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Intentional ingestion of alcohol-based hand sanitizers in healthcare settings: a narrative review of clinical risks, toxicological concerns and patient safety implications

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ABSTRACT

Alcohol-based hand sanitizers are essential for infection prevention, but in selected clinical situations, they may also become a hidden source of highly concentrated alcohol. This narrative review synthesizes evidence on intentional or concealed ingestion of these products as a clinically relevant patient safety problem. PubMed and Google Scholar were searched for case reports, poison center studies, toxicological papers, reviews, and patient safety sources. Reference lists of key publications were hand-searched, and an official NHS England patient safety resource was also reviewed. Published reports describe ingestion in emergency departments, hospital wards, psychiatric units, addiction treatment settings, and postoperative care. The recurring pattern was the combination of patient vulnerability, access to an alcohol-containing product, and delayed recognition of sanitizer as a possible source of intoxication. Alcohol use disorder was the most consistent risk factor, but psychiatric vulnerability, self-harm risk, delirium, cognitive impairment, and older age were also relevant. Presentations ranged from apparent alcohol intoxication to respiratory depression, recurrent altered consciousness, acid-base abnormalities, cardiac arrest, and death. Persistent intoxication, rising blood alcohol concentration, or unexplained laboratory abnormalities may suggest concealed access to sanitizer. Methanol-contaminated products represent a distinct toxicological and regulatory risk, associated with severe metabolic acidosis, visual impairment, and death. Intentional or concealed sanitizer ingestion appears to be infrequently reported, but it is clinically important and potentially preventable. Prevention should be proportionate, risk-based, and non-stigmatizing, preserving infection-control standards while reducing avoidable harm in selected vulnerable patients.

Keywords: alcohol-based hand sanitizers; intentional ingestion; alcohol use disorder; methanol poisoning; patient safety

1. INTRODUCTION

Alcohol-based hand sanitizers (ABHS) are a routine and necessary element of infection prevention in modern healthcare. Their widespread availability in hospitals, emergency departments, outpatient clinics, psychiatric units, and long-term care facilities reflects their important role in reducing pathogen transmission when soap and water are unavailable or when rapid hand hygiene is required. Most alcohol-based hand hygiene products contain high concentrations of ethanol, isopropyl alcohol, or propanol-based compounds, often substantially exceeding the alcohol content of standard alcoholic beverages. When used as intended, these products are safe and effective. When ingested, however, they may become a source of clinically significant poisoning (Saha et al., 2021; Yip et al., 2020; Pourmand et al., 2021).

Intentional ingestion of alcohol-based hand sanitizers has been described in healthcare settings and other supervised environments. Published reports include patients who ingested sanitizer as a substitute for beverage alcohol, patients with alcohol use disorder or withdrawal symptoms, individuals with psychiatric comorbidity or self-harm risk, and patients with delirium, confusion, or cognitive impairment. Emergency departments, psychiatric units, general hospital wards, and addiction treatment settings appear particularly relevant because they combine clinical vulnerability, restricted access to conventional alcohol or other substances, and ready availability of alcohol-containing hand hygiene products (Gormley et al., 2012; Stevens and Hix, 2020; Pourmand et al., 2021; Lim, 2020; NHS England, 2023).

The problem is clinically important for several reasons. First, sanitizer ingestion may be concealed and difficult to recognize. Affected patients may present with symptoms resembling beverage alcohol intoxication, delirium, withdrawal, psychiatric deterioration, or acute medicalillness. In some cases, persistent intoxication, unexpectedly rising blood alcohol concentration, recurrent altered consciousness, or unexplained acid-base abnormalities were the clues that led clinicians to suspect access to sanitizer. Second, different alcohols produce different toxicological patterns. Ethanol-based products may resemble beverage alcohol intoxication, whereas isopropanol- or propanol-containing products may cause prominent central nervous system depression, ketosis, elevated osmolal gap, or other laboratory abnormalities. Methanol-containing or methanol-contaminated products represent a separate and more dangerous toxicological problem, associated with severe metabolic acidosis, visual impairment, and death (Wilson et al., 2015; Pourmand et al., 2021; Stevens and Hix, 2020; Chan and Chan, 2018; Yip et al., 2020).

Despite these risks, the issue should not be interpreted as an argument against the use of alcohol-based hand sanitizers in healthcare. Their role in infection control remains essential. The relevant question is how to preserve access to hand hygiene while recognizing circumstances in which a product that is safe for most patients may become hazardous for selected vulnerable individuals. Accordingly, risk management should integrate clinical assessment, recognition of relevant diagnostic features, targeted environmental safeguards, and non-stigmatizing patient care (Stewart, 2017; Richards, 2021; NHS England, 2023).

Evidence relating to sanitizer ingestion is distributed across case reports, poison center analyses, toxicological studies, and patient safety publications. Consequently, individual events are frequently interpreted as unusual occurrences rather than as manifestations of a recurring and clinically relevant pattern. The present narrative review examines alcohol-based hand sanitizer ingestion as both a toxicological concern and a patient safety issue (Gormley et al., 2012; Richards, 2021; Arnold et al., 2025; Hanchey et al., 2025).

Aim

The objective of this review is to integrate evidence concerning intentional or concealed ingestion of alcohol-based hand sanitizers and other alcohol-containing hand hygiene products, with particular emphasis on healthcare institutions and other medically supervised environments. The review focuses on clinical risk factors, the settings in which ingestion has been reported, and the associated diagnostic challenges, toxicological concerns, and patient safety implications. A further aim is to distinguish typical ethanol- or isopropanol-based sanitizer misuse from methanol-contaminated or methanol-containing products, which represent a separate toxicological and regulatory problem. By bringing together case reports, poison center data, toxicological publications, and patient safety sources, this review seeks to frame sanitizer ingestion as a recognizable and potentially preventable clinical risk, while preserving the essential role of alcohol-based hand sanitizers in infection prevention.

2. REVIEW METHODS

A narrative review was conducted to examine published evidence on intentional or concealed ingestion of alcohol-based hand sanitizers and other alcohol-containing hand hygiene products, particularly in healthcare institutions and medically supervised

environments. PubMed and Google Scholar were searched between December 2025 and 1 February 2026, with the final search conducted on 1 March 2026. No publication-date restriction was applied. Reference lists of key publications and relevant institutional patient safety sources were also screened. Search terms included hand sanitizer, alcohol-based hand sanitizer, alcohol-based hand rub, hand rub, ABHS, ingestion, intentional ingestion, intoxication, poisoning, alcohol use disorder, alcoholism, alcohol dependence, psychiatric unit, emergency department, hospital, inpatient, patient safety, and methanol. Eligible sources included case reports, case series, case-based letters, poison center studies, reviews, toxicological publications, and patient safety sources concerning ethanol-, isopropanol-, propanol-, or methanol-containing sanitizer exposure. The review focused on reports from healthcare settings, psychiatric units, emergency departments, addiction treatment settings, hospitals, and other supervised environments. Publications dealing exclusively with accidental pediatric ingestion, isolated dermal or ocular exposure, hand-disinfection efficacy without ingestion or toxic exposure, topics related to coronavirus disease 2019 (COVID-19) without a direct link to sanitizer ingestion or poisoning, or breath alcohol testing, and false-positive alcohol results were excluded from the main analysis.

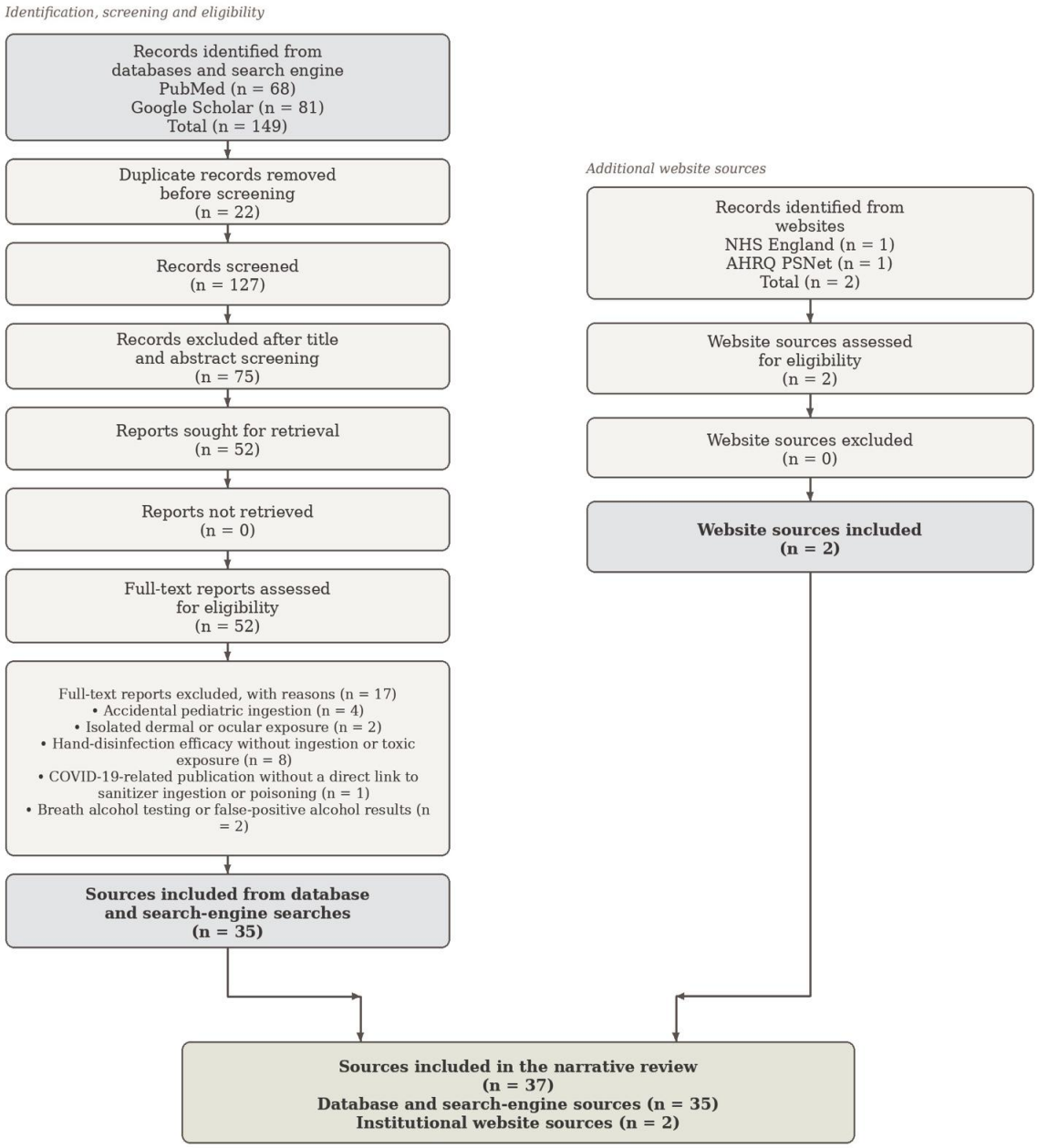

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram of literature identification and selection for the narrative review.

The search identified 149 records (68 from PubMed and 81 from Google Scholar). Following the removal of 22 duplicate records, 127 records were screened by title and abstract. Fifty-two full-text reports were assessed for eligibility, and 17 were excluded for predefined reasons. Thirty-five sources from database and search-engine searches, and two additional institutional website sources were included in the final review. Figure 1 summarizes the identification, screening, eligibility assessment, and selection of sources included in the review. Data were extracted descriptively and synthesized narratively. The aim was to summarize recurring clinical patterns, diagnostic challenges, toxicological concerns, and practical prevention strategies.

3. RESULTS AND DISCUSSION

Alcohol-Based Hand Sanitizers

Composition and Toxicological Relevance Alcohol-based hand sanitizers are commonly supplied as liquids, gels, or foams. Most formulations contain ethanol, isopropyl alcohol, or a propanol derivative as the active antiseptic, together with water and excipients such as humectants, gelling agents, fragrances, or hydrogen peroxide. These products remain an important element of infection prevention in healthcare settings. Their relevance in the context of ingestion results mainly from their high alcohol concentration, commonly reaching 60–95%, which is substantially higher than that of most alcoholic beverages (Saha et al., 2021; Yip et al., 2020; Pourmand et al., 2021). Ethanol-based products usually produce a clinical picture resembling acute ethanol intoxication. Depending on the ingested dose, alcohol tolerance, and coexisting illness, patients may present with impaired coordination, vomiting, central nervous system depression, respiratory depression, lactic acidosis, or coma; death is rare. Several reports show that patients with alcohol use disorder may use ethanol-containing sanitizers as non-beverage alcohol, particularly when access to conventional alcohol is restricted during hospitalization or supervised care (Gormley et al., 2012; Wilson et al., 2015; Pourmand et al., 2021). Isopropanol-based products are clinically important because their toxicity differs from that of ethanol. Isopropanol is metabolized to acetone and may cause prominent central nervous system depression, respiratory depression, hypotension, elevated osmolal gap, and ketosis, usually without the same pattern of severe anion-gap metabolic acidosis seen in methanol or ethylene glycol poisoning. Products containing 1-propanol or mixed propanol compounds may further complicate clinical interpretation. Methanol represents a separate and more dangerous toxicological problem and is discussed later in this review (Emadi and Coberly, 2007; Blanchet et al., 2007; Vujasinovic et al., 2007; Stevens and Hix, 2020; Chan and Chan, 2018).

Patients and Settings at Risk

The published cases suggest that sanitizer ingestion is concentrated in specific clinical contexts rather than evenly distributed across hospital populations. The most consistent risk group consists of patients with alcohol use disorder, especially those with severe dependence, withdrawal symptoms, previous non-beverage alcohol use, or limited access to conventional alcohol during admission. In several reports, sanitizer was used as a surrogate alcohol source in general hospital wards, emergency departments, and addiction treatment settings (Gormley et al., 2012; Thanarajasingam et al., 2007; Bookstaver et al., 2008; Raza et al., 2014; Pourmand et al., 2021).

Psychiatric settings form another important risk area. Reported cases include patients with depression, previous suicide attempts, borderline personality disorder, polysubstance use, posttraumatic stress disorder, or acute behavioral dysregulation. In this context, ingestion may reflect alcohol-seeking behavior, self-poisoning, impulsivity, or a combination of these mechanisms. This is particularly relevant in supervised or closed psychiatric units, where access to other potentially harmful substances may be restricted, whereas hand hygiene products remain available (Tavolacci et al., 2007; Henry-Lagarrigue et al., 2010; Darracq et al., 2013; Stevens and Hix, 2020; Richards, 2021). Emergency departments and observation areas also deserve attention. These settings often combine the care of intoxicated patients and prolonged waiting periods with withdrawal monitoring, psychiatric assessment, and easy access to sanitizer dispensers, bathrooms, or waiting areas. Reports by Pourmand et al., (2021); Schneir and Clark, (2013) Moore, (2019) and Weiner (2007) illustrate that ingestion may occur during observation, after apparent clinical improvement, or outside the immediate treatment space. Importantly, the risk is not limited to alcohol dependence or psychiatric illness. Lim described ethanol sanitizer ingestion in a postoperative patient with delirium and no prior addiction history. The NHS England case study similarly highlighted the danger of bedside alcohol-based hand gel in a confused patient. Older age, visual impairment, delirium, cognitive impairment, and postoperative confusion may therefore create risk even in patients without known alcohol misuse. Despite differences among settings, the reports repeatedly identify the same combination of factors: patient vulnerability, availability of a high-concentration alcohol product, and access arrangements designed for infection control that do not fully account for the risk of ingestion (Lim, 2020; Richards, 2021; NHS England, 2023).

Clinical Presentation and Diagnostic Challenges

The clinical manifestations of sanitizer ingestion vary according to the alcohol involved, the ingested dose, co-ingestants, tolerance, and underlying medical conditions. In many reports, the presentation was consistent with acute alcohol intoxication, with slurred speech, ataxia, vomiting, somnolence, behavioral change, reduced level of consciousness, or coma. Severe presentations included respiratory depression, aspiration, hypotension, acute kidney injury, metabolic encephalopathy, arrhythmia, cardiac arrest, and death (Gormley et al., 2012; Schneir and Clark, 2013; Shetty et al., 2013; Wilson et al., 2015). Laboratory findings may provide important clues, but they are not uniform. Ethanol-based products may produce markedly elevated blood alcohol levels and, in some cases, lactic acidosis, ketosis, or an increased anion gap. Wilson et al. described recurrent episodes of depressed consciousness with elevated ethanol, acetone, and lactate concentrations and an increased anion gap, which initially complicated clinical interpretation. Following isopropanol exposure, an elevated osmolal gap and detectable acetone may be more informative. Severe high-anion-gap metabolic acidosis is less typical unless there is a mixed ingestion or another cause. Stevens and Hix showed that isopropanol-based sanitizer ingestion in a psychiatric unit may present with respiratory failure, acute kidney injury, and metabolic encephalopathy rather than a straightforward toxicological history (Wilson et al., 2015; Stevens and Hix, 2020). A recurring diagnostic problem is that sanitizer ingestion may mimic more common hospital conditions, including delirium, sepsis, hypoglycemia, stroke, effects of sedative medication, alcohol withdrawal, psychiatric decompensation, or relapse involving conventional alcohol. Persistent intoxication, a rising blood alcohol concentration during observation, recurrent unexplained altered consciousness, or repeated acid-base abnormalities should raise suspicion of concealed access to sanitizer. In such situations, clinical evaluation should be accompanied by inspection of the patient's room, bathroom, belongings, and nearby dispensers. Methanol- containing products require particular caution, especially when high-anion-gap metabolic acidosis, visual symptoms, seizures, or unexplained severe deterioration occur (Pourmand et al., 2021; Wilson et al., 2015; Chan and Chan, 2018; Yip et al., 2020).

Evidence from Published Case Reports

Collectively, the case reports indicate a recurrent clinical pattern rather than a series of unrelated events. The cases included in the synthesis by Gormley et al., (2012) indicate that intentional ingestion was already documented in emergency departments, hospital wards, and psychiatric or supervised settings before 2012. Most patients had a history of alcohol misuse, other substance use, or mental health comorbidity, and outcomes ranged from full recovery to death. In the present review, early reports were included individually when full-text data provided useful clinical information for patient safety interpretation; otherwise, they were considered through the Gormley synthesis (Doyon and Welsh, 2007; Gormley et al., 2012). The principal evidence categories used in this review and their contribution to the synthesis are summarized in Table 1.

Table 1. Evidence categories included in the narrative review

Evidence category	Main sources	Role in the review
Early clinical reports	Archer 2007; Doyon and Welsh, 2007; Emadi and Coberly, 2007; Tavolacci, 2007; Thanarajasingam et al., 2007; Blanchet et al., 2007; Vujasinovic et al., 2007; Weiner, 2007; Bookstaver et al., 2008; Henry-Lagarrigue et al., 2010	Establish the early clinical basis for considering alcohol-based hand sanitizers and hand rubs as potential sources of toxic alcohol exposure in hospitals, emergency departments, rehabilitation wards, psychiatric units, and other supervised environments.
Foundational synthesis	Gormley et al., 2012	Provides the historical anchor for the review by combining a case report, a literature review, and a National Poison Data System analysis, supporting the view that intentional ingestion is a recurring clinical and public health concern.
Post-Gormley clinical reports	Schneir and Clark, 2013; Shetty et al., 2013; Jones et al., 2013; Darracq et al., 2013; Raza et al., 2014; Wilson et al., 2015; Gardecki et al., 2018; Moore, 2019; Stevens and Hix, 2020; Lim 2020; Heldeweg et al., 2021; Pourmand et al., 2021; Higueras et al., 2022; El-Hussein et al., 2024	Update the clinical picture and broaden the described settings and mechanisms, including emergency department ingestion, psychiatric inpatient ingestion, addiction treatment settings, recurrent in-hospital intoxication, postoperative delirium, and severe or fatal outcomes.
Poison center and epidemiological studies	Gormley et al., 2012; Santos et al., 2017; Phillips et al., 2021; Arnold et al., 2025; Hanchey et al., 2025	Contextualize individual case reports by summarizing exposure trends, pediatric data, intentionality, changes observed during the COVID-19 pandemic, adult ingestion patterns, and surveillance of

Evidence category	Main sources	Role in the review
		methanol-containing sanitizers.
Methanol-related literature	Chan and Chan, 2018; Yip et al., 2020; Holzman et al., 2021; Hanchey et al., 2025; Higueras et al., 2022	Supports a separate toxicological discussion of methanol-contaminated or methanol-containing hand sanitizers, including severe metabolic acidosis, visual impairment, antidotal treatment, hemodialysis, and fatal outcomes.
Composition and toxicology background	Saha et al., 2021; Gold et al., 2023; Blanchet et al., 2007; Vujasinovic et al., 2007; Wilson et al., 2015; Stevens and Hix, 2020	Provides background on sanitizer composition and the clinical relevance of ethanol, isopropanol, 1-propanol, 2-propanol, acetone, methanol, osmolal gap, anion gap, and supportive or antidotal management.
Patient safety and prevention sources	Archer, 2007; Weiner, 2007; Raza et al., 2014; Stewart, 2017; Richards, 2021; Wilson et al., 2015; Stevens and Hix, 2020; Pourmand et al., 2021; El-Hussein et al., 2024; NHS England, 2023	Inform recommendations for identifying high-risk patients and alcohol-seeking behavior, restricting access selectively, improving dispenser safety, supervising patients in psychiatric and addiction settings, securing alcohol-based hand gel, and maintaining infection-control standards.

Early reports established several key clinical scenarios. Some patients ingested sanitizer as a substitute for beverage alcohol during hospitalization or supervised care, as described by Thanarajasingam et al., (2007); Bookstaver et al., (2008) and Archer et al., (2007) and others reflected psychiatric vulnerability, self-harm, or behavioral dysregulation, including the cases reported by Tavolacci et al., (2007) and Henry-Lagarrigue et al., (2010). Reports involving isopropanol- or propanol-containing products, such as Emadi and Coberly (2007), Blanchet et al., (2007) and Vujasinovic et al., (2007) showed that ingestion of sanitizer may produce clinical and laboratory findings that differ from those of typical ethanol intoxication.

Post-Gormley reports expanded both the severity and the range of settings. Schneir and Clark (2013) described fatal ingestion of ethanol-based sanitizer in a bathroom in an emergency department waiting room. Shetty et al., (2013) reported suspected isopropanol-based sanitizer ingestion in a hospitalized young adult, complicated by ventricular arrhythmias, cardiac arrest, and severe acidosis. Wilson et al., (2015) described recurrent in-hospital intoxication with repeated altered consciousness, lactic acidosis, and elevated ethanol-related markers. More recent reports further emphasize the importance of the healthcare environment. Pourmand et al., (2021) described concealed ingestion during emergency department observation, with persistent intoxication and a rising blood alcohol concentration. Stevens and Hix (2020) reported intentional ingestion in an adult psychiatric unit, leading to respiratory failure, acute kidney injury, and metabolic encephalopathy. Lim (2020) showed that risk may also occur in postoperative delirium, even without known alcohol dependence. El-Hussein et al., (2024) added a recent emergency department case in which alcohol-seeking behavior was concealed behind a factitious clinical presentation.

Taken together, the published cases suggest that the clinical problem is not defined by one ward type or one patient profile. The common elements are vulnerability, access to a high- concentration alcohol product, and delayed recognition of the product as a possible source of intoxication. Recurring clinical and toxicological patterns, representative reports, and patient- safety implications emerging from the published literature are summarized in Table 2 (Gormley et al., 2012; Stevens and Hix, 2020; Pourmand et al., 2021).

Table 2. Clinical and toxicological patterns emerging from published reports of alcohol-based hand sanitizer or hand-rub ingestion

Clinical pattern / setting	Representative reports	Typical context or mechanism	Key clinical or laboratory clues	Severity and outcome range	Main patient safety lesson
Surrogate alcohol use in alcohol use disorder	Archer et al., 2007; Thanarajasingam et al., 2007; Bookstaver et al., 2008; Wilson et al., 2015; Pourmand et al., 2021	Patients with alcohol dependence, withdrawal symptoms, restricted access to beverage alcohol, or previous non-beverage alcohol use.	High or rising blood alcohol concentration, persistent intoxication, recurrent altered consciousness, hidden bottles, or dispenser access.	Outcomes ranged from recovery with supportive care to ICU admission, ventilation, or dialysis in severe cases.	In patients with alcohol use disorder, ABHS should be considered a possible concealed alcohol source during admission or observation.
Emergency	Weiner, 2007; Schneir	Intoxicated or alcohol-	Intoxication during	Outcomes include	ED bathrooms,

Clinical pattern / setting	Representative reports	Typical context or mechanism	Key clinical or laboratory clues	Severity and outcome range	Main patient safety lesson
department and observation-area concealed ingestion	and Clark, 2013; Moore, 2019; Pourmand et al., 2021; El-Hussein et al., 2024	dependent patients in ED rooms, bathrooms, waiting areas, or observation spaces.	observation, delayed clinical improvement, repeated intoxication after apparent stabilization, or sanitizer bottles found in belongings or bathrooms.	recurrent intoxication, respiratory arrest, ICU care, and death in selected reports.	waiting areas, and observation rooms should be included in a targeted environmental risk assessment.
Psychiatric vulnerability, impulsivity, or self-harm risk	Tavolacci et al., 2007; Henry-Lagarrigue et al., 2010; Darracq et al., 2013; Stevens and Hix, 2020; Richards, 2021; Higueras et al., 2022	Depression, previous suicide attempts, personality disorder, psychosis, posttraumatic stress disorder, polysubstance use, or acute behavioral dysregulation.	Rapid ingestion of large volumes, coma, respiratory depression, severe intoxication, or toxic alcohol findings.	Ranges from full recovery after ICU care to death in case-based safety reports.	Sanitizer access should be considered in psychiatric safety planning, especially when self-harm risk or impulsivity is present.
Addiction treatment, correctional, and other supervised settings	Doyon and Welsh, 2007; Jones et al., 2013; Raza et al., 2014	Settings where conventional alcohol access is restricted but alcohol-containing hygiene products remain available.	Use of sanitizer as an intoxicant or preferred alcohol source; recurrent or opportunistic ingestion despite supervised care.	Published reports generally describe recovery, but the risk of recurrent exposure may persist.	Supervised settings are not automatically protected if ABHS, visitor-brought products, or refill containers remain accessible.
Delirium, cognitive impairment, or postoperative confusion	Lim, 2020; Richards, 2021; NHS England, 2023	Older, confused, delirious, visually impaired, or postoperative patients, not necessarily with known alcohol use disorder.	Sudden altered mental status, unexplained intoxication, or access to bedside or foot-of-bed sanitizer bottles.	Severe intoxication, aspiration, escalation of care, and death have been reported in safety sources.	Risk is not limited to alcohol dependence; bedside placement should be reviewed in confused or delirious patients.
Isopropanol- or propanol-containing product ingestion	Emadi and Coberly, 2007; Blanchet et al., 2007; Vujasinovic et al., 2007; Stevens and Hix, 2020	Hospitalized or psychiatric patients exposed to isopropanol-, 1-propanol-, or mixed propanol-containing sanitizers or antiseptic solutions.	CNS depression, respiratory depression, hypotension, elevated osmolal gap, acetone, or ketosis; ethanol may be undetectable, or its measured concentration may not explain the clinical severity.	Recovery with supportive care in some reports; respiratory failure and ICU care in others.	Non-ethanol alcohols should be considered when the degree or pattern of intoxication is not explained by ethanol alone.
Recurrent or delayed recognition during admission	Wilson et al., 2015; Heldeweg et al., 2021; Pourmand et al., 2021	Patients remaining under observation or hospitalized after initial intoxication, with continued access to sanitizer.	Recurrent altered consciousness, repeated acid-base abnormalities, rising alcohol markers, or delayed discovery of the access route.	Repeated exposure, unnecessary diagnostic escalation, ICU-level care, or hemodialysis in selected cases.	Persistent or recurrent abnormalities should prompt inspection of the room, bathroom, belongings, and nearby dispensers.
Unconventional routes, extraction	Gormley et al., 2012; Darracq et al., 2013;	Patients seeking intoxication despite	Infusion through a gastrostomy tube, crude	Severe ethanol intoxication, coma,	Prevention should consider product

Clinical pattern / setting	Representative reports	Typical context or mechanism	Key clinical or laboratory clues	Severity and outcome range	Main patient safety lesson
methods, or product manipulation	Jones et al., 2013	restricted alcohol access; psychiatric, substance-use, or chronic medical comorbidity may coexist.	extraction with salt, hidden bottles, or repeated theft from clinical areas.	and ICU care were reported.	design, storage, refill systems, and the possibility that patients may adapt access routes.
Methanol-contaminated or methanol-containing sanitizer exposure	Chan and Chan, 2018; Yip et al., 2020; Holzman et al., 2021; Hanchey et al., 2025; Higueras et al., 2022	Product contamination, substitution, or mislabeling; intentional ingestion may coexist but the toxicological mechanism is distinct.	HAGMA, elevated osmolal gap, visual symptoms, seizures, severe metabolic acidosis, or rapid deterioration.	Visual impairment, treatment with hemodialysis or CRRT, and fatal outcomes were reported.	Methanol exposure from sanitizer is a toxicological and regulatory emergency requiring rapid treatment and product vigilance.

Note: This table synthesizes clinically informative case reports, case-based safety reports, and key methanol-related toxicological or surveillance reports by recurring pattern rather than by individual case. Broader population-level poison center data, general toxicological reviews, and composition-focused papers are summarized separately in Table 1 and in the narrative text. ABHS = alcohol-based hand sanitizer; ED = emergency department; ICU = intensive care unit; CNS = central nervous system; HAGMA = high-anion-gap metabolic acidosis; CRRT = continuous renal replacement therapy.

Poison Center Data and Trends

Poison center data provide a broader context for the case-report literature. In the foundational study by Gormley et al., (2012), 68,712 exposures to ethanol-based hand sanitizers were reported to the National Poison Data System in the United States between 2005 and 2009. Both overall exposures and intentional exposures increased during this period. Although most outcomes were not severe, moderate and major medical outcomes were recorded, supporting the view that sanitizer ingestion is relevant to poison surveillance rather than being limited to isolated case reports.

Pediatric data are useful as background but are not the main focus of this review. Santos et al., (2017) analyzed hand sanitizer exposures in children aged 12 years or younger and found that most exposures involved alcohol-based products and occurred by ingestion. These findings show the broader public health relevance of sanitizer exposure, but differ from the adult patterns of intentional or healthcare-associated ingestion emphasized here. The COVID-19 period changed the context of exposure by increasing the availability and visibility of alcohol-based hand sanitizers. Phillips et al., (2021) reported a marked increase in sanitizer exposures reported to Texas poison centers in 2020 compared with 2019, including cases linked to unsafe or potentially contaminated products. Arnold et al., (2025) later identified 876 adult single-substance ingestions of alcohol-based hand sanitizers in Florida, with higher annual case numbers during the COVID-19 period; intentional exposure and younger age were associated with more severe outcomes. Hanchey et al., (2025) also showed the value of an enhanced poison center surveillance system after reports of methanol-containing products.

Methanol-Contaminated Hand Sanitizers as a Distinct Toxicological Risk

Ingestion of methanol-contaminated or methanol-containing sanitizer warrants separate consideration from misuse of ethanol- or isopropanol-based products. In most case reports discussed in this review, the main mechanism was intentional ingestion of an accessible alcohol-containing product as a surrogate alcohol source or as a method of self-poisoning. Methanol-related harm is different: it usually reflects product contamination, substitution, or mislabeling, and may affect users who do not expect methanol exposure (Chan and Chan, 2018; Yip et al., 2020; Holzman et al., 2021).

Chan and Chan (2018) emphasized that methanol should never be used in alcohol-based hand rubs because oral, inhalational, or dermal exposure may cause severe systemic toxicity. Symptoms may initially resemble those of ethanol intoxication, but as methanol is metabolized to toxic metabolites, patients may develop high-anion-gap metabolic acidosis, seizures, visual impairment, blindness, and death. Reports from the COVID-19 period show why this issue became more visible. Yip et al., (2020) described 15 hospitalized adults with methanol poisoning associated with ingestion of alcohol-based hand sanitizers in Arizona and New Mexico. Four patients died,

and three patients were discharged with visual impairment. Holzman et al., (2021) later described five fatal cases of methanol poisoning from contaminated hand sanitizers, with severe high-anion-gap metabolic acidosis and, in most cases, elevated osmolal gap. Management is time-sensitive because methanol levels may not be rapidly available, and a delay in treatment can be fatal. Clinicians should rely on history, clinical suspicion, anion gap, osmolal gap, pH, visual symptoms, and early toxicology consultation. Treatment may require supportive care, correction of acidosis, alcohol dehydrogenase inhibition with fomepizole or ethanol, and hemodialysis or continuous renal replacement therapy in severe cases (Yip et al., 2020; Holzman et al., 2021).

Enhanced poison center surveillance further supports the public health relevance of this problem. Hanchey et al., (2025) identified more than two thousand methanol-based hand sanitizer exposure calls during a short surveillance period in 2020, with ingestion accounting for a minority of exposures, but all major or fatal outcomes occurring after ingestion. Methanol- contaminated products therefore constitute a distinct toxicological and regulatory hazard. Prevention requires not only limiting access among high-risk patients but also ensuring product quality, implementing recalls, issuing public warnings, and maintaining coordinated toxicovigilance.

Discussion

The evidence reviewed here highlights an important tension in patient safety. Alcohol-based hand sanitizers are indispensable for infection prevention, but in selected clinical circumstances they may also provide ready access to high-concentration alcohol. This does not undermine their role in healthcare. Rather, it shows that their safety depends not only on correct use but also on the clinical context in which they are made available (Saha et al., 2021; Richards, 2021; NHS England, 2023).

Across the reviewed literature, the most clinically relevant pattern was not a single product, ward, or diagnosis, but the combination of patient vulnerability, easy access to an alcohol- containing product, and delayed recognition of sanitizer as a possible source of intoxication. This pattern was reported in emergency departments, hospital wards, psychiatric units, addiction treatment settings, and postoperative care. Therefore, intentional or concealed sanitizer ingestion should be understood not merely as an unusual toxicological event, but as a recognizable patient safety event (Gormley et al., 2012; Stevens and Hix, 2020; Lim, 2020; Pourmand et al., 2021).

Alcohol use disorder was the most consistent risk factor in the published cases, particularly when alcohol-based hand sanitizer was used as a substitute for beverage alcohol during admission or supervised care. However, risk cannot be reduced to alcohol dependence alone. Psychiatric illness, suicidality, impulsivity, delirium, cognitive impairment, postoperative confusion, older age, and visual impairment may also create conditions in which a hand hygiene product becomes a source of harm (Gormley et al., 2012; Raza et al., 2014; Stevens and Hix, 2020; Lim, 2020; NHS England, 2023).

A risk-based approach should not be confused with a stigmatizing approach. Identifying risk should serve to prevent avoidable harm, not to label patients or restrict care in a punitive way. Assessment should therefore be clinical, proportionate, and respectful, and should be combined with appropriate withdrawal management, psychiatric evaluation when indicated, and environmental safety measures (Stewart, 2017; Richards, 2021). From a diagnostic perspective, sanitizer ingestion should be considered when the clinical course does not fit the expected pattern of beverage alcohol intoxication, withdrawal, delirium, or acute medical illness. Persistent intoxication during observation, an unexpected rise in blood alcohol concentration, recurrent episodes of altered consciousness, unexplained osmolal or anion-gap abnormalities, ketosis, lactic acidosis, or acetone elevation may all suggest concealed exposure to an alcohol-containing product. In supervised settings, this suspicion should prompt not only toxicological evaluation but also a careful review of the patient's immediate environment, including bedside products, bathrooms, personal belongings, and access to wall-mounted dispensers. Early recognition is important because delayed diagnosis may lead to repeated exposure, unnecessary diagnostic procedures, escalation of care, or preventable deterioration (Wilson et al., 2015; Stevens and Hix, 2020; Pourmand et al., 2021).

Methanol-containing or methanol-contaminated hand sanitizers require separate interpretation. Unlike the typical cases of ethanol- or isopropanol-based sanitizer misuse, methanol-related harm may result from product contamination, substitution, or mislabeling rather than from deliberate use of sanitizer as a surrogate alcohol source. This distinction is important clinically and organizationally. In individual patients, methanol poisoning may initially resemble ethanol intoxication, but delayed recognition can lead to severe metabolic acidosis, visual impairment, seizures, and death. At the system level, methanol events show that prevention cannot rely only on identifying high-risk patients or restricting access in selected wards. It also requires product quality control, regulatory oversight, rapid public warnings, recall mechanisms, and poison center surveillance (Chan and Chan, 2018; Yip et al., 2020; Holzman et al., 2021; Hanchey et al., 2025). These findings do not support routine removal of alcohol-based hand sanitizers from healthcare facilities.

A universal restriction would be impractical and could compromise infection-prevention standards. Instead, the reviewed literature supports a proportionate, risk-based strategy applied to selected patients and locations. In patients with clear risk factors, temporary

modification of access may be justified, such as replacing bedside bottles with supervised use, using lockable or tamper-resistant dispensers, removing excess containers from bathrooms or patient rooms, and ensuring closer observation when clinically indicated (Weiner, 2007; Raza et al., 2014; Stewart, 2017; Pourmand et al., 2021; Richards, 2021; NHS England, 2023). This balance is especially important because infection control and patient safety are not opposing goals. Both aim to prevent avoidable harm. The challenge is to recognize when a product that is safe and necessary for most patients may become hazardous in a specific clinical context. These findings support practical ward-level measures that preserve access to hand hygiene for staff and visitors while reducing the likelihood of ingestion among patients at increased risk (Stewart, 2017; Richards, 2021; NHS England, 2023).

By integrating evidence from case reports, poison center data, toxicological studies, and patient safety publications, this review characterizes sanitizer ingestion as a recurrent and potentially preventable clinical problem. Its principal contribution is to organize existing evidence within a practical patient safety framework rather than to define a novel toxicological exposure. The reviewed literature suggests that prevention should begin with awareness: clinicians should recognize that alcohol-based hand sanitizers may become a hidden source of intoxication in selected circumstances. This awareness should then be translated into proportionate environmental measures, appropriate clinical assessment, and non-stigmatizing care for vulnerable patients. Practical strategies to reduce risk while preserving infection-control standards are summarized in the following section (Gormley et al., 2012; Richards, 2021; Arnold et al., 2025; Hanchey et al., 2025).

Practical Recommendations

Preventive measures should be guided by individualized risk assessment rather than by routine restriction of alcohol-based hand sanitizers. Relevant risk factors should be assessed at admission, during emergency department observation, and following transfer to psychiatric, addiction, medical, or surgical wards. These include severe alcohol use disorder, active withdrawal or craving, previous non-beverage alcohol use, acute intoxication, suicidality, impulsivity, delirium, cognitive impairment, visual impairment, postoperative confusion, or unexplained recurrent altered mental status (Gormley et al., 2012; Stewart, 2017; Stevens and Hix, 2020; Lim, 2020; Pourmand et al., 2021; NHS England, 2023).

In patients identified as higher risk, environmental measures should be proportionate and temporary. Bedside bottles or loose containers may be removed or replaced with supervised hand hygiene. Access to large refill bottles, bathrooms, storage areas, and wall-mounted dispensers should be reviewed, especially in emergency departments, psychiatric units, and other areas where vulnerable patients may remain under observation for prolonged periods. Where feasible and consistent with infection-control policy, lockable or tamper-resistant dispensers, smaller- volume containers, staff-controlled products, or non-alcohol alternatives for selected patient use may be considered (Weiner, 2007; Raza et al., 2014; Stewart, 2017; Pourmand et al., 2021; Richards, 2021; NHS England, 2023).

Clinical management is equally important. Patients with alcohol use disorder should receive appropriate assessment and treatment for withdrawal, craving, and coexisting psychiatric symptoms. Ingestion risk should not be addressed only by removing access to the sanitizer, because environmental control without clinical care may leave the underlying driver of alcohol- seeking behavior untreated. Similarly, patients with suicidality, delirium, or cognitive impairment may require closer observation, a mental state assessment, a medication review, reorientation strategies, or safer placement of potentially harmful products (Raza et al., 2014; Stewart, 2017; Richards, 2021).

Staff training should address the possibility that sanitizer ingestion may manifest as unexplained intoxication, persistent or rising blood alcohol concentration during observation, recurrent altered consciousness, osmolal or anion-gap abnormalities, ketosis, lactic acidosis, or acetone elevation. When suspicion arises, staff should inspect the patient's immediate environment, including bedside products, bathrooms, personal belongings, and nearby dispensers. Early recognition can prevent repeated exposure and reduce unnecessary diagnostic delay (Wilson et al., 2015; Stevens and Hix, 2020; Pourmand et al., 2021). After any suspected or confirmed ingestion, a structured safety review should be performed. This should include documentation of the product involved, the alcohol type (if known), the access route, the clinical course, laboratory abnormalities, treatment required, and environmental factors that enabled ingestion. Ward-level learning is important because these events often reveal modifiable system issues, such as poorly secured bottles, large-volume dispensers in high-risk areas, or a lack of staff awareness (Stewart, 2017; Richards, 2021; NHS England, 2023). Methanol-related risk requires additional measures. Healthcare facilities should ensure that hand hygiene products are obtained from reliable suppliers and are appropriately labeled. Facilities should also respond promptly to regulatory warnings or recalls. Suspected methanol exposure should prompt urgent toxicology consultation and should be reported to the poison center or through public health channels when appropriate (Chan and Chan, 2018; Yip et al., 2020; Hanchey et al., 2025).

Overall, prevention should aim to preserve infection-control standards while reducing avoidable harm in selected patients. Suggested patient safety strategies are summarized in Table 3 (Stewart, 2017; Richards, 2021; NHS England, 2023).

Table 3. Practical patient safety strategies to reduce the risk of alcohol-based hand sanitizer ingestion in healthcare settings

Area	Risk addressed	Suggested patient safety strategy	Supporting literature
Admission and triage assessment	Undetected alcohol use disorder, withdrawal risk, previous non-beverage alcohol use, or concealed alcohol-seeking behavior	Screen for alcohol use disorder, withdrawal symptoms, prior severe intoxication, withdrawal seizures, suicidal ideation, and previous use of non-beverage alcohols, including hand sanitizer, mouthwash, rubbing alcohol, or similar products.	Thanarajasingam et al., 2007; Bookstaver et al., 2008; Raza et al., 2014; Stewart, 2017; Pourmand et al., 2021; El-Hussein et al., 2024
Alcohol withdrawal and craving management	In-hospital craving or withdrawal leading to sanitizer-seeking behavior	Start withdrawal protocols early when indicated, including symptom-triggered pharmacotherapy, thiamine, and supportive care. Consider addiction medicine or psychiatry consultation in patients with severe dependence or repeated non-beverage alcohol use.	Raza et al., 2014; Wilson et al., 2015; Stewart, 2017; Pourmand et al., 2021
Emergency department and observation areas	Concealed ingestion during prolonged waiting periods, monitoring of intoxication, or transfer for detoxification	Suspect sanitizer ingestion when intoxication persists beyond the expected period or when blood alcohol concentration increases during observation. Review access to sanitizer in ED rooms, bathrooms, waiting areas, and registration zones. Search personal belongings only when clinically justified and permitted by local policy.	Weiner, 2007; Schneir and Clark, 2013; Moore, 2019; Pourmand et al., 2021; El-Hussein et al., 2024
Psychiatric units and self-harm risk	Intentional ingestion in patients with suicidality, impulsivity, personality disorder, psychosis, or polysubstance use	Include ABHS access in individual safety planning. Avoid unsupervised access to large-volume containers in high-risk rooms. Use supervised access, staff-carried products, secured dispensers, or alternative hand hygiene arrangements when clinically necessary.	Henry-Lagarrigue et al., 2010; Darracq et al., 2013; Stevens and Hix, 2020; Richards, 2021; Higueras et al., 2022
Addiction treatment settings	Access to alcohol-containing sanitizer in units treating alcohol dependence, including products brought by visitors	Restrict patient access to unsecured ABHS in addiction treatment areas. Do not allow visitors to bring hand sanitizers onto the unit without staff approval. Place products in supervised or staff-only areas when risk is high.	Jones et al., 2013; Raza et al., 2014; Bookstaver et al., 2008
Older, confused, or delirious patients	Unintentional ingestion due to delirium, dementia, confusion, visual impairment, or postoperative mental status changes	Avoid placing large bottles at the bedside or foot of the bed in patients with delirium or cognitive impairment. Reassess access daily and use supervised hand hygiene, staff-carried sanitizer, wipes, or soap and water when feasible.	Tavolacci et al., 2007; Lim, 2020; Richards, 2021; Stewart, 2017; NHS England, 2023
General medical and surgical wards	Sudden unexplained altered mental status misattributed to delirium, sepsis, medication effects, or alcohol relapse	Include ABHS ingestion in the differential diagnosis of sudden coma, recurrent intoxication, unexplained osmolal gap, anion gap, lactic acidosis, ketosis, or unexpected blood alcohol findings during admission.	Gormley et al., 2012; Wilson et al., 2015; Stevens and Hix, 2020; Heldeweg et al., 2021
Dispenser design and ward environment	Removable bottles, pump containers, refill pouches, or large-volume products that can be taken and consumed	Replace removable bottles and pump containers with tamper-resistant or lockable dispensers in high-risk clinical areas. Avoid large unsecured containers in patient rooms. Prevent decanting of sanitizer into cups or personal containers.	Weiner, 2007; Bookstaver et al., 2008; Pourmand et al., 2021; Richards, 2021; NHS England, 2023

Area	Risk addressed	Suggested patient safety strategy	Supporting literature
Product format and safer alternatives	Maintaining infection-control standards while limiting misuse	In selected high-risk settings, consider alcohol-based wipes, lockable dispensers, staff-controlled sanitizer, supervised use, or additional sinks with soap dispensers. Restrictions should be targeted and proportionate to the identified risk.	Weiner, 2007; Stewart, 2017; Pourmand et al., 2021; NHS England, 2023
Labeling and product visibility	Visible alcohol concentration may attract patients seeking intoxication	Ensure required safety information remains available, but consider whether patient-facing placement of labels displaying a high alcohol concentration may increase misuse risk. Use clear warnings that products are for external use only and must not be ingested.	Pourmand et al., 2021; Saha et al., 2021; Richards, 2021
Staff education	Low awareness among healthcare workers that ABHS may be ingested intentionally or accidentally	Educate ED, ward, psychiatric, and addiction-treatment staff about ABHS as a possible source of toxic alcohol exposure. Training should cover warning signs, high-risk groups, and local procedures for suspected ingestion.	Archer et al., 2007; Stewart, 2017; Stevens and Hix, 2020; Pourmand et al., 2021; Richards, 2021
Post-incident response	Recurrent ingestion, escalation of risk or failure to remove access after first episode	After confirmed or suspected ingestion, remove or secure sanitizer access, inspect the room and bathroom, increase observation if needed, document the event, and involve toxicology, psychiatry, or addiction services depending on context.	Bookstaver et al., 2008; Raza et al., 2014; Wilson et al., 2015; Stevens and Hix, 2020; Stewart, 2017
Methanol-contaminated products	Severe poisoning from contaminated or methanol-containing sanitizer, with visual symptoms, seizures, or high-anion-gap metabolic acidosis	Treat suspected methanol exposure as a medical emergency. Consult a poison center or toxicologist; assess anion gap, osmolal gap, pH, and methanol concentration. Consider fomepizole or ethanol, correction of acidosis, and hemodialysis as indicated.	Chan and Chan, 2018; Yip et al., 2020; Holzman et al., 2021; Hanchey et al., 2025; Higueras et al., 2022
Surveillance and organizational learning	Unrecognized incidents and limited institutional sharing of lessons	Report incidents through local patient safety systems and, when appropriate, to poison centers. Use incident reviews to revise placement, storage, and dispenser policies. Include secure ABHS/ABHG access in environmental audits.	Richards, 2021; Hanchey et al., 2025; NHS England, 2023
Infection-control balance	Over-restriction of ABHS could reduce hand hygiene compliance and infection prevention	Maintain ABHS availability for infection prevention, but adapt access in selected high-risk patients, rooms, or units. Decisions should involve clinical teams, infection prevention and control staff, nursing staff, and facilities management.	Archer et al., 2007; Tavolacci et al., 2007; Saha et al., 2021; Gold et al., 2023; NHS England, 2023

Note. ABHS = alcohol-based hand sanitizer; ABHG = alcohol-based hand gel; ED = emergency department.

Limitations

This review has several limitations. First, the available evidence base is dominated by case reports, case-based letters, poison center analyses, and patient safety commentaries. These sources are useful for identifying clinical patterns, diagnostic pitfalls, and potentially preventable hazards, but they do not allow reliable estimation of incidence, prevalence, or comparative risk across healthcare settings. Therefore, the true frequency of intentional or concealed sanitizer ingestion in hospitals, emergency departments, or psychiatric units remains unknown. Second, publication bias is likely. Severe, unusual, or fatal cases are more likely to be reported than mild, rapidly recognized, or locally managed events. Consequently, the published literature may overrepresent dramatic presentations, while underestimating less visible episodes of sanitizer misuse, near-misses, or staff-managed incidents that do not result in publication. Third, the included reports are heterogeneous. They differ in patient population, clinical setting, product type, alcohol involved, amount ingested, diagnostic work-up, treatment, and level of reporting detail. Ethanol-, isopropanol-, propanol-, and methanol-related events also represent partly different toxicological and patient safety problems. This heterogeneity limits direct comparison between

cases and precludes quantitative synthesis. Fourth, poison center data provide important surveillance information but have inherent limitations. They depend on reporting practices, coding accuracy, follow-up availability, and the information provided at the time of the call. In addition, they capture exposures rather than confirmed healthcare-associated ingestion events, which limits their usefulness for estimating ward-level or institution-level risk. Finally, this study was undertaken as a narrative review and did not use the full methodology of a systematic review or meta-analysis. Although the searches were structured and reference lists of key publications were screened, no formal risk-of-bias assessment or quantitative pooling was performed. The conclusions should therefore be interpreted as a clinically oriented synthesis of available evidence, intended to support awareness, risk recognition, and patient safety planning rather than to provide definitive epidemiological estimates.

4. CONCLUSION

Intentional or concealed ingestion of alcohol-based hand sanitizers in healthcare settings appears to be infrequently reported but is clinically relevant and potentially preventable. Alcohol-based hand sanitizers remain essential for infection prevention; however, in selected clinical situations, they may also become an accessible source of highly concentrated alcohol. Published case reports and poison center data suggest that patients with alcohol use disorder, psychiatric vulnerability, self-harm risk, delirium, or cognitive impairment may be particularly vulnerable. The main clinical challenge is delayed recognition. Sanitizer ingestion may resemble intoxication caused by beverage alcohol, alcohol withdrawal, delirium, or acute medical illness. It should be considered when intoxication is prolonged, blood alcohol concentration rises unexpectedly, or unexplained acid-base abnormalities recur during observation. Methanol-containing or methanol- contaminated products represent a separate toxicological and regulatory risk, requiring early suspicion, urgent toxicology input, and effective surveillance. Prevention should be proportionate, risk-based, and non-stigmatizing. Awareness of this risk, early recognition of unexplained intoxication, appropriate management of alcohol withdrawal and coexisting psychiatric symptoms, and simple environmental modifications may improve patient safety without compromising infection-control standards. Alcohol-based hand sanitizers should remain widely available for infection prevention, but healthcare systems should recognize that, for selected vulnerable patients, alcohol may literally be within reach.

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Data and materials availability

The data supporting the findings of this review are included in the manuscript as well as the referenced publications.

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