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Review Article

Hepatitis E virus infection among sewer/sewage workers: a systematic review

Hepatitis-E-Virus-Infektionen bei Kanal- und Abwasserarbeitern: eine systematische Übersichtsarbeit

Abstract

Background: Hepatitis E virus (HEV) is an enterically transmitted RNA virus and an established cause of endemic zoonotic infection in many high-income countries. Sewer and sewage workers may have occupational contact with raw sewage, fecally contaminated water, aerosols, and contaminated surfaces, providing a biologically plausible route of exposure. However, it remains unclear whether this translates into an increased occupational risk of HEV infection or clinical hepatitis E.
Methods: We conducted a systematic review to assess HEV infection, seroprevalence, seroconversion, and clinical hepatitis E among sewer/sewage workers. In accordance with PRISMA guidelines, MEDLINE via PubMed and Google Scholar were searched for publications up to June 30, 2026, using terms related to HEV and occupational sewage exposure. Evidence was synthesized descriptively.
Results: The seroprevalence search identified 69 records, and the clinical case search identified 121 records. After applying eligibility criteria, only two independent baseline seroprevalence study populations and one prospective follow-up study were included. One Indian cross-sectional study found substantially higher anti-HEV IgG seroprevalence among workers with close sewage contact than among controls (57/92 [62.0%] vs 38/201 [18.9%]; odds ratio 7.0, 95% CI 3.9–12.6). In contrast, a Swiss baseline study found no excess seroprevalence among wastewater-exposed workers compared with municipal manual workers without wastewater exposure (10/338 [3.0%] vs 15/414 [3.6%]). In the subsequent Swiss prospective follow-up, no clinical hepatitis E was diagnosed; 26 HEV seroconversions occurred among 667 initially seronegative workers, with identical seroconversion rates in exposed and nonexposed workers (1 case per 100 person-year). No confirmed occupational HEV case report or outbreak among sewer/sewage workers was identified.
Conclusions: The evidence on HEV infection among sewer/sewage workers is sparse and inconsistent. Overall, the findings do not provide sufficient evidence that sewer/sewage workers in high-income settings have an increased occupational risk of HEV infection. They also do not justify HEV-specific preventive measures beyond established occupational hygiene, exposure reduction and appropriate personal protective equipment. Future studies should use precise occupational definitions, suitable controls and adjustment for major nonoccupational HEV risk factors including zoonotic foodborne paths from infected animals like pigs and wild boars.

Keywords: hepatitis E virus, occupational exposure, sewage, seroprevalence, systematic review

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Zusammenfassung

Hintergrund: Das Hepatitis-E-Virus (HEV) ist als enteral übertragenes RNA-Virus eine etablierte Ursache für endemische zoonotische Infektionen. Kanal- und Abwasserarbeiter können mit Roh-Abwasser, fäkal kontaminiertem Wasser, Aerosolen und kontaminierten Oberflächen in Kontakt kommen, sodass ein biologisch plausibler Expositionsweg besteht. Unklar ist jedoch, ob sich daraus ein erhöhtes berufliches Risiko für eine HEV-Infektion oder eine klinische Hepatitis E ergibt.
Methoden: Wir führten eine systematische Übersichtsarbeit durch, um HEV-Infektionen, Seroprävalenz, Serokonversionen und klinische Hepatitis E bei Kanal-/Abwasserarbeitern zu untersuchen. Unter Beachtung der PRISMA-Richtlinien durchsuchten wir bis Ende Juni 2026 die Datenbanken MEDLINE über PubMed und Google Scholar nach einschlägigen Publikationen, wobei Suchbegriffe zu HEV und beruflicher Abwasserexposition verwendet wurden. Die Evidenz wurde deskriptiv zusammengefasst.
Ergebnisse: Die Seroprävalenzsuche identifizierte 69 Treffer, die Suche nach klinischen Fällen 121 Treffer. Entsprechend der Einschlusskriterien konnten nur zwei unabhängige Baseline-Seroprävalenzstudienpopulationen und eine prospektive Follow-up-Studie eingeschlossen werden: Eine indische Querschnittsstudie zeigte eine deutlich höhere Anti-HEV-IgG-Seroprävalenz bei Beschäftigten mit engem Abwasserkontakt als bei Kontrollen (57/92 [62,0%] vs. 38/201 [18,9%]; Odds Ratio 7,0; 95%-KI 3,9–12,6). Demgegenüber fand eine Schweizer Baseline-Studie keine erhöhte Seroprävalenz bei abwasserexponierten Beschäftigten im Vergleich zu nicht abwasserexponierten kommunalen Beschäftigten mit manuellen Tätigkeiten (10/338 [3,0%] vs. 15/414 [3,6%]). In der anschließenden prospektiven Schweizer Follow-up-Studie wurde keine klinische Hepatitis E diagnostiziert; bei 667 zu Beginn seronegativen Beschäftigten traten 26 HEV-Serokonversionen mit identischen Serokonversionsraten bei exponierten und nicht exponierten Beschäftigten auf (0,01 pro Personenjahr). Es wurde kein bestätigter beruflicher HEV-Fallbericht und kein beruflicher HEV-Ausbruch bei Kanal-/Abwasserarbeitern identifiziert.
Schlussfolgerungen: Die Evidenz zu HEV-Infektionen bei Kanal-/Abwasserarbeitern ist spärlich und uneinheitlich. Insgesamt liefern die Befunde keinen ausreichenden Beleg dafür, dass Kanal-/Abwasserarbeiter in Ländern mit hohem Einkommen ein erhöhtes berufliches HEV-Infektionsrisiko haben. Sie rechtfertigen auch keine über etablierte Maßnahmen der Arbeitshygiene wie Expositionsreduktion und geeignete persönliche Schutzausrüstung hinausgehenden HEV-spezifischen Präventionsmaßnahmen. Zukünftige Studien sollten präzise Berufsdefinitionen, geeignete Kontrollgruppen und eine Adjustierung für wesentliche nicht berufliche HEV-Risikofaktoren berücksichtigen.

Schlüsselwörter: Hepatitis-E-Virus, berufliche Exposition, Abwasser, Seroprävalenz, systematische Übersichtsarbeit

Introduction

Hepatitis E is an acute, usually self-limiting, liver infection caused by hepatitis E virus (HEV), an enterically transmitted RNA virus. The World Health Organization (WHO) estimates that approximately 20 million HEV infections occur globally each year, of which 3.3 million are symptomatic; approximately 4,431 deaths were attributed to HEV in 2023 [1]. HEV is found worldwide, but the highest disease burden is reported from sub-Saharan Africa and from East and South Asia. Transmission is predominantly fecal-oral, principally through contaminated water, particularly in settings with inadequate water, sanitation and hygiene infrastructure [1].

In Europe, HEV is now increasingly understood as an endemic zoonotic infection in high-income countries rather than merely as an imported travel-associated disease [2] ,[3]. Genotype 3 predominates in EU/EEA countries, where transmission is mainly zoonotic and has been linked especially to contaminated pork and shellfish products [2], [3]. Interpretation of surveillance data is complicated, however, because, unlike hepatitis A, B and C, HEV is not notifiable at the European level and no EU-wide case definition is available; national surveillance systems, case definitions and testing recommendations therefore vary between EU/EEA Member States [3]. Despite this heterogeneity, the ECDC baseline assessment for 2005–2015 documented 21,018 confirmed hepatitis E cases from 22 EU/EEA countries, with Germany, France and the United Kingdom accounting for most reported cases and most infections classified as locally acquired [2]. German notification data illustrate this endemic pattern: in 2024, the Robert Koch Institute recorded 4,734 notified hepatitis E cases, including 2,578 cases in men, with the highest age-specific incidence among men aged 60–69 years [4]. Among cases with information on the probable country of infection, Germany was named in 86% of reports, supporting predominantly domestic rather than imported acquisition [4].

Against this background, the occupational relevance of HEV remains uncertain. Routine occupational disease data provide only indirect evidence. In a recent analysis of routine data from the Institution for Statutory Accident Insurance and Prevention in the Health and Welfare Services (BGW), suspected HEV occupational disease notifications among healthcare and welfare workers were rare: 24 suspected cases were reported between 2018 and 2023, and only two were recognized as occupational disease cases, both in 2019 [5]. These data suggest that recognized occupational HEV infection is uncommon in the BGW-covered sector, but they cannot be directly extrapolated to municipal sewer or wastewater workers, who are not the primary occupational population represented in this dataset [5].

For sewer and sewage workers, an occupational exposure pathway is biologically plausible. These workers may have direct contact with untreated sewage, fecally contaminated water, aerosols, splashes and contaminated surfaces. Environmental evidence supports the presence of HEV in water and wastewater matrices: a systematic review and meta-analysis found an overall HEV RNA prevalence of 9.8% in water samples, with the highest prevalence in untreated wastewater (15.1%) and lower prevalences in treated wastewater (3.8%) and drinking water (4.7%) [6]. However, environmental detection is not equivalent to occupational infection. The presence of HEV RNA in wastewater does not necessarily demonstrate viable infectious virus, a sufficient exposure dose, seroconversion, clinically apparent hepatitis E or an excess risk among exposed workers.

Existing reviews leave the specific occupational question unresolved. Wilhelm et al. summarized anti-HEV IgG seroprevalence in blood donors and general populations in non-endemic, highly developed countries and later reviewed broader predictors of human HEV exposure, but neither review provided occupation-specific estimates for sewer, sewage or wastewater workers [7], [8]. The review by Takuissu et al. addressed HEV in water matrices and therefore supports environmental plausibility rather than occupational epidemiology [6]. A recent review of hepatitis virus seroprevalence among sanitary workers included heterogeneous occupations and hepatitis viruses; although it reported a pooled HEV estimate, its broad grouping of sewage and waste-treatment workers, solid-waste collectors and street sweepers limits its usefulness for assessing risk specifically among sewer/sewage workers [9].

A focused systematic review is therefore needed to distinguish past serological exposure from acute infection, seroconversion and clinical disease; to separate direct sewer or raw-sewage exposure from broader sanitation and waste occupations; and to assess whether available studies demonstrate an occupational excess risk or primarily reflect endemic community exposure.

Methods

This systematic review was conducted to assess whether sewer/sewage workers are at increased occupational risk of hepatitis E virus (HEV) infection and whether clinical hepatitis E cases, outbreaks or seroconversions attributable to sewer or sewage exposure have been documented in this occupational group.

Definition of sewer/sewage workers

For the purpose of this review, sewer/sewage workers were defined as workers whose occupational tasks involved direct contact with raw sewage or sewerage infrastructure, including inspection, maintenance, cleaning or repair of sewer pipes, drains, manholes, pumping stations or sewerage depots, and work requiring entry into sewers or handling of raw sewage. The decisive criterion was the existence of a plausible fecal-oral exposure pathway through direct occupational contact with untreated sewage or sewage-contaminated surfaces, aerosols or splashes. Workers employed in wastewater treat-

ment plants were not considered eligible unless the study reported a separately extractable subgroup with direct sewer or raw-sewage exposure. If studies included broader sanitation or wastewater-exposed occupational groups, they were eligible only when data for sewer/sewage workers could be separated.

Literature search and study selection

A comprehensive literature search was conducted up to 30 June 2026 using two complementary strategies: one focusing on HEV seroprevalence among sewer/sewage workers and the other on clinical hepatitis E cases, occupational outbreaks, seroconversion or incident HEV infection in this occupational group. PubMed was used as the primary bibliographic database, and Google Scholar as a supplementary source for gray literature, citation-linked publications, non-indexed reports and studies not captured by PubMed. Searches combined terms for hepatitis E and occupational sewage exposure, including "hepatitis E", "HEV", "anti-HEV", "seroprevalence", "sewer workers", "sewage workers", "sanitation workers", "wastewater workers", "drainage workers", "occupational exposure", "case report", "outbreak", "seroconversion" and "incidence", with source-specific adaptations. Full search strings are provided in Attachment 1.

Original studies were eligible if they reported individual-level HEV data in sewer/sewage workers or in a separately extractable subgroup with direct contact with raw sewage or sewerage infrastructure. Eligible outcomes included anti-HEV IgG or total anti-HEV seroprevalence, acute HEV infection based on IgM or HEV RNA, occupationally attributed case reports or outbreaks, and seroconversion or incidence during follow-up.

Review articles, guidelines, conference abstracts and editorials were excluded a priori. No restrictions were applied regarding publication year, study design, occupational subgroup, or prospective versus retrospective data collection; eligible languages were English, German, French, Italian and Spanish.

The reference lists of included reports, surveillance summaries and relevant review articles were additionally screened to identify cases missed by database searching. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guideline [10]. Methodological guidance for systematic reviews of observational studies reporting prevalence or cumulative incidence data informed the descriptive evidence synthesis [11].

Data extraction

Data were extracted from all included studies independently by two reviewers (RD and AN). Duplicates and overlapping reports were identified across databases and within study populations. Where several publications reported data from the same cohort, they were not counted as independent baseline seroprevalence studies unless they provided distinct study populations or non-overlapping outcome data. Any discrepancies were resolved by consensus.

Data were extracted on country, study period where available, occupational population, exposure definition, comparison group, sample size, HEV outcome, serological or molecular methods used, prevalence or incidence estimates, effect estimates, adjustment for confounders and major limitations.

Statistics

For comparative studies, numerators, denominators, crude proportions and reported effect estimates, including odds ratios and adjusted regression estimates, were extracted where available. Information on variables included in multivariable models was recorded to assess adjustment for potential confounders. For longitudinal studies, follow-up duration, numbers at risk, seroconversions, seroconversion rates, clinical outcomes and loss to follow-up were extracted where reported. No additional inferential statistical analyses or meta-analysis were planned a priori because only a small number of eligible studies was expected. The evidence was therefore synthesized descriptively.

Assessment of study quality

Risk of bias and potential confounding were assessed qualitatively rather than by applying a formal quality score, because only a small number of heterogeneous observational studies were eligible. The assessment considered the selection and comparability of exposed and control groups, specificity of occupational exposure, background HEV endemicity, possible nonoccupational HEV exposure, laboratory methods, adjustment for confounders, use of personal protective equipment and, for longitudinal data, completeness of follow-up.

Results

Study selection

Figure 1 summarizes the flow diagram of the literature search. Across the two complementary searches, 190 records were identified before duplicate and overlap assessment. The systematic search for HEV seroprevalence in sewer/sewage workers identified 69 records: 27 from PubMed and 42 from Google Scholar. After removal of five duplicate or overlapping records, 64 unique records remained, of which three reports were retained for the evidence synthesis: two independent baseline seroprevalence studies and one prospective follow-up report from the same Zurich cohort. The two independent baseline study populations were from India and Switzerland, reported by Vaidya et al. [12] and Jeggli et al. [13], respectively. The German short report by Jeggli et al. [14] was treated as a preliminary/companion report and was not counted as an additional independent study.

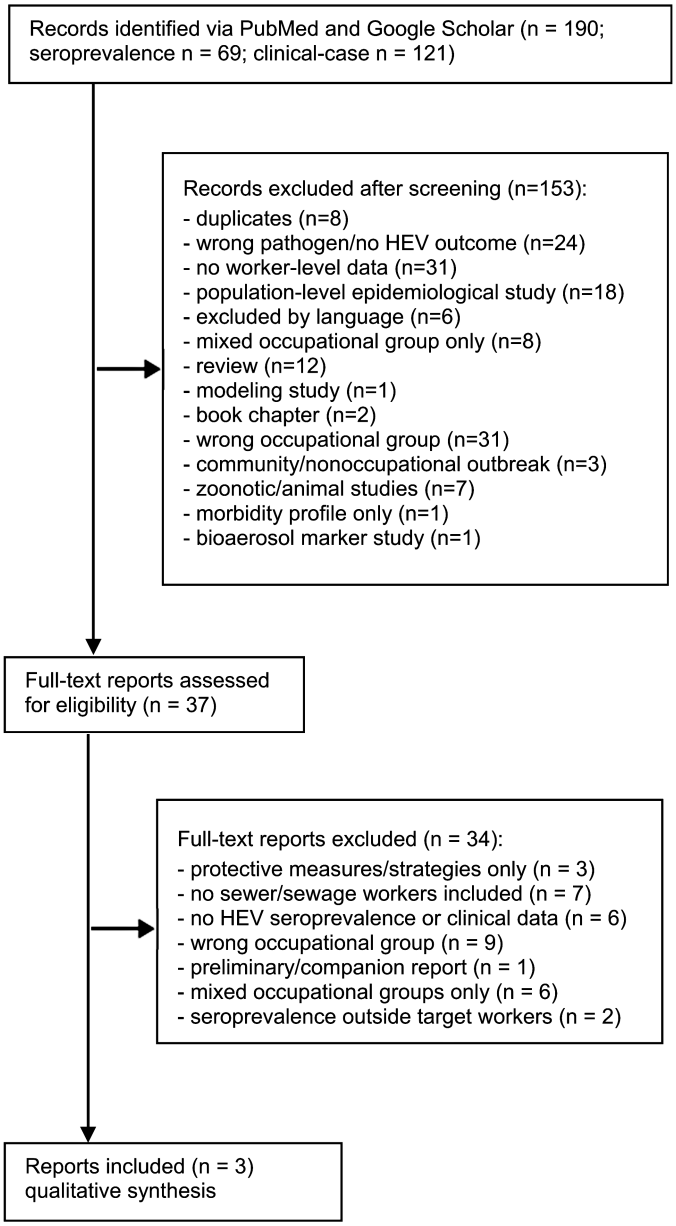


Figure 1: PRISMA flow diagram of study selection

For the clinical case search, PubMed yielded 90 records and the supplementary Google Scholar search yielded 31 records. After comparison of both sources, three cross-source duplicates were identified, leaving 118 unique records. Among these 118 unique records, no confirmed clinical HEV case report or occupational HEV outbreak among sewer/sewage workers was identified. One prospective cohort study by Tschopp et al. [15] was retained as negative clinical-disease evidence because it explicitly assessed clinical hepatitis E and HEV seroconversion during follow-up. Although Vaidya et al. [12] and Jeggli et al. [13] were also retrieved by the clinical case search, both had already been assigned to the seroprevalence evidence synthesis because they reported baseline seroprevalence data rather than clinical hepatitis E cases, occupational outbreaks or seroconversion.

Excluded near-target reports

Several reports initially appeared potentially relevant but were excluded after application of the predefined narrow population definition and outcome criteria. The Egyptian reports by El-Esnawy et al. [16], [17], as well as the study by Albatanony and El-Shafie [18], investigated wastewater treatment plant workers rather than sewer workers in the strict sense and did not provide a separately extractable subgroup with direct sewer or raw-sewage exposure. Moreover, interpretation of the Egyptian HEV findings was limited by the very high background anti-HEV seroprevalence in the general population. A recent systematic review reported anti-HEV IgG seroprevalence estimates of up to 85.1% in Egypt [19], making occupational attribution vulnerable to confounding by nonoccupational community exposure. Vildosola et al. [20] reported drinking-water and sewerage-system workers only as a mixed occupa-

tional group without a separable sewer-worker estimate. The study by Helal and Rashed [21] was excluded because, although it included sewer-network workers, HEV was mentioned only in the discussion and no original HEV-specific outcome was reported.

Characteristics of included studies

Table 1 summarizes the characteristics, HEV endpoints, main findings and interpretation of the three included reports. Two reports were conducted in Switzerland, a high-income country [13], [15], and one in India, a lower-middle-income country [12]; all were published between 2003 and 2009.

The Indian cross-sectional study by Vaidya et al. [12] assessed 147 sewage staff members in Pune, including workers from sewage treatment plants, a pumping station and a sewerage/drainage depot. Ninety-two workers had direct and frequent contact with raw or treated sewage, and 55 had less frequent exposure. None used personal protective equipment. Age-matched controls without sewage exposure from the same area and lower socioeconomic status were used for comparison, and the main outcome was IgG anti-HEV positivity by ELISA.

The Swiss baseline study by Jeggli et al. [13] was conducted in the Canton of Zurich and compared 349 wastewater-exposed workers with 429 municipal manual controls. It assessed clinical history, gastrointestinal symptoms, anti-HEV antibodies and major potential confounders, including age, socioeconomic indicators, country of childhood and travel to endemic areas. The prospective follow-up by Tschopp et al. [15] was based on the same occupational cohort and included 332 wastewater-exposed workers and 446 nonexposed municipal manual workers after correction of exposure misclassification. It was retained for incident and clinical outcomes because it assessed clinical hepatitis E and HEV seroconversion during follow-up.

Seroprevalence findings

In the Indian study [12], IgG anti-HEV positivity was substantially higher among sewage staff than among controls. Overall, 83/147 sewage staff members (56.5%) were anti-HEV positive compared with 38/201 controls (18.9%). Among workers with close sewage contact, 57/92 (62.0%) were positive, corresponding to an odds ratio of 7.0 (95% CI 3.9–12.6). Workers with close sewage contact for five years or more had a seroprevalence of 50/74 (67.6%) compared with 32/145 controls (22.1%; OR 7.4, 95% CI 3.8–14.5). Multivariable analysis identified sewage exposure as the only independent variable associated with anti-HEV positivity.

In contrast, the Swiss baseline study [13] found no excess anti-HEV seroprevalence in wastewater-exposed workers. In the final 2004 report, anti-HEV IgG was found in 10/338 exposed workers (3.0%) and 15/414 controls (3.6%). The authors reported no association between sewage exposure and HEV seropositivity; travel to endemic areas appeared to be the dominant risk factor. Because only two independent baseline seroprevalence populations were available, and because the studies differed markedly by region, endemicity, sanitation context, study design, exposure definition and protective equipment, no pooled seroprevalence estimate was calculated.

Clinical hepatitis E, seroconversion and case evidence

No confirmed clinical hepatitis E case report or occupational outbreak among sewer/sewage workers was identified. The only retained clinical/incidence study was the Zurich prospective follow-up [15]. In that cohort, 667 workers who were seronegative for HEV at baseline had at least one follow-up determination. No clinical hepatitis E was diagnosed during follow-up. HEV seroconversion occurred in 26 subjects, with identical incidence rates among exposed and nonexposed workers (0.01 per person-year in both groups). Twenty-four seroconversions were asymptomatic; in the remaining two seroconverters, liver abnormalities were reported but were not diagnosed as hepatitis E: one subject had hepatitis B and one had abnormal liver enzymes detected during a routine check-up.

Risk of bias and adjustment for confounding

The included studies differed substantially in their handling of confounding and potential sources of bias. Vaidya et al. [12] assessed several nonoccupational risk factors, including age, socioeconomic background, family size, history of jaundice, household toilet type, residential water source and household water treatment. In univariable analyses, age, sewage exposure, duration of service and household toilet type were associated with anti-HEV positivity; in multivariable logistic regression, exposure to sewage remained the only independent variable associated with anti-HEV positivity. However, the study was conducted in a highly endemic setting, none of the workers used personal protective equipment, and residual confounding by environmental, household or community exposure cannot be excluded.

The Zurich baseline study by Jeggli et al. [13] considered travel to endemic areas, socioeconomic level, age, country of childhood and number of siblings as major confounders. Logistic regression did not show an increased risk of HEV seropositivity among wastewater-exposed workers. Nevertheless, the number of anti-HEV-positive participants was small, which limited the precision of adjusted estimates, and the authors noted that separating occupational exposure effects from confounding was difficult.

In the prospective Zurich follow-up, Tschopp et al. [15] assessed exposure individually over time and used several exposure indicators, including duration of exposure, contact with raw sewage and splashes. The analyses

Table 1: Comparative synthesis of HEV evidence in sewer/sewage workers

Study	Setting	Design	Exposed group	Comparator	HEV endpoint	Main result	Interpretation
Vaidya SR, et al. 2003 [12]	India; endemic setting	Cross-sectional seroprevalence study	92 direct sewage workers; 55 other sewage-facility staff	201 age-matched controls from the same area and lower-middle socioeconomic status	Anti-HEV IgG	Direct sewage workers: 57/92 (62.0%); other staff: 26/55 (47.3%); controls: 38/201 (18.9%). Sewage exposure remained independently associated with anti-HEV positivity.	Supports increased HEV IgG seroprevalence in an endemic setting with intensive sewage exposure and no personal protective equipment. No clinical disease endpoint.
Jeggli S, et al. 2004 [13]	Zurich, Switzerland; low-endemic, high-sanitation setting	Baseline cross-sectional study of the Zurich cohort	349 wastewater-exposed workers; anti-HEV results available for 338	429 municipal manual controls; anti-HEV results available for 414	Anti-HEV antibodies	Anti-HEV positivity was found in 10/338 exposed workers (3.0%) and 15/414 controls (3.6%). No increased HEV seroprevalence was associated with wastewater exposure; travel to endemic areas was reported as the dominant risk factor.	No evidence of increased HEV seroprevalence among wastewater-exposed workers in the definitive Zurich baseline study.
Tschopp A, et al. 2009 [15]	Zurich, Switzerland; low-endemic, high-sanitation setting	Prospective follow-up of the Zurich cohort with annual examinations	332 workers classified as wastewater-exposed after review of occupational history; number initially HEV-seronegative not separately reported	446 municipal manual workers classified as nonexposed after review of occupational history; number initially HEV-seronegative not separately reported	Clinical hepatitis E; anti-HEV seroconversion among initially seronegative workers	No clinical hepatitis E was diagnosed. Of 778 workers included in the follow-up cohort, 667 were HEV-seronegative at baseline and had at least one follow-up HEV determination; 26 HEV seroconversions occurred. HEV seroconversion rates were identical in exposed and nonexposed workers: 0.01/person-year in each group.	Strong negative prospective evidence for trained workers with available protective equipment in a low-endemic, high-sanitation region. The seroconversion denominator is smaller than the total cohort because only initially HEV-seronegative workers with follow-up serology could contribute to this analysis.

considered travel to endemic areas, socioeconomic level, age, country of childhood, number of siblings, blood transfusion and personal protective equipment; laboratory analyses were performed blinded to exposure status. The prospective design reduced the healthy-worker and temporality limitations inherent to cross-sectional studies. However, the ability to detect rare clinical hepatitis E events was limited, some loss to follow-up occurred, and the findings may not be generalizable to endemic regions or settings with poorer sanitation or less systematic use of training and protective equipment.

Overall synthesis

The available direct evidence is therefore very limited and consists of two independent baseline seroprevalence studies and one prospective follow-up report from one of these cohorts. The Indian study [12] reported substantially increased anti-HEV IgG seroprevalence among workers with close sewage contact, whereas the Swiss studies [13], [15] found no increased seroprevalence or seroconversion among trained workers in a low-endemic, high-sanitation setting. We identified no confirmed published occupational clinical HEV case report or outbreak among sewer/sewage workers.

Discussion

This systematic review identified only very limited direct evidence on hepatitis E virus infection among sewer/sewage workers in the strict occupational sense. The scarcity of occupational evidence must be interpreted against the background of established endemic HEV circulation in Germany and other high-income European countries, predominantly involving genotype 3. According to the RKI, the increase in notified HEV infections over time is most likely explained by greater clinical awareness, more frequent testing and the use of more sensitive diagnostic assays, rather than necessarily by a true increase in disease incidence [22]. Population-based seroprevalence data nevertheless indicate substantial lifetime exposure: in the German DEGS1 survey, anti-HEV IgG seroprevalence among adults was 16.8% and increased with age [23], while higher but declining estimates were reported in southeastern Germany, from 51% in samples collected in 1996 to 34% in samples collected in 2011 [24]. The Committee for Biological Agents (Ausschuss für Biologische Arbeitsstoffe, ABAS) also emphasized that seroprevalence estimates depend strongly on assay sensitivity and noted that about half of pigs in Germany and many other European countries are seropositive [25]. Thus, zoonotic and foodborne exposure constitutes a substantial background risk, making occupational attribution of HEV seropositivity particularly difficult.

The clinical and public health relevance of HEV is nevertheless clear. In the RKI infectious disease yearbook for 2024, 4,734 hepatitis E cases fulfilled the reference definition, compared with 1,001 hepatitis A cases in the same year, and 13 deaths were reported in association with hepatitis E [4]. The same report noted that substantial underascertainment must be assumed because symptoms are variable and often mild [4]. This is consistent with Pischke et al., who described hepatitis E in Germany as an underreported infection and emphasized that most HEV infections are clinically inapparent [26]. The predominance of mild or clinically inapparent infections may help explain why HEV is common and relevant at the population level, while confirmed occupational clinical cases among sewer workers remain absent from the published literature: such infections would not be detected without active serological follow-up or molecular testing, and routine surveillance often lacks sufficient occupational detail to distinguish sewer-related exposure from the predominant zoonotic and foodborne routes.

After applying the narrow population definition used in this review, only two independent baseline seroprevalence study populations and one prospective follow-up report from one of these cohorts remained eligible.

The Indian study by Vaidya et al. [12] reported markedly higher anti-HEV IgG seropositivity among sewage staff, particularly among workers with direct sewage contact, than among age-matched controls, and multivariable analysis identified sewage exposure as the only independent variable associated with anti-HEV positivity. This study provides the strongest evidence suggesting a possible occupational association. However, it was conducted in a setting with higher background HEV endemicity than is typical of high-income European countries, workers reportedly did not use personal protective equipment, and community or household exposures may have contributed to infection risk. Its findings may therefore be most applicable to settings with substantial environmental HEV circulation, close raw-sewage contact and limited occupational protection.

The Zurich cohort provides contrasting evidence from a low-endemic, high-sanitation setting. Jeggli et al. [13] found no increase in anti-HEV seroprevalence among wastewater-exposed workers compared with municipal manual controls. In the subsequent prospective follow-up, Tschopp et al. [15] found no increased incidence of clinical hepatitis E and no increased HEV seroconversion rate among sewage-exposed workers; seroconversion occurred at approximately the same rate in exposed and nonexposed groups. This negative prospective evidence is important because the study assessed incident outcomes and exposure indicators, including raw-sewage contact and splashes. However, it cannot exclude higher risk under less favorable conditions, such as poorer sanitation, higher environmental HEV circulation or limited occupational protection.

The absence of confirmed occupational clinical HEV case reports or outbreaks among sewer/sewage workers was one of the most striking findings of the case search. After assigning Vaidya et al. [12] and Jeggli et al. [13] to the seroprevalence evidence synthesis, Tschopp et al. [15] remained the only eligible study addressing clinical or incident HEV outcomes, and it provided negative prospec-

tive evidence rather than a positive occupational case report. This does not prove that occupational HEV infection cannot occur. Rather, it shows that the published evidence is insufficient to establish sewer work as a high-risk occupation for clinical HEV disease, particularly in high-income settings where other transmission routes, including consumption of insufficiently heated pork or game meat, blood products and infection in immunosuppressed patients, are better documented [26].

A further biological factor that may help explain the weak occupational association is the dose requirement for productive HEV infection. Detection of HEV RNA in wastewater does not necessarily mean that workers receive an infectious inoculum. Available dose estimates are route- and matrix-dependent and cannot be directly extrapolated to sewer work. Nevertheless, the German Committee for Biological Agents reported that the infectivity titer of HEV-3 in feces was estimated experimentally at $10^{4.5}$/g, corresponding to approximately 10^{6} genome equivalents, while a 55% infectious dose in blood or plasma recipients contained about 20,000 IU HEV RNA [25]. In transfusion settings, an absolute dose of approximately 50,000 IU HEV RNA per blood product usually led to infection, whereas doses between 7,100 and 50,000 IU might be infectious [27]. These dose estimates contrast with hepatitis A virus, for which low-dose infectivity is well recognized [28]. Together with dilution of fecal material in sewage, limited ingestion during occupational exposure, temperature- and matrix-dependent loss of infectivity [29], and personal protective equipment in settings with high sanitation standards, this may reduce the probability that sewer/sewage workers receive an infectious HEV inoculum despite biologically plausible exposure.

The German regulatory position is consistent with this cautious interpretation. TRBA 220 classifies the HEV risk in wastewater facilities as equal to or possibly slightly increased compared with the general population. It notes that HEV can occur in the sewer system, but that infection is considered unlikely because of the low concentration; it also states that a hepatitis E vaccine exists only in China and is neither authorized nor available in the European Union [30]. This differs from hepatitis A in practical prevention terms: hepatitis A is vaccine-preventable, whereas no HEV vaccine is currently authorized in Europe [31]. Consequently, HEV prevention for sewer workers cannot rely on immunization and remains based on occupational hygiene, exposure reduction, appropriate personal protective equipment, hand hygiene and avoidance of aerosol or splash exposure where possible.

Overall, the evidence does not support a uniform classification of sewer/sewage workers as a high-risk group for HEV infection. The available data are better interpreted as showing biological plausibility, substantial background exposure in the general population, one positive seroprevalence signal from an endemic setting, and negative seroprevalence and prospective incidence data from Switzerland. Future studies should use precise occupational definitions, suitable controls, detailed exposure metrics and adjustment for relevant nonoccupational HEV risks, including age, socioeconomic status, country of childhood, travel, food exposures and immunosuppression. Until such data are available, routine risk assessment and hygiene-based prevention are justified, whereas the evidence base remains insufficient for stronger HEV-specific occupational conclusions in sewer workers.

Notes

Background

This work was stimulated by discussions at the biohazard and occupational health meeting of the International Commission on Occupational Health (ICOH), 6 to 7 October 2025 in Hamburg, Germany, see https://www.scboh2025.com/.

Competing interests

The authors declare that they have no competing interests.

Attachments

Available from https://doi.org/10.3205/dgkh000687

1. Attachment1_dgkh000687.pdf (106 KB)
   Search strategies

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