



Home Parenteral Nutrition in Adults: Catheter Complications, Quality of Life and the Cost of Getting Follow-Up Wrong

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Abstract

Catheter-related infection is the commonest serious complication of home parenteral nutrition, and the reported rate spans a twelve-fold range. A systematic review of 39 studies found bloodstream infection rates between 0.38 and 4.58 episodes per 1,000 catheter days, median 1.31, and reported extensive variability in the terminology and definitions used, to the point that ten of the thirty papers giving a rate could not be categorised at all. The denominator moves the figure too: one cohort reported 0.91 episodes per 1,000 total catheter days and 1.49 per 1,000 nutrition days. Device type matters more than either, with 1.91 for peripherally inserted catheters against 0.63 for tunnelled and none recorded for implanted ports. Where a standardised protocol was applied in a high-risk oncology population, the rate was 0.54 per 1,000 nutrition days.

Keywords: Home parenteral nutrition; Catheter-related bloodstream infection; Intestinal failure; Venous access; Follow-up

Introduction

Home parenteral nutrition sustains patients whose gastrointestinal tract cannot absorb sufficient nutrition, delivering it through a central venous catheter in the patient's own home [1,2]. It converts a condition that would otherwise require indefinite hospital admission into one managed largely by the patient and family [3].

The catheter is both the mechanism and the principal hazard. Catheter-related infection is described across this literature as the most common and most serious complication, alongside thrombosis, occlusion and mechanical problems [4,5]. Because patients on long-term therapy usually receive tunnelled catheters or implanted ports, with peripherally inserted catheters preferred only where the expected duration is limited to twelve to eighteen months, device selection is itself a long-term decision [4].

This review examines what infection rates have been reported and why they vary so widely, how far device type and care protocol account for the variation, and what the reported

complications imply for the organisation of follow-up.

Objective

This review sets out to establish four things from the published literature. First, the reported range of catheter-related infection rates and how much of that range is attributable to definition rather than to practice. Second, how the choice of denominator alters the figure within a single cohort. Third, whether device type and standardised care protocols explain the remaining variation. And fourth, what has been reported about complications that follow-up arrangements are positioned to detect or to miss.

Literature Review

The reported range: A systematic review screened four databases for studies published between 1970 and March 2012 and included 39. After re-categorising the definitions used, the overall catheter-related bloodstream infection rate ranged between 0.38 and 4.58 episodes per 1,000 catheter days, with a median of 1.31 (Figure 1) [6]. Gram-positive bacteria of human skin flora caused more than half of infections, which the authors take as evidence that hand hygiene and training remain essential [6].

REPORTED INFECTION RATE ACROSS 39 STUDIES

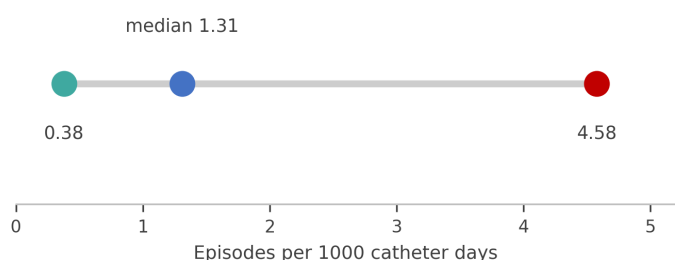


Figure 1: Reported infection rate across 39 studies [6]

How much of that range is definitional: The same review reported extensive variability in terminology and definitions as well as in how the rate was expressed. Thirty of the 39 studies, or 77 per cent, reported an overall infection rate, using three different terms for it; ten of those thirty gave no clear definition and could not be re-categorised at all [6]. The authors conclude that the included studies were of low quality and used poorly described risk factors and differing definitions [6].

The denominator moves the number: A quality improvement initiative collected data on 141 central venous catheters in 89 adults, covering 25,273 total catheter days and 15,474 nutrition days. Bloodstream infection was 0.91 episodes per 1,000 total catheter days and 1.49 per 1,000 nutrition days in the same cohort (Figure 4) [7]. The difference is arithmetic rather than clinical, and reviews reporting one convention cannot be compared directly with those reporting the other.

THE SAME COHORT UNDER TWO DENOMINATORS

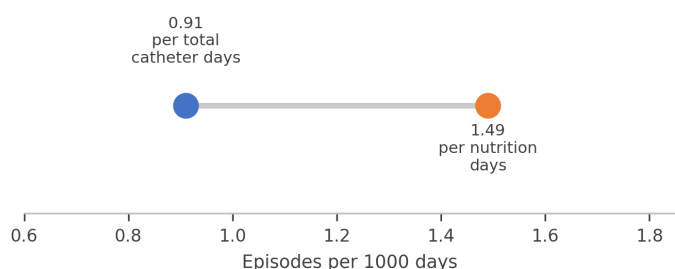


Figure 4: The same cohort expressed under two denominators [7]

Device type explains a substantial part: In that cohort, 63 per cent of catheters were peripherally inserted, 27 per cent tunnelled and 10 per cent implanted ports. Infection rates were 1.91 per 1,000 total catheter days for peripherally inserted

catheters, 0.63 for tunnelled and zero for ports; per 1,000 nutrition days the figures were 2.61 and 0.76, with no episodes in ports (Figure 2). Rates were significantly greater for peripherally inserted than tunnelled catheters on both denominators, at $p = 0.023$ and $p = 0.011$ [7].

INFECTION RATE BY CATHETER TYPE

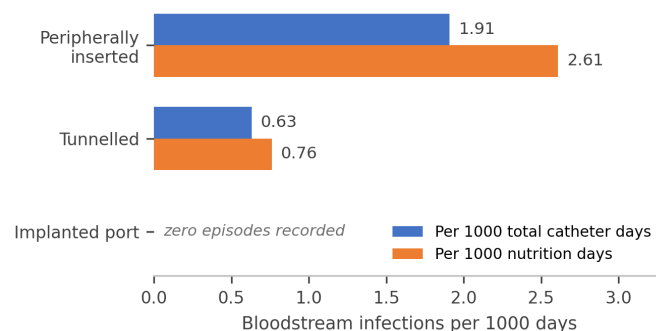


Figure 2: Infection rate by catheter type [7]

Table 1: Bloodstream infection by device type in 141 catheters [7]

Device	Per 1000 catheter days	Per 1000 nutrition days
Peripherally inserted	1.91	2.61
Tunnelled	0.63	0.76
Implanted port	None recorded	None recorded
All devices	0.91	1.49

Non-infectious complications behaved differently: In the same initiative, the rate of non-infectious complications did not differ significantly between tunnelled and peripherally inserted catheters, and was zero for ports. Infection rates were greater for multiple than single lumen catheters, though not significantly so [7].

Where protocol is standardised: A cohort of 335 patients with advanced solid tumours managed under a standardised catheter maintenance protocol used 408 venous access devices over 29,403 nutrition days, of which 206 were ports, 191 peripherally inserted and 7 tunnelled (Figure 3). Sixteen infection episodes were recorded, giving an overall incidence of 0.54 per 1,000 nutrition days (95% CI 0.32 to 0.86). Median time from starting nutrition to infection was 43.5 days, and no variable was significantly associated with incidence on univariate analysis [8].

Presentation can be subtle: A prospective survey of the 42 adults enrolled at one centre since its opening recorded catheter-related sepsis 39 times, a rate of 3 per 1,000 days of therapy, confirmed by both peripheral and central blood cultures in 37 of the 39. In 56 per cent of patients clinical signs were discrete, delaying diagnosis [11].

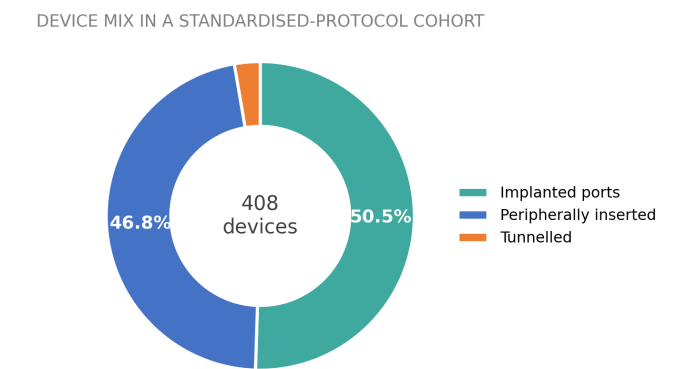


Figure 3: Device mix in a standardised-protocol cohort of 335 patients [8]

A centralised model of oversight: A cohort study of 126 adults with advanced cancer receiving palliative parenteral nutrition used a centralised model discharging patients remotely from an oncology centre across a wide geographic area. Median distance between the patient's home and the intestinal failure centre was 17.5 kilometres, with an interquartile range of 10.9 to 39.1 and a maximum of 317.4 (Figure 6). Twenty-eight patients, 22 per cent, experienced at least one complication, most commonly catheter occlusion and electrolyte abnormality, and the infection rate was 0.49 per 1,000 catheter days [9].

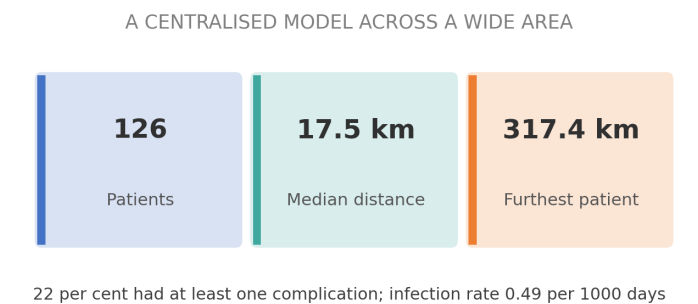


Figure 6: Outcomes under a centralised model of oversight [9]

Complications that go undetected: A cohort of non-oncological patients hospitalised for catheter-related bloodstream infection recorded 23 infections over 51,563 days of therapy, a rate of 0.45 per 1,000. In 10 of the 23 episodes, or 43.5 per cent, pulmonary lesions compatible with septic pulmonary embolism were identified (Figure 5). The authors conclude that infection can produce asymptomatic embolism with lung infiltrates and suggest checking for secondary lung infection when selecting antimicrobial therapy [10].

Table 2: Why reported infection rates span a twelve-fold range

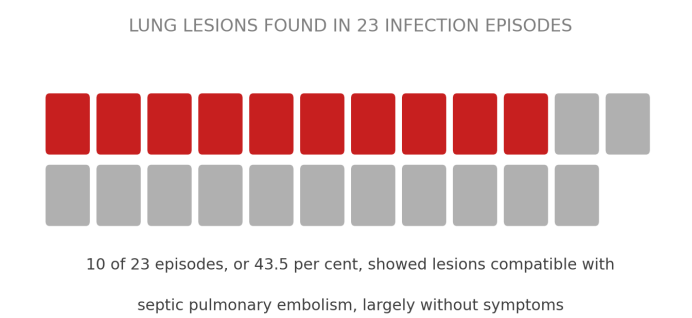


Figure 5: Lung lesions identified in 23 infection episodes [10]

Source of variation	Effect on the reported rate
Definition of infection	Three terms in use; ten papers uncategorisable [6]
Choice of denominator	0.91 against 1.49 in one cohort [7]
Device type	1.91 against 0.63 against none [7]
Standardised protocol	0.54 in a high-risk population [8]
Study quality	Included studies judged low quality [6]

Quality of life on long-term therapy: Reviews of quality of life in adults treated with long-term parenteral nutrition describe consistent impairment relative to population norms [20,21], and an international study measured it across multiple countries [21]. Qualitative work has explored the experience of living with the therapy directly [22], and a review of its impact on daily life sets out the practical burden [19]. Whether affiliation with a national support and education organisation improves outcomes has been examined separately [34].

Wider complication profiles: A systematic review examined both infectious and non-infectious catheter complications in this population [31], and registry data from a national cohort reported infection outcomes at scale [32]. Radiological patterns of catheter-related complications have been described [23], and a prospective study covering more than 51,000 catheter days characterised complications in cancer patients [24]. Parenteral nutrition itself has been examined as a risk factor for catheter infection independent of the home setting [33], and environmental risk factors were followed over six years [26]. Vascular access and its related complications have been reviewed as a distinct topic [27].

Locking solutions and prevention: Randomised trials have compared taurolidine with saline locking in patients on home parenteral support [28] and taurolidine-citrate-heparin against placebo in intestinal failure [29], both addressing recurrent infection. Earlier work reported taurolidine as an antimicrobial lock for recurrent infection [13] and a reduction in children after starting a taurolidine lock [30]. Dressing change frequency has been assessed in Cochrane review [12], prevention and treatment of implanted catheter sepsis reported after six years of practice [25], and risk factors for recurrent sepsis analysed directly [15].

Epidemiology of bloodstream infection associated with parenteral nutrition has been summarised separately [14].

Outcome by underlying indication: Benchmarking of outcomes on home parenteral nutrition for benign intestinal failure has been carried out against a European prospective survey [16], while prognosis in incurable cachectic cancer patients was followed prospectively in 414 patients [17]. Systematic review with meta-analysis has examined survival, quality of life and cost-effectiveness in inoperable malignant bowel obstruction [18]. Risk factors for developing infection have been analysed in a dedicated study [5]. These populations differ in expected duration of therapy, which bears directly on how their infection rates should be compared [16,17].

Method

Search strategy: PubMed and the archives of the major clinical nutrition, infectious disease and intestinal failure journals were searched for studies of complications in adults receiving home parenteral nutrition. Search terms combined home parenteral nutrition with catheter-related bloodstream infection, central venous access, complications and quality of life. Reference lists of the systematic review [6] and the quality improvement report [7] were screened by hand for primary sources.

Eligibility: Studies were included if they reported infection or complication rates in defined adult populations receiving home parenteral nutrition, or examined the influence of device type or care protocol. Oncological and non-oncological cohorts are both included and are identified as such, since duration of therapy and underlying risk differ between them.

Data extraction and handling: Population, device types, the denominator used, the definition of infection where stated, and the reported rate were extracted as published. The denominator is stated alongside every rate, because catheter days and nutrition days differ by roughly two thirds in one cohort and the distinction is rarely made explicit when figures are quoted. This review reports published findings and does not constitute guidance on device selection, catheter care or the management of infection in any individual patient, all of which are matters for the treating team. No pooling or re-analysis was performed. Figures 1 to 6 and Tables 1 to 3 reproduce published values only. This is a narrative synthesis of published literature and was not registered as a systematic review.

Concluding Remarks

A twelve-fold range in a headline safety statistic is a finding about the literature before it is a finding about patients. Rates from 0.38 to 4.58 per 1,000 catheter days were reported across 39 studies, and the reviewers state that terminology and definitions varied so widely that ten of the thirty papers giving a rate could not be categorised at all [6]. Any single figure quoted from this literature carries that uncertainty whether or not it is acknowledged.

Two sources of variation are avoidable and one is not. The denominator is arithmetic: the same cohort reported 0.91 and 1.49 depending on whether total catheter days or nutrition days were used, and stating which was applied costs nothing [7]. Definitions are equally fixable by convention. Underlying patient risk is not, and separating it from the first two requires the first two to be standardised first [6,7].

Device type is the clearest modifiable factor in the reviewed evidence. Peripherally inserted catheters carried roughly three times the infection rate of tunnelled ones, significantly so on both denominators, and no episodes were recorded in implanted ports [7]. That said, the port group was small at 10 per cent of catheters, and zero events in a small denominator is a weaker result than the same rate in a large one [7].

The protocol evidence points the same way and is arguably more encouraging. A cohort of 335 patients with advanced solid tumours, a population one would expect to fare badly, recorded 0.54 infections per 1,000 nutrition days under a standardised maintenance protocol, at the favourable end of the published range [8]. No variable was significantly associated with incidence on univariate analysis, which is consistent with protocol adherence compressing the differences between patients [8].

On follow-up, the cost named in the title is visible in what goes undetected rather than in what goes wrong. Clinical signs were discrete in 56 per cent of patients with sepsis at one centre, delaying diagnosis [11], and pulmonary lesions compatible with septic embolism were present in 43.5 per cent of infection episodes in another, largely without symptoms [10]. A follow-up arrangement calibrated to obvious presentation will miss both.

The centralised model offers a partial answer and defines its own limit. Oversight from a specialist centre delivered a rate of 0.49 per 1,000 catheter days across a population whose median distance from that centre was 17.5 kilometres and whose furthest patient lived 317 kilometres away [9]. Twenty-two per cent still experienced a complication, most often occlusion or electrolyte disturbance, which are precisely the problems that routine contact rather than proximity is positioned to catch [9].

Three limitations belong with these conclusions. The systematic review covers publications to 2012 and its authors judged the included studies to be of low quality, so the range it

reports may overstate variation achievable under current practice [6]. The device comparison derives from 141 catheters at a single service, with only 14 ports, so the zero rate in that group rests on few catheter days [7]. And the oncology cohorts had a median therapy duration of 54 days, far shorter than in benign intestinal failure, so their favourable rates should not be transferred to patients treated for years [8,9].

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Conflict of Interest

The authors declare no competing interests.

Ethics Statement

This article reviews previously published studies only. No new patient data were collected and no participants were recruited, so ethical approval was not required.

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