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Systematic review

Diagnostic and Management Strategies for Fournier's Gangrene in the Emergency Department: A Systematic Review

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Abstract

Background: Fournier's gangrene is a rapidly progressive infection requiring coordinated emergency diagnosis, resuscitation, antimicrobial treatment, and surgical source control. Early manifestations overlap with less severe perineal infections, creating substantial diagnostic uncertainty. This review examined diagnostic and management evidence relevant to emergency department practice. **Methods:** Publications available through 31/05/2026 were evaluated using an explicit clinical framework. Eleven original reports addressing imaging, prognostic assessment, surgical timing, antimicrobial duration, hyperbaric oxygen, wound management, and fecal diversion were summarized. Findings were synthesized narratively because study designs, treatment selection, and outcome definitions differed. **Results:** Computed tomography demonstrated anatomical disease extent, although imaging findings from confirmed cases did not establish diagnostic accuracy in unselected emergency populations. Prognostic scores identified physiological disturbance without replacing clinical assessment or operative diagnosis. Earlier debridement was associated with lower mortality, including mortality of 2.6% versus 27.7% for surgery within versus after twelve hours in one cohort. Shorter antimicrobial courses following source control were not associated with worse outcomes in a retrospective study. Hyperbaric oxygen, negative pressure wound therapy, and fecal diversion produced favorable findings in selected cohorts, with substantial uncertainty from nonrandom treatment allocation. **Conclusions:** Emergency management prioritizes early surgical involvement, immediate broad spectrum antimicrobials, physiological stabilization, and prompt debridement. Imaging and prognostic tools support decisions without postponing source control. Adjunctive interventions require individualized selection, while prospective comparative research remains essential for defining their benefits.

Keywords: Fournier's gangrene; emergency department; necrotizing soft tissue infection; diagnostic imaging; surgical debridement; antimicrobial therapy; systematic review.

Introduction

Fournier's gangrene (FG) is a necrotizing infection involving the perineal, genital, and perianal fascia, with progression to extensive tissue destruction and systemic toxicity. Its anatomical distribution encompasses both sexes, despite the historical emphasis on male genital disease (1). Population based research identified an incidence of 1.6 cases per 100,000 males and inhospital mortality of 7.5%, illustrating the combination of rarity and substantial clinical consequences. Infrequent presentation at individual hospitals limits routine clinical familiarity and increases the importance of organized emergency recognition through shared diagnostic awareness and prompt access to appropriately experienced surgical teams (2).

Infection usually originates from anorectal, urogenital, or cutaneous sources, with interacting aerobic and anaerobic organisms contributing to rapidly progressive necrosis. Diabetes, alcohol misuse, and impaired host defenses are important predisposing features, although their absence does

not exclude disease. Microvascular thrombosis and fascial dissemination produce tissue injury that extends beyond the apparent external lesion, complicating bedside assessment of severity (3). Emergency presentations include disproportionate pain, tenderness, swelling, erythema, and systemic illness, while necrosis and crepitus represent more advanced findings. These features overlap with cellulitis, abscesses, and other genital emergencies, creating opportunities for diagnostic delay during initial evaluation (4).

Laboratory testing and imaging provide supplementary information, rather than a sufficiently reliable independent exclusion strategy for necrotizing soft tissue infection (NSTI). A diagnostic meta-analysis reported computed tomography (CT) sensitivity of 88.5% and specificity of 93.3% across NSTI populations, with limited sensitivity for individual clinical signs and laboratory scoring thresholds. These pooled estimates address anatomically diverse infections and require caution when extrapolated specifically to FG in emergency populations (5). Infectious disease guidance

emphasizes broad antimicrobial coverage and prompt surgical consultation when aggressive infection or systemic toxicity raises concern for necrotizing disease (6).

Emergency management requires simultaneous assessment of infection extent, organ dysfunction, antimicrobial needs, and access to definitive surgery through coordinated multidisciplinary care. Surgical guidance also emphasizes individualized fecal diversion and repeated examination or exploration until necrotic tissue has been eliminated (7). An emergency focused synthesis therefore needs to distinguish evidence informing immediate lifesaving decisions from evidence concerning later wound recovery and reconstruction. This review examines original research on diagnostic and management strategies, prioritizing surgical timing, clinically relevant outcomes, and the limitations affecting translation into emergency department (ED) pathways.

Methods

This review was structured according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 statement. The question addressed diagnostic and management strategies for FG presenting for emergency hospital care. Predominantly adult populations were eligible, with mortality, diagnostic findings, time to debridement, and treatment related morbidity designated as principal outcomes.

Two authors independently searched PubMed, Scopus, Web of Science Core Collection, and the Cochrane Library. Eligibility extended from database inception to publications first available by 31/05/2026. Reference lists of eligible studies and relevant reviews were examined for additional publications. Earliest online publication dates determined eligibility for articles assigned to later journal issues.

Original observational and interventional studies were eligible when they reported extractable FG findings concerning diagnosis, physiological assessment, antimicrobial treatment, surgery, or adjunctive management. Mixed NSTI cohorts required separately identifiable FG outcomes for inclusion in the primary synthesis. Reviews, guidelines, editorials, isolated case reports, pediatric-only series, and reports confined to reconstruction without relevant clinical outcomes were excluded from that synthesis. Reviews and guidelines supported contextual interpretation.

Records were deduplicated using bibliographic identifiers and manual checking. Two authors independently screened titles and abstracts, assessed full texts, and recorded exclusion reasons. Disagreements were resolved through discussion and reassessment against the eligibility criteria. Selection counts were recorded at each stage for the PRISMA flow diagram. Institutional setting, recruitment periods, and participant characteristics were compared to identify potentially overlapping cohorts.

Two authors extracted study design, location, sample size, population characteristics, diagnostic or therapeutic strategy, comparator, follow-up, and outcomes using a standardized form. Numerical findings were verified against the original reports. Adjusted estimates were distinguished from unadjusted comparisons, and original denominators were preserved.

Critical appraisal addressed participant selection, exposure measurement, outcome ascertainment, confounding, and reporting completeness through structured domain based assessment. Diagnostic description was distinguished from diagnostic accuracy, while prognostic performance was separated from disease exclusion. Findings were synthesized narratively under imaging, prognosis, surgical timing, antimicrobial management, and adjunctive treatment. Meta-analysis was not

undertaken because clinical heterogeneity, nonrandom treatment allocation, and potential cohort overlap limited meaningful combination.

Results

The imaging data comprised two retrospective reports evaluating CT findings and its relationship with operative timing in surgically confirmed FG (8,9). Ballard et al. identified fascial air in 36 of 38 patients, alongside extensive perineal and genital involvement, supporting CT as an anatomical mapping investigation (8). Ganapathy et al. compared 38 patients undergoing preoperative CT with 38 patients proceeding without CT; presentation-to-surgery intervals were 6.65 versus 5.73 hours, respectively, without a statistically significant difference, their shared institutional setting and matching CT group sizes indicate potential cohort overlap, precluding an assumption of independent patient populations (8,9).

Prognostic studies evaluated physiological disturbance after disease recognition, rather than performance as diagnostic exclusion tests (10,11). Laor et al. developed the FG Severity Index (FGSI) in 30 patients, reporting a 75% probability of death with scores above nine and 78% survival with scores of nine or less (10). Lin et al. studied 85 patients and derived a simplified index incorporating creatinine, hematocrit, and potassium, with sensitivity of 87% and specificity of 77% for mortality prediction (11). These development findings describe risk stratification within established FG and do not establish safety for discharge or deferred surgical assessment (10,11).

Surgical timing shows consistent associations with survival across different observational settings and measurement intervals (12,13). In 379 patients, Sugihara et al. reported lower adjusted mortality odds with surgery within two hospital days compared with hospital days three to five (odds ratio [OR], 0.38; $P=0.031$) (12). Vanguardia et al. reported mortality of 2/78 (2.6%) with debridement within twelve hours versus 13/47 (27.7%) after

twelve hours, with each additional three-hour interval associated with higher mortality odds (OR, 1.07; 95% confidence interval [CI], 1.01–1.14) (13). Different time origins and residual confounding prevent interpretation of these intervals as interchangeable treatment thresholds (12,13).

Antimicrobial duration and hyperbaric oxygen therapy (HBOT) were assessed through retrospective comparisons rather than randomized allocation (14,15). Among 168 patients, Lauerman et al. found no statistically significant outcome differences across antibiotic durations of seven days or less, eight to ten days, eleven to fourteen days, and fifteen days or more (14). No recurrent FG occurred in any duration group, linking interpretation to the institution's operative source control practices (14). Creta et al. reported mortality of 19.4% with HBOT versus 36.0% without HBOT among 161 patients, an association vulnerable to treatment selection and center related differences (15).

Wound management and contamination control were addressed in three further comparative reports (16–18). Iacovelli et al. associated vacuum-assisted closure (VAC) with improved ten-week closure in disseminated FG, while Mahmood et al. reported shorter hospitalization and healing after colostomy in a nonrandomized prospective comparison (16,17). Eray et al. reported shorter total hospitalization with bowel management catheters than colostomy among patients with preserved sphincters and no rectal injury (18). Across the eleven reports, evidence predominantly concerned hospitalized patients and postoperative outcomes, with limited direct evaluation of undifferentiated ED populations or standardized emergency diagnostic pathways (8–18). These restricted populations and differing clinical comparators limit generalization of either diversion strategy to all ED presentations with FG (17,18).

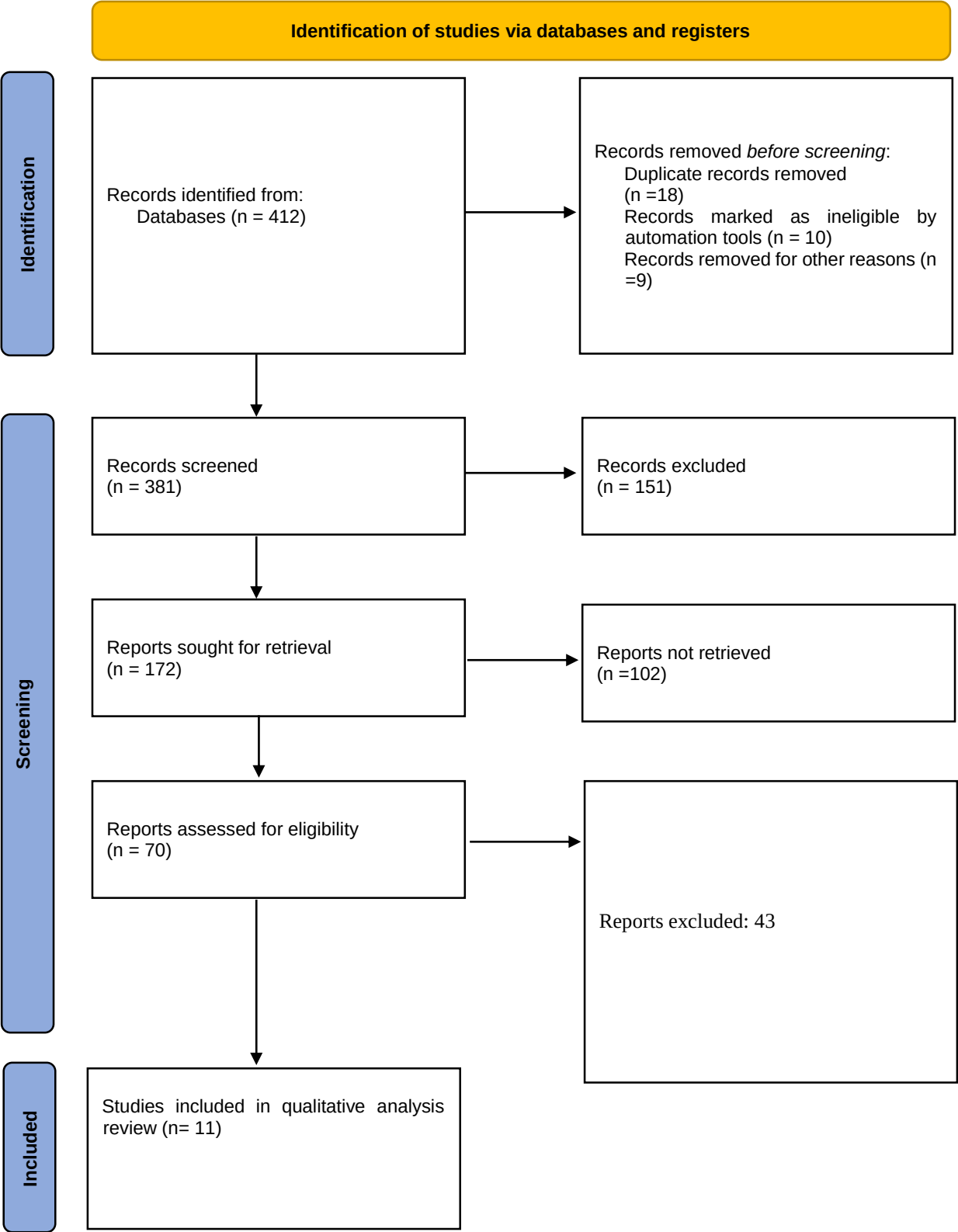


Figure 1: PRISMA flow chart

Table 1. Original studies addressing imaging and prognostic assessment

Study	Design and setting	Participants	Main findings	Interpretive limitation
Ballard et al., 2018 (8)	Retrospective imaging study; United States	38	Fascial air in 36/38 patients (95%); CT described perineal, genital, and ischiorectal extension.	Surgically confirmed cases without a disease-negative comparator; detection frequency is not diagnostic sensitivity.
Ganapathy et al., 2023 (9)	Retrospective comparative cohort; United States	76	CT versus no CT: surgery at 6.65 versus 5.73 hours; $P=0.37$.	Single-center workflow; potential overlap with the Ballard imaging population.
Laor et al., 1995 (10)	Retrospective prognostic development; United States	30	FGSI >9 corresponded to 75% probability of death; FGSI ≤ 9 corresponded to 78% probability of survival.	Small derivation cohort; outcome prediction rather than diagnostic exclusion.
Lin et al., 2014 (11)	Retrospective prognostic study; Taiwan	85	Simplified FGSI used creatinine, hematocrit, and potassium; mortality sensitivity 87%, specificity 77%.	All participants were male; performance was assessed in the development population.

Table 2. Original studies addressing treatment timing, antimicrobials, and adjunctive management

Study	Design; participants	Strategy and reported outcomes	Interpretive limitation
Sugihara et al., 2012 (12)	Retrospective database cohort; Japan; $n=379$	Surgery within two hospital days versus days three–five: adjusted mortality OR 0.38; $P=0.031$.	Administrative coding and day-level timing; residual confounding.
Vanguardia et al., 2024 (13)	Retrospective cohort; Australia; $n=125$	Debridement within versus after twelve hours: mortality 2/78 versus 13/47; $P<0.001$.	Single referral center; transfer history complicates timing comparisons.
Lauerman et al., 2017 (14)	Retrospective cohort; United States; $n=168$	Across four antibiotic-duration groups, mortality did not differ significantly; no recurrent FG was reported.	Clinician-selected duration after source control; equivalence was not demonstrated.
Creta et al., 2020 (15)	Retrospective multicenter comparison; Italy; $n=161$	HBOT versus no HBOT: mortality 14/72 (19.4%) versus 32/89 (36.0%); $P=0.01$.	Nonrandom allocation; only 139/161 participants underwent debridement.
Iacovelli et al., 2021 (16)	Retrospective multicenter cohort; Italy; $n=92$	Disseminated subgroup: VAC associated with higher ten-week wound-closure odds, OR 6.5; 95% CI 1.1–37.4.	Subgroup analysis with imprecise estimates; nonrandom treatment selection.
Mahmood et al., 2023 (17)	Prospective nonrandomized comparison; Egypt; $n=30$	Colostomy versus no colostomy: mean hospitalization 9.5 versus 29.9 days; healing 16.5 versus 42.9 days; both $P<0.001$.	Extensive perianal disease; control participants declined colostomy; no deaths occurred.
Eray et al., 2015 (18)	Retrospective comparative cohort; Turkey; $n=48$	Catheter versus colostomy: total hospitalization 24.1 versus 40.5 days, including stoma-related readmissions; $P=0.008$.	Preserved sphincters and no rectal injury; initial hospital stay difference was nonsignificant.

Discussion

The principal implication is that emergency care organization needs to prioritize rapid surgical source control alongside recognition and physiological stabilization, reflecting consistent timing associations across FG cohorts. Broader NSTI

data supports this interpretation: a meta-analysis associated surgery within six hours with mortality of 19%, compared with 32% after six hours. Its inclusion of infections outside the perineum limits direct numerical extrapolation to FG, while reinforcing the clinical importance of avoiding preventable delay. These timing associations

establish urgency within the available observational evidence; they do not define a safe waiting period for patients requiring immediate exploration (19).

Diagnostic testing is most useful when it resolves uncertainty or delineates extension while surgical assessment proceeds concurrently (4,7). The frequency of fascial gas in a confirmed-case CT series does not equal sensitivity in an unselected ED population, because patients without FG were absent from that study (8). The absence of a significant CT associated delay in one institution does not establish equivalent workflow performance across hospitals with different imaging access and operating capacity (9). Prognostic indices inform the assessment of disease severity, while low scores provide no validated basis for withholding surgical consultation when clinical suspicion persists (5,10,11).

Initial treatment requires immediate intravenous vancomycin plus piperacillin–tazobactam or a carbapenem, with resuscitation guided by perfusion and organ dysfunction (6,20). Sepsis guidance supports prompt antimicrobial administration in septic shock, crystalloid resuscitation, and norepinephrine as the first-line vasopressor when indicated (20). These recommendations complement FG source control, without providing FG specific comparative evidence for a particular resuscitation volume or antimicrobial combination (6,20). The antibiotic duration study supports stewardship after adequate source control, rather than restriction of empiric coverage during the initial undifferentiated emergency presentation (6,14).

Evidence for HBOT remains less secure than the evidence supporting urgent surgery and antimicrobials (6,15,21). A Cochrane review identified no eligible randomized trials of HBOT for necrotizing fasciitis, preventing a trial based estimate of benefit or harm (21). A subsequent FG meta-analysis, available online in January 2026,

reported lower mortality across thirteen retrospective studies, alongside inconsistent findings for hospitalization and debridement frequency (22). These findings support uncertainty about the incremental causal benefit of HBOT and the importance of avoiding transfers that postpone definitive surgery (7,21,22). VAC and diversion decisions similarly depend on wound extent, contamination, sphincter integrity, and local expertise after initial source control (7,16–18).

Interpretation is constrained by retrospective designs, small samples, treatment allocation according to clinical circumstances, and inconsistent outcome measurement across the primary reports. Potential overlap between imaging cohorts further restricts estimation of an independent combined sample size (8,9). Survival associations from adjunctive cohorts also remain sensitive to differences in severity, access to centers, and the timing of treatment selection (15,16). Future studies require multicenter prospective recruitment, standardized presentation-to-incision timestamps, explicit adjustment for severity and transfers, and outcomes encompassing survival, wound healing, functional recovery, and the burden of additional procedures.

Conclusion

Fournier's gangrene requires coordinated emergency recognition, immediate antimicrobial treatment, physiological stabilization, and prompt surgical debridement. Available evidence consistently associates earlier source control with improved survival. CT assists anatomical assessment in selected patients, while prognostic indices describe severity without excluding disease. Antimicrobial duration after source control remains a separate decision from initial empiric coverage. HBOT, VAC, and fecal diversion require individualized selection because their supporting evidence largely reflects nonrandomized

comparisons. An effective ED pathway integrates early surgical consultation, parallel resuscitation, and timely operating access.

List of abbreviations

Abbreviation Definition

CI	Confidence interval
CT	Computed tomography
ED	Emergency department
FG	Fournier's gangrene
FGSI	Fournier's Gangrene Severity Index
HBOT	Hyperbaric oxygen therapy
NSTI	Necrotizing soft tissue infection
OR	Odds ratio
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
VAC	Vacuum-assisted closure

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