Author(s) (year) ***Journal*** **Country**	**Setting**	**Risk analysis**	**Mitigation strategies**	**Results**	***Level of evidence*** **Risk of bias**
Risk analysis					
Murr et al. (2020)[22] *Am Journal Rhinol Allergy* USA	Prospective, observational cohort study n=5	Measurement of aerosol concentration with optical particle sizer following use of cold instrumentation, microdebrider and drill	None	Use of microdebrider and drill exposed surgeon to higher levels of aerosols than use of cold instrumentation (both p=0.001) No significant difference between microdebrider and drill (p=0.59)	*Level 4 (case-control study)* Risk of bias: Low
Sim et al. (2020)[17] *Ann Otol Rhinol Laryngol* USA	Experimental cadaveric simulation	Measurement of vitamin B2 and fluorescein with both UV blacklight and cascade impactor following nebulisation and use of drill	None	Vitamin B2 proposed as superior to fluorescein as fluorescent tracer for particles ≤3.30µm Particles ≤3.30µm measured after endonasal drill use	*Level 4 (case series)* Risk of bias: Moderate (cadaveric simulation may not accurately represent *en vivo* dynamics)
Workman et al. (2020a)[13] *Int Forum Allergy Rhinol* USA	Experimental cadaveric simulation	Measurement of fluorescein with a blue-light filter and digital image processing following	None *(N95 and VENT-N-95 masks considered in setting of outpatient endoscopy, not in*	Cold instrumentation and microdebrider use did not generate detectable aerosols Significant	*Level 4 (case-control study)* Risk of bias: Moderate

		use of cold steel instrumentation, microdebrider and drill	*surgical simulation, so not considered further)*	aerosolisation was detected with use of drill	(cadaveric simulation may not accurately represent *en vivo* dynamics)
Workman et al. (2020b)[19] *Otolaryngol Head Neck Surg* USA	Experimental cadaveric simulation	Measurement of aerosol concentration with optical particle sizer following use of cold steel instrumentation, electrocautery, microdebrider and drill	None *(N95 and VENT-N-95 masks considered in setting of outpatient endoscopy, not in surgical simulation, so not considered further)*	Cold steel instrumentation and microdebrider use did not produce measurable particles Particles 1-10.0μm measured with use of electrocautery and drill	*Level 4 (case-control study)* Risk of bias: Moderate (cadaveric simulation may not accurately represent *en vivo* dynamics)
Sharma et al. (2021b)[23] *Laryngoscope Investig Otolaryngol* USA	Prospective, observational cohort study n=9 (septoplasty n=3, sinus surgery n=3, anterior skull base surgery n=3)	Measurement of aerosol concentration with optical particle sizer during septoplasty, endoscopic sinus surgery and skull base surgery with use of cold steel instrumentation, microdebrider, drill and coblator	None *(standard surgical mask and VENT-N-95 masks considered in setting of outpatient endoscopy, not in surgical simulation, so not considered further)*	No detectable spikes in aerosolisation during septoplasty Detectable particles produced during sinus surgery (including during cold instrumentation) and skull base surgery (with electrocautery and coblation but not with drill use)	*Level 4 (case-control study)* Risk of bias: Low
Patient testing and PPE use					
Naik et al. (2020)[25] *J Laryngol Otol*	Retrospective, observational cohort	None	Pre-operative patient COVID-19 testing and	No evidence of symptomatic COVID-	*Level 4 (case series)*

UK	study n=24		14 day self-isolation PPE (level 3 FFP) for staff	19 infection amongst patients at 14 days postoperatively	Risk of bias: Moderate (no patient testing; did not report on infections in staff)
Penner et al. (2020)[12] *J Endocrinol Invest* Italy	Observational cohort study n=5	None	Pre-operative patient COVID-19 testing PPE (level 3 FFP) for staff Surgery restricted to cold instrumentation	No evidence of COVID-19 infection amongst staff on testing No evidence of symptomatic COVID-19 infection amongst patients	*Level 4 (case series)* Risk of bias: Moderate (no patient testing)
Taha et al. (2020)[27] *Am Journal Rhinol Allergy* USA	Prospective, observational cohort study n=152	None	PPE (p100 respiratory filters) for staff	No evidence of COVID-19 infection amongst staff on testing	*Level 4 (case series)* Risk of bias: Moderate (did not report on infections in patients)
CRANIAL Consortium (2021)[26] *World Neurosurg* UK	Multicenter, prospective, observational cohort study at 12 sites n=124	None	Pre-operative patient COVID-19 testing PPE (level 3 FFP) for staff	No evidence of symptomatic COVID-19 infection amongst patients or staff at 30 days postoperatively	*Level 4 (case series)* Risk of bias: Moderate (variable levels of intervention; not all patients

					tested; did not report on infections in staff)
Role of suction					
Sharma et al. (2020)[14] *Otolaryngol Head Neck Surg* USA	Experimental cadaveric simulation	Fluorescein droplet dispersal measured on grids following use of cold steel instrumentation, microdebrider, drill and ultrasonic aspirator	Concurrent suctioning	Droplet spread was noted with use of microdebrider and high speed drill but was eliminated with use of suction	*Level 4 (case-control series)* Risk of bias: Moderate (cadaveric simulation may not accurately represent *en vivo* dynamics)
Workman et al. (2020c)[20] *Int Forum Allergy Rhinol* USA	Experimental cadaveric simulation	Measurement of aerosol concentration with optical particle sizer following use of drill and electrocautery	Nasopharyngeal placed suction tubing	Particles 1-10µm measured after endonasal drill use and electrocautery Use of nasopharyngeal placed suction lead to significant change in detection ($p<0.001$) comparable to baseline levels	*Level 4 (case-control study)* Risk of bias: Moderate (cadaveric simulation may not accurately represent *en vivo* dynamics)
Dharmarajan et al. (2021)[24] *Otolaryngol Head Neck Surg* USA	Experimental simulation with both cadaveric specimens and 3D printed models	Measurement of vitamin B2 as a flourescent tracer with cascade impactor following use of drill	SPIWay nasal sheaths Flexible suction within the anterior nasal cavity	Particles ≤3.30µm measured after endonasal drill use Use of a flexible suction inside the	*Level 4 (case-control study)* Risk of bias: Moderate

				naris eliminated detectable aerosols	(cadaveric simulation may not accurately represent *en vivo* dynamics)
Leong et al. (2021)[15] *Clin Otol* UK	Experimental simulation with 3D printed model and fluorescein soaked grapes and porcine ribs	Fluorescein droplet dispersal measured on grids following use of microdebrider and drill	Use of variable suction and microdebrider settings	Configuration of both suction pressure and microdebrider setting can prevent detection of extranasal droplet spread High speed drilling within the nasal cavity results in detectable droplet spread outside the nasal cavity despite use of suction	*Level 4 (case-control study)* Risk of bias: Moderate (laboratory setting with simulation methods which may not accurately represent *en vivo* dynamics)
Sharma et al. (2021a)[21] *Otolaryngol Head Neck Surg* USA	Experimental cadaveric simulation	Measurement of aerosol concentration with optical particle sizer following use of electrocautery, microdebrider, drill and ultrasonic aspirator	Concurrent nasal suctioning	Particles 0.3-10.0µm measured in all endonasal procedures considered Suction significantly decreases particle detection with use of rigid suction and surgical smoke evacuation system most effective	*Level 4 (case-control study)* Risk of bias: Moderate (cadaveric simulation may not accurately represent *en vivo* dynamics)
Use of specific patient mask					

Helman et al. (2020)[18] *Oper Neurosurg* USA	Experimental cadaveric simulation	Fluorescein droplet dispersal with use of drill	3D printed mask permitting laparoscopic port for instrumentation	Droplet dispersal reduced by 86% with use of mask	*Level 4 (case-control study)* Risk of bias: Moderate (cadaveric simulation may not accurately represent *en vivo* dynamics)
Viera-Artiles et al. (2020)[28] *Eur Arch Otorhinolaryngol* Spain	Experimental simulation with SIMONT rubber head model and fluorescein tracer	Fluorescein droplet dispersal measured and mapped following use of drill	3D printed Maskpirator	Droplet spread reduced, though not prevented, with use of suction and Maskpirator	*Level 4 (case-control study)* Risk of bias: Moderate (laboratory setting with simulation methods which may not accurately represent *en vivo* dynamics)
Jones et al. (2020)[16] *Laryngoscope* UK	Experimental cadaveric simulation with smoke from wood chips and fluorescein tracer	Fluorescein droplet dispersal measured and mapped using software following use of microdebrider and drill	Negative pressure mask	No droplets noted with or without mask use with use of microdebrider Droplets produced following use of drill but not with	*Level 4 (case-control study)* Risk of bias: Moderate (cadaveric simulation may

				concurrent use of negative pressure mask	not accurately represent *en vivo* dynamics)
Use of specific drape					
D'Amico et al. (2020)[30] *World Neurosurg* USA	Feasibility study	None	Patient draped in clear polyethylene sheet with apertures cut around nares	No data reported	*Level 5 (expert opinion based on first principles)* Risk of bias: n/a
Maharaj (2020)[31] *Eur Arch Otorhinolaryngol* South Africa	Feasibility study	None	Procedure carried out with surgeon's hands and instruments beneath a clear polyethylene sheet connected to low flow suction device	No data reported	*Level 5 (expert opinion based on first principles)* Risk of bias: n/a
Solari et al. (2020)[32] *Acta Neurochir* Italy	Feasibility study	None	Non-latex glove used to drape nose with apertures cut around nares Povidone Iodine used topically to prepare patient	No data reported	*Level 5 (expert opinion based on first principles)* Risk of bias: n/a
Tsagkovits et al. (2020)[33] *Eur Arch Otorhinolaryngol* UK	Feasibility study	None	Procedure carried out with surgeon's hands and instruments beneath a clear polyethylene sheet	No data reported	*Level 5 (expert opinion based on first principles)*

					Risk of bias: n/a
Ioannidis et al. (2020)[34] *J Laryngol Otol* UK	Experimental simulation with plastic manikin and smoke generator	Smoke generator for aerosolisation Air particle counter for particle detection	Procedure carried out with surgeon's hands and instruments beneath a clear polyethylene sheet connected to suction device	A reduction in particles of 0.3 and 0.5µm towards baseline levels with use of drape and suction device	*Level 4 (case-control study)* Risk of bias: Moderate (laboratory setting with simulation methods which may not accurately represent *en vivo* dynamics)
David et al. (2020)[35] *Head Neck* USA	Retrospective, observational cohort study n=4	Fluorescein droplet dispersal analysed with black light following powered endonasal procedures	Negative pressure viral isolation drape (polyethylene sheet and smoke evacuator suction tubing)	Droplets noted outside of drape system in 2 of 4 cases	*Level 4 (case series)* Risk of bias: Moderate (limited reporting of aerosolisation detection)
Arefin et al. (2021)[29] *Indian J Otolaryngol Head Neck Surg* Bangladesh	Feasibility study	None	Procedure carried out with surgeon's hands and instruments beneath a clear polyethylene sheet Povidone Iodine used	No COVID-19 infections in 12 healthcare workers over 5 month period	*Level 4 (case series)* Risk of bias: Moderate (data on staff

			as nasal spray and mouthwash by staff and patients		infections not robust; infections in patients not reported)

Table 1 – Summary table for all studies included in review