11]	Face shields, surgical gown, goggles[11]
	Chemical/material – allergy or irritation	16.2[12‡]	Education on correct protective equipment usage and allergen avoidance, banning of allergenic material[12], moisturiser dispensers, occupational dermatitis warning posters
	Chemical/material – radiation or laser exposure	Not Recorded	Protective equipment (lead aprons and goggles), appropriate barriers and initiation of therapy outside theatre
*Psychosocial**	Psychological impact of surgical error	10-40[13]	Support (from Trusts and professional bodies), improved training and mentorship
	Organizational stress – increased operating duration/busy lists/faulty equipment	Not Recorded	Triage, availability of support, testing of equipment
	Burnout	39.6[14†]-50[15]	Wellness, mindfulness and enhancing preferred aspects of work[14]
Accidental	Sharps Injury	65[5]-100[16]	No-touch technique for needle adjustment, needle guards, correct transfer of instruments (neutral zone or suture counter box use)[5]
	Other Injury (diathermy/laser burns, falls etc.)	Not Recorded	Correct training and staff awareness of hazards[17]
Ergonomic	Musculoskeletal pain	37[18]-81[19]	Education on ergonomics, assistance with heavy loads and

	patient positioning[20]

*Table 1 Hazards in dermatological surgery, *indirectly impacts operator safety, †prevalence in all surgeons, ‡prevalence in healthcare workers*

Solutions

How can risk from hazards be mitigated? A non-exhaustive list of novel solutions and the feasibility of piloting these is presented in Table 2. Assessment on feasibility was adapted from methodology suggested by two studies[21,22] (Table 3); a rudimentary score from 1 (very difficult to implement) to 5 (little difficulty) was given to summarise feasibility; parameters were weighted equally.

Solutions can be categorised into four groups: training, checklists, new services, and optimization of available resources. Training, checklists and enhancement of existing resources are more likely to be adopted due to convenience of implementation. Solutions to prevent musculoskeletal pain are the most effective to trial due to the high prevalence and simplicity of interventions. Solutions are discussed in supplementary recording.

Hazard	*Novel Solutions*	*Feasibility Score*	*Summary of Key Issues*
Bloodborne/ bodily fluid infections and needlestick	Dedicated/streamlined out of hours service for prophylaxis	1	Challenging to establish a new service and accrue personnel and resources. Measurements (e.g. estimated time saved by using service instead of ED) would be difficult to record. Immunisation of doctors/nurses to Hep B and recommendation of 'undetectable = untransmissible' by BHIVA suggests actual risk of infection is small and does not warrant a specialised service.
	Strict enforcement of needle-guard, double-gloving and neutral-zone use by theatre nursing staff, with recording and reporting of non-compliance	5	There is potential concern over the mis/underreporting of unsafe practice and influence from reporter bias.
Smoke and airborne	Routine (portable) smoke extractor use	3	Despite evidence supporting efficacy and theoretical advantages[23], it is

infections	positioned close to the site of plume/droplet generation[23] LOE: 5		difficult to measure the contribution smoke extractor use has on improving operator safety.
	Increase air exchange cycles[24]* LOE: 1A	3	Limited to dedicated operating theatres only; difficult to implement in office-based settings, difficult to measure variables (number of operators acquiring infection intraoperatively and quantity of pathogen per unit volume) - despite theoretical benefit; no standardized quantification methods[25].
	Conducting surgery in a negative-pressure environment – specialised operating theatre[26]* or portable environment[27]* LOE: 5 and 4 respectively	1	Very resource intense and not logistically or economically viable, difficult to measure variables. Portable negative pressure environments are a new invention and have not been trialled in dermatological surgery.
	Cessation of surgery in an office environment	3	Limited by the availability of theatres and difficult to develop a protocol that does not interfere with other processes within a hospital.
Allergy and Irritation	Specific protective, cleaning and hygiene products based on the requirement of individual operators	3	Resource intense and risk of using non-certified protective, cleaning and hygiene equipment from multiple sources.
	Stream-lined patch testing service for healthcare workers with occupationally relevant sensitizers	1	Difficulty of access to and tailoring of surgery-specific patch testing. Benefit of patch testing can be measured by the reduction in prevalence of contact dermatitis in tested individuals.
Lasers and Radiation	Checklist ensuring: donning of correct protective equipment by all present personnel, clear sign indicating active laser use, equipment checks up-to-date and clear communication between team members when unsafe practice is noted[28] LOE: 5	5	Low-cost and uses available resources, data on the number of accidents can be easily recorded.
Stress and Burnout	Regular Balint Group-like meetings[29]* LOE: 1B	3	Issues with participant uptake and generating durable protocols.

	Improved triaging and referrals using applications and technology[30] LOE: 2A	3	Smart phone based applications and photo-based telemedicine may supplement current systems but require training, new resources and establishing new protocol.
Musculoskeletal Pain	Fully adjustable patient couch, good lighting, adjustable seating/footstools, a checklist or time dedicated to optimising these features	3	Compliance to protocol may be difficult due to busy lists and dependence on patient factors such as habitus, position and operative location. Few additional resources required.
	Alexander technique training (training for self-awareness and correction of posture during procedures) [31]* LOE: 2A	4	Evidence shows effectiveness[32], not resource intense and easy to measure. Effected by the time to train surgeons and compliance.
	Intraoperative Micropauses[31]* LOE: 1A	5	Evidence shows effectiveness[33], not resource intense, easy to measure.

*Table 2 Solutions to hazards faced by dermatological surgeons, *adapted from another surgical/medical specialty, LOE: level of evidence*

Parameters Considered	*Abridged summary of the content considered for each parameter*[21,22]
Process	Assessment of the difficulty of designing and implementing the protocol.
Resources	Assessment of the difficulty of acquiring sufficient numbers of investigators, materials, finances and technology.
Management	Assessment of the difficulty of collating, organizing and processing data and minimizing breaches in protocol.
Scientific	Assessment of the difficulty of measuring and estimating findings.

Table 3 Parameters considered when assessing feasibility of piloting novel solutions

Dermatological Surgery and COVID

Currently, COVID-19 undoubtedly poses the greatest risk to the safety of dermatological surgeons. Optimizing the identification of COVID-19 positive patients, and delaying surgery until non-infectious, provides ideal protection from intraoperative transmission. Recommendations by SAGE for prevention and mitigation of transmission are illustrated in Figure 1.

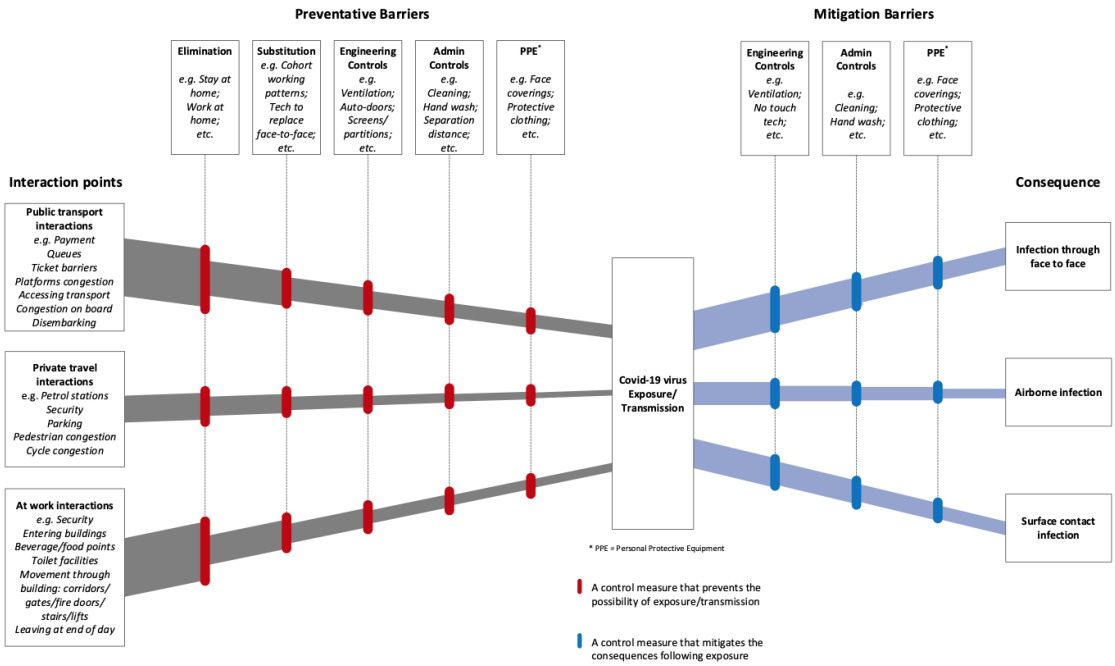

Figure 1 SAGE 2020, bowtie diagram demonstrating measures to minimise risk of transmission[34]

PPE, patient and surgeon screening/testing, cleaning protocols and telemedicine have been implemented to reduce operator exposure to high-risk patients[35], but the risk is still not negligible[36]. One study suggested as many as 12.5% of surgeons positive for COVID-19 were infected intraoperatively[37]. Another reported that 14 surgical healthcare workers contracted COVID-19 from a single patient[38]. Mohs and aesthetic/cosmetic surgeons are at greater risk, due to close proximity to the unmasked nose and mouth during facial surgery. FFP3 masks are effective at reducing transmission but are dependent on availability, fit and adherance[39]. Powered air-purifying respirators may provide superior protection and mitigate issues with fit, but are more costly, require careful decontamination, and are challenging to wear and communicate through[40]. Adjuncts to the FFP3 mask may be more effective. Portable smoke evacuating devices represent a cost-effective adjunct[41]. When used in enclosed environments, evacuators can absorb both infective aerosol droplets and smoke[42]. Aside from being toxic and carcinogenic, plumes carry virions[23] (unconfirmed for COVID-19) and bypass masks. Enclosed environments around the wound, nose and/or mouth may be

difficult to achieve. Nilson *et al.* developed a novel portable negative pressure environment with a smoke extractor (Image 1), that may reduce transmission. It could be adapted for facial surgery but requires studies to validate its efficacy, and practicality in dermatological surgery[27]. Alternatively, a semi-enclosed environment with strategically placed surgical drapes/mask, that form a barrier between the operator and patient's nose/mouth, could be used[42], with an extractor placed beneath the drapes, near the patient's nasal/oral cavities. Additionally, transition from an office to theatre with increased air exchange cycles may augment protection[24].

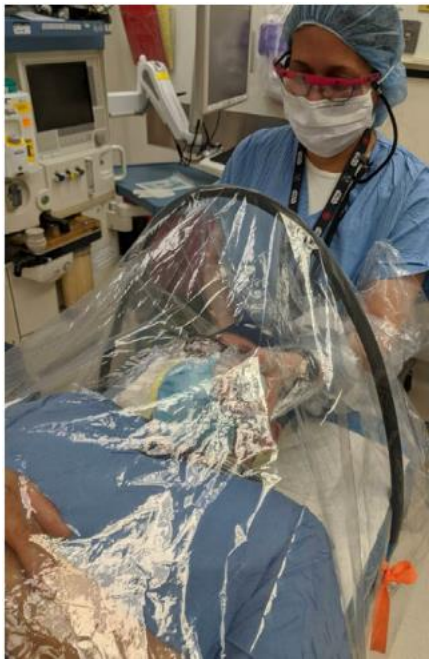

Image 1 Nilson et al. 2020, a portable negative pressure environment for laryngoscopy[27]

Conclusion

Musculoskeletal issues are ubiquitous among dermatological surgeons and are associated with chronic morbidities. Solutions to improve ergonomics and posture are cost-effective, convenient and practicable. Additionally, adaptations that improve intraoperative air quality are vital to reduce transmission and avoid adverse outcomes in the COVID-19 era.

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