surgery). This turbulent jet stream carried droplet particles into the room as vapour that could subsequently be seen wafting at head height in the operating room. Of note, no energy devices or other smoke-inducing instrumentation was used.

We present this video to vividly demonstrate the occurrence of forceful, unfiltered gas emissions during surgery separate from smoke venting and evacuation. This mechanism can also contribute to the blood and fluid splatter often seen on surgical masks and visors during minimally invasive surgery. Apart from pathogens, such leaks can also carry other pollutants into the operating room atmosphere [6–8]. We urge surgeons to be mindful of this hazard and be diligent with respect to personal protective equipment [9] alongside careful smoke management [10], including when operating on asymptomatic patients (who have so far accounted for approximately 80% of infections of healthcare professionals).

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### Supporting Information

The video may be found in the online version of this article and also on the Colorectal Disease Journal YouTube and Vimeo channels:

**Video S1**. Gas aerosol jetstreams from trocars during laparoscopic surgery.

## Laparoscopic pneumoperitoneum escape and contamination during surgery using the Airseal Insufflation System – a video vignette

doi:10.1111/codi.15255

*Dear Sir*,

Unanticipated behaviours of the Airseal Insufflation and Access System (Conmed, Utica, NY, USA), in the public domain since 2018 [1], have recently been restated by the manufacturer [2] in the light of the COVID-19 pandemic and widespread concerns regarding aerosolization hazards during surgery [3]. Video S1 illustrates this device's tendency for intra-abdominal gas effluvium to be continually blown into the operating room during use as well as it's phenomenon of air entrainment (i.e. the tendency for room air to be sucked into the abdomen) via the device during high pressure intra-operative suctioning.

We used a combination of assessment technologies in a high-fidelity simulation model (fresh porcine cadaver) as well as during clinical surgery to examine gas flow through the Airseal 12-mm valveless trocar with

the Airseal IFS carbon dioxide ($CO_2$) insufflator in Airseal mode. Schlieren Imaging (an optical imaging technology that identifies differences in gas densities) as well as a specific near-infrared $CO_2$ visualization system (FLIR GF343; Flir Systems Ltd, Kent, ME, UK) were used to dynamically visualize gas flow around the trocar. A specific laparoscopic nebulizer (Aeroneb Solo; Aerogen, Galway, Ireland) enabled abdominal gas and droplet egress visualization by transillumination in a darkened room [4]. A flowmeter (TSI Series 5000; TSI Inc., Shoreview, MI, USA) measured directional velocity of flow just outside of the trocar.

By these methods, a continuous $CO_2$ plume flowing at a rate of 1–2 l/min is shown arising from the trocar in Airseal mode. This continues, albeit to a lesser extent, with placement of the cap packaged along with the trocar. The nebulization model shows this gas vortex contains unfiltered gas exiting from the peritoneum. This flow reverses with suctioning (whether via a separate port or the Airseal trocar itself) reaching a peak inflow velocity in these tests of 8 l/min. At the same time, the pressure of the pneumoperitoneum is relatively maintained without compensatory increase in Airseal insufflation consistent with room air being sucked directly into the abdomen via the valveless trocar.

The video illustrates a mechanism of direct operating room pollution by intra-abdominal gas and associated airborne particles, corroborated by direct clinical observation of the $CO_2$ flue during live surgery [5]. This accounts for some of the excess $CO_2$ consumption seen with use of Airseal insufflation [6]. Contamination of the intra-abdominal space with non-medical grade air during suctioning dilutes the purity of the $CO_2$ pneumoperitoneum risking infection, combustion and persistence of gas beyond pure $CO_2$ timeframes (prolonging interstitial emphysema or hollow viscus distension). It may also hazard air embolism during surgery (including transanal total mesorectal excision [7,8]).

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## Conflicts of interest

RC receives speaker fees from Stryker (visualisation), consultancy fees from Touch Surgery and Distal Motion, and holds research funding from Intuitive Corporation and with IBM Ireland (from the Irish Government). JD, FZ and KN have no conflicts of interest to declare.

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