

# This Week's Citation Classic™

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**Maki D G, Goldmann D A & Rhame F S. Infection control in intravenous therapy. *Ann. Intern. Med.* 79:867-87, 1973.**

[Hosp. Infections Sect., Bacterial Dis. Br., Epidemiol. Program, Ctr. for Dis. Control, Health Serv. and Mental Health Admin., HEW, Atlanta, GA, and Harvard Med. Serv., Boston City Hosp., MA]

The intravenous infusion has become indispensable in modern medical therapy, but infection, especially infusion-related septicemia, remains a life-threatening hazard. This review pointed out the magnitude, clinical and microbiological profile, and epidemiology of infections complicating intravenous therapy and provided specific recommendations for prevention of these infections. [The SC<sup>19</sup> indicates that this paper has been cited in over 200 publications since 1973.]

Dennis G. Maki  
Section of Infectious Diseases  
Department of Medicine  
University of Wisconsin Medical School  
Madison, WI 53792

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"Although intravenous therapy had been in wide use in hospitals throughout the world for over 35 years, it was not until the late 1960s that it began to be recognized that intravenous cannulas were a major cause of serious iatrogenic infection, usually with *Staphylococcus aureus*. I became interested in the problem of nosocomial (hospital-acquired) infection and, particularly, bacteremias deriving from intravascular devices during a two-year appointment as an Epidemic Intelligence Service Officer with the US Center for Disease Control (CDC) in Atlanta, Georgia, between 1969 and 1971.

"For nearly six months in 1970-1971, we worked 100 hours per week in wide-ranging investigations of an extraordinary nationwide epidemic caused by the contaminated intravenous products of one US manufacturer.<sup>1-3</sup> This outbreak awakened medicine to the considerable potential of intravenous therapy to produce life-threatening iatrogenic disease. Our investigations demonstrated conclusively that intravenous fluid could become contaminated, during its manufacture or during administration in the hospital, by gram-negative bacilli, particularly *Enterobacter* species, and produce devastating bacteremic illness. The source of the epidemic was ultimately traced to the company's manufacturing plants where, paradoxically, microorganisms in the plant environment were being introduced into intravenous products after the autoclaving stage of production.<sup>4</sup>

"By July, I was back in Boston resuming my post-graduate training in internal medicine and infectious diseases at Harvard Medical School. Most of

my free time away from my residency training at the Massachusetts General Hospital that year was spent completing manuscripts dealing with research done at CDC during the preceding two years.

"By 1972, ever-increasing numbers of patients in US hospitals were receiving infusion therapy in some form, no longer simply for administration of fluid and electrolytes and blood products, but increasingly for delivery of parenteral drugs, hemodynamic monitoring, or hyperalimentation (total parenteral nutrition)—which had recently been introduced into clinical practice. Moreover, knowledge of the nature and magnitude of nosocomial infections complicating intravenous therapy and, especially, measures to reduce the risk of these infections was rapidly advancing. It was apparent to me and two of my former CDC coworkers, Frank Rhame and Don Goldmann, yet at CDC in the second year of their appointments as Epidemic Intelligence Service Officers, that a well-written review could greatly enhance awareness of the risk of infusion-related infections and help improve hospital infection control practices aimed at prevention.

"Thus, during a serendipitously quiet weekend in the spring of 1972 while on-call as the hospital senior medical resident, between occasional calls to assist interns or provide consultation on surgical patients, working around the clock, I wrote the first draft of the needed review, including incorporation of the nearly 300 citations. I sent the manuscript to my two CDC colleagues who further added to and revised the paper, after which we submitted it to the *Annals of Internal Medicine*. Edward Huth, editor of the *Annals*, called me several weeks later to say that his editorial board liked the paper and wanted to publish it, but would like us to also submit an accompanying short article summarizing our recommendations for prevention of infection in intravenous therapy, which we did.<sup>5</sup>

"We have been gratified by the reception the paper has received through the years. We believe it achieved our goals and has been frequently cited in great measure because of its timing: the 1970-1971 nationwide outbreak was yet painfully fresh in the minds of American infection control personnel, and there was a clear-cut need for a comprehensive review of this newly recognized iatrogenic health care problem. All of us have remained in academic medicine and are actively involved in research on the epidemiology of nosocomial infection. I have continued to pursue the increasingly complex problem of infection related to intravascular devices and have published several updated reviews."<sup>6,7</sup>

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7. Maki D G. Infections associated with intravascular lines. (Swartz M & Remington J, eds.) *Current topics in clinical infectious disease*. New York: McGraw-Hill, 1982. p. 309-63.