

Alcohol-based hand sanitizers: a warning to mitigate future poisonings and deaths

Alcohol-based hand sanitizers, if ingested, can have toxic effects and may even be lethal. Preventable deaths from ingesting hand sanitizers have been identified. This article describes a Prevent Future Death case report, and recommends eight actions to mitigate the intentional and accidental ingestion of alcohol-based hand sanitizer in healthcare and community settings.

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This article is part of the Coroners' Concerns to Prevent Harms series which discusses the toxicity of alcohol-based hand sanitizers from two Prevent Future Deaths reports [1,2].

Since the COVID-19 outbreak, alcohol-based hand sanitizers have become one of the most in-demand commodities globally [3,4]. Panic buying left many shelves empty, and production increased to fill demands. Alcohol-based hand sanitizers are liquids, gels or foams that contain 60-95% ethyl alcohol (ethanol) or 70-95% isopropyl alcohol (isopropanol) used to disinfect hands [5], see Box 1. The volume of these products now to be found around homes, hospitals, schools, workplaces, and elsewhere may be a cause for concern. Warnings about the toxicity and lethality of intentionally or unintentionally ingesting alcohol-based hand sanitizers have not been widely disseminated.

Box 1. EBM facts: alcohol-based hand sanitizers [5-7]

Formulations

- liquids;
- gels; and
- foams.

Ingredients

- alcohol: ethanol (60-95%) or isopropanol (70-95%);
- hydrogen peroxide (in selected products);
- gelling or foaming agents, depending on formulation;
- an emollient (e.g. glycerol); and
- sterile distilled or boiled water.

Indications for use

- To disinfect hands, external use only.
- In healthcare settings, it should be regularly used in line with the WHO's 'My 5 Moments for Hand Hygiene' except when hands are soiled then water and soap is advised.
- In all other settings, it may be used when access to water and soap are not readily accessible.

Regulations

- In the UK, the MHRA categorize alcohol-based hand sanitizers as biocides if they claim to kill germs, disinfect, sanitize or use an active antimicrobial ingredient, and are regulated through the Health and Safety Executive.
- Other products such as liquid or solid soap bars which are primarily used to clean or moistures skin and have a secondary antimicrobial effect are regulated as cosmetics through the Cosmetic Production Regulation.
- Products that claim to treat or prevent infection associated with named pathogens such as surgical scrubs in operating theatres are regulated as medicines by the MHRA.

Harms

Intended use

- allergic reactions

Off-label use

- if ingested, headache, blurred vision, nausea, vomiting, abdominal pain, loss of coordination, decreased level of consciousness, among others; and in some cases, death.

Hazards

- flammability if exposed to high temperatures or flames; and
- eye irritation if not used as intended (i.e. rub hands until dry).

There has been a 61% increase in alcohol-based hand sanitizer poisonings reported to the National Poisons Information Service (NPIS) in the UK between January-September 2019 and January-September 2020, see Figure 1 [8]. Two case studies have also described accidental poisonings from the ingestion of hand sanitizers at home by children in Australia and the USA during the SARS-CoV-2 pandemic [9,10]. The US CDC reported 15 poisonings and four deaths associated with the ingestion of hand sanitizers that were intentionally made with methanol instead of ethanol or isopropanol since during the COVID-19 outbreak [6], and the FDA is taking action by regularly updating their "should not use" list of hand sanitizers to protect the public from further harms (www.fda.gov/handsanitizerlist). This BMJ EBM Coroners' Concerns to Prevent Harms article describes two deaths in England that occurred after the intentional and unintentional ingestion of alcohol-based hand sanitizers in healthcare facilities [1,2], and outlines recommendations to mitigate further harms.

Case 1: Intentional consumption

In 2013, a 30-year-old woman was admitted to a mental health center in an English tertiary care hospital. Twenty days later she was detained under the provisions of the Mental Health Act 1983, and given [venlafaxine](#), an antidepressant medicine. She was found dead in her hospital bed three days later, with *PURELL*® hand sanitizing gel (containing ethanol and isopropanol at 66% weight per volume) in a container beside her. The gel was readily accessible to patients on the ward from a communal dispenser, and patients were allowed to fill cups or other containers to keep in their rooms. A post-mortem blood analysis found “214 mg of alcohol in 100 mL of blood”. The medical cause of death was “ingestion of alcohol and venlafaxine”, and the coroner concluded that the combination of these substances caused the patient’s breathing to be suppressed resulting in death.

The coroner’s report identified four concerns (see Box 2) which were addressed to the UK’s Department of Health, and the NHS Trust [1]. Under regulation 28 of the Coroners’ (Investigations) Regulations 2013, parties who receive the report have 56 days to respond to the coroner, outlining actions taken or proposed, with a timetable for action; otherwise, the addressees must explain why no action is proposed. The Department of Health responded 59 days later describing national guidelines and strategies to prevent suicides [15]. They also alluded to data from the [National Reporting and Learning System](#), which can only be accessed if you are a general practitioner or pharmacist or have an NHS email. Thus, no actions were undertaken or proposed by the Department of Health.

At the time of writing this verdict (August 2020), a response from the NHS Trust was not available on the Judiciary website, making it six years overdue [1]. A freedom of information (FOI) request to the Trust revealed a response may have been received by the Coroner’s Office which reported replacing wall-mounted sanitizers with alcohol-free alternatives, and that the Trust had taken steps to review access to, and use of sanitizers, as well as raise awareness of the potential risks associated with the ingestion of alcohol-based hand sanitizers with staff [15]. However, there are no mechanisms for verifying or monitoring the implementation of these actions, nor is it possible to determine whether the actions became standard practice and are still being endorsed across the Trust.

Box 2: Coroner’s concerns from Case 1 [1]

1. Patients had unlimited access to alcohol-based hand sanitizer.
2. Patients were allowed to decant alcohol-based hand sanitizer into cups and other such containers.
3. Patients were allowed to keep cups and containers of alcohol-based hand sanitizer in their rooms.
4. The lack of awareness among hospital staff (e.g. nurses, physicians) of the alcohol content of alcohol-based hand sanitizers, and the potential for such substances to be ingested [16].

Case 2: Unintentional consumption

In 2015, a 76-year-old man developed acute ethanol toxicity after ingesting an unknown quantity of *Purell® Advanced Hygienic Hand Sanitizing Foam*, containing about 75% ethanol, which was attached to the foot of his bed while he was an inpatient in an NHS hospital in England. He had a history of agitation and depression, which was being treated with antidepressants, and a nine-month history of increasing confusion, with some evidence that he might be developing vascular dementia. His blood ethanol concentration was 463 mg/dL (100 mmol/L) initially and 354 mg/dL (77 mmol/L) 10 hours later. He was given lorazepam and haloperidol and treated with ventilation in the intensive care unit (ICU), with a plan to allow the alcohol to be naturally metabolized. After removal of his endotracheal tube in the ICU, he developed aspiration pneumonitis and bilateral bronchopneumonia. He died six days later, and the causes of death were recorded as: 1a) bronchopneumonia; 1b) acute alcohol toxicity; 2) acute delirium and coronary artery atherosclerosis.

The coroner's primary concern (see Box 3), addressed to NHS England, was that lessons from this incident were not widely communicated within the NHS or to the public. No response was available from NHS England at the time of writing this article (August 2020), making it more than three years overdue under regulation 28 of the Coroners' (Investigations) Regulations 2013 [2]. After the inquest, a news article reported that the Trust had introduced lockable dispensers and staff were carrying their own sanitizers [17]. However, there are no mechanisms for verifying or monitoring these actions, nor is it possible to determine whether the imposed actions are now standard practice. In another news article the medical director of NHS England stated that they could not directly influence the public's use of alcohol-based sanitizers, but that he would flag the risk with the Medicines and Healthcare products Regulatory Agency (MHRA), and that NHS Improvement would update the coroner on both steps "as developments emerge" [18]. But no record of whether this communication occurred is available on the Judiciary website [2].

Box 3: Coroner's concerns from Case 2 [2]

1. The coroner first acknowledged the challenge between preventing cross-infection in hospitals and the possibility that confused patients may consume sanitizers. The coroner discussed increased public awareness of hand hygiene and the resultant increase in access to alcohol-based hand sanitizers outside of hospitals.
2. The coroner was concerned that information about this incident had not been disseminated in the NHS and public and private sectors.
3. The coroner recommended that such organizations need to be made aware of this potential hazard and take appropriate action, which might include making formal risk assessments when such materials are used.

Encouraging hand hygiene while mitigating harms

Hand hygiene is the cornerstone of infection control, and efforts are still needed to improve practices, particularly during the COVID-19 outbreak. In healthcare facilities, the WHO's "My 5 Moments for Hand Hygiene" should be performed, and increasing the availability of alcohol-based hand sanitizers in point of use areas can improve adherence [19]. In most clinical settings, alcohol-based hand sanitizers is the preferred approach unless hands have visible contamination with blood, body fluids, proteinaceous material or are exposed to spore-forming

organisms then hand washing with soap, water and drying agents should be used [20]. In all other settings, washing hands with soap and water is a simple and effective way to decrease the spread of pathogens and infections. If soap and water are not available, alcohol-based hand sanitizers can be used. Thus, the deaths discussed in this article should not deter the use of hand sanitizers. However, these deaths have serious safety implications for healthcare facilities, the public and other private settings. They provide an opportunity to develop and implement mitigation strategies, see Box 4, and an opportunity to educate healthcare professionals and the public in harm reduction.

Had appropriate actions been taken at a national level by the UK's Department of Health in 2014, the death described in Case 2, and the hundreds of poisonings reported to the NPIS in 2019 and 2020 (Figure 1), might have been prevented. The combination of increased demand and exposure to alcohol-based hand sanitizers, and the negative impacts of the COVID-19 outbreak on mental health, social supports, financial insecurities, and disruption to health services is a cause of serious concern [21,22]. This complex interplay of issues may lead to a further increase in poisonings and deaths that could be mitigated if recommendations from these deaths were implemented.

While governments and public health authorities have successfully heightened our awareness of, and need for better hand hygiene during the COVID-19 outbreak, they must also make the public aware of the potential harms, and encourage the reporting of such harms to poison information centers. Data reported to poisons centers should be monitored, openly shared, and used to design and implement mitigation strategies to serve patient and public safety.

Box 4: Recommendations to improve hand hygiene while mitigating harms from alcohol-based hand sanitizers

All settings:

1. launch an understandable and convincing public health campaign to educate the public as well as healthcare professionals about hand hygiene, when alcohol-based hand sanitizers may be preferred over water and soap, and the potential for misuse, and serious adverse health events if alcohol-based hand sanitizers are ingested, including death;
2. when supplying large volumes of alcohol-based hand sanitizers, secure bottles or contents in lockable dispensers;
3. mandate manufacturers to display clear warning labels on products about the potential for misuse and harms if ingested;
4. enforce and monitor the reporting and analysis of poisonings and deaths from the ingestion of alcohol-based hand sanitizers to public health authorities;
5. alcohol-based hand sanitizers should only be used to disinfect hands, should never be swallowed. Children should be supervised when using, and products kept out of reach when not in use;

Healthcare settings:

6. develop and disseminate national guidance on where and how alcohol-based hand sanitizers should be located (see number 2. and 8.), and how to treat people who have

- ingested alcohol-based hand sanitizers, tailoring the guideline to the availability of treatments, types of sanitizers available, and contacts for poison information centers;
7. track the daily volume of sanitizer being dispensed (e.g. using a force-sensitive resistor and a microcontroller recording device [23]) to provide feedback on hand hygiene practices, and to alert staff when overuse is detected; and
 8. for patients at risk and with alcohol use disorder, particularly those in geriatric, pediatric or mental health facilities, access to alcohol-based hand sanitizers should be removed to prevent intentional or accidental ingestion, and staff provided with individual sanitizers.
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Data sharing

All data affiliated with this article including the PFD reports, responses to PFDs, Freedom of Information (FOI) requests submitted and their responses, are openly available via an online repository (<https://osf.io/gk4vc/>) [15] and the poisonings data, analyses and figures are openly available at GitHub [8] (https://github.com/georgiarichards/georgiarichards.github.io/tree/master/hand_sanitizer_death).

Declarations of interests

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