



Control and prevention measures for legionellosis in hospitals: A cross-sectional survey in Italy

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ABSTRACT

Risk assessment, environmental monitoring, and the disinfection of water systems are the key elements in preventing legionellosis risk.

The Italian Study Group of Hospital Hygiene of the Italian Society of Hygiene, Preventive Medicine, and Public Health and the Italian Multidisciplinary Society for the Prevention of Health Care-Associated Infections carried out a national cross-sectional survey to investigate the measures taken to prevent and control legionellosis in Italian hospitals.

A multiple-choice questionnaire was developed, comprising 71 questions regarding hospital location, general characteristics, clinical and environmental surveillance, and control and preventive measures for legionellosis in 2015. Overall, 739 hospitals were enrolled from February to June 2017, and 178 anonymous questionnaires were correctly completed and evaluated (response rate: 24.1%). The survey was conducted using the SurveyMonkey® platform, and the data were analyzed using Stata 12 software.

Of the participating hospitals, 63.2% reported at least one case of legionellosis, of which 28.2% were of proven nosocomial origin. The highest case numbers were reported in the Northern Italy, in hospitals with a pavilion structure or cooling towers, and in hospitals with higher numbers of beds, wards and operating theaters. Laboratory diagnosis was performed using urinary antigen testing alone (31.9%), both urinary antigen testing and single antibody titer (17.8%), or with seroconversion also added (21.5%). Culture-based or molecular investigations were performed in 28.8% and 22.1% of the clinical specimens, respectively.

The water systems were routinely tested for *Legionella* in 97.4% of the hospitals, 62% of which detected a positive result (> 1000 cfu/L). *Legionella pneumophila* serogroup 2–15 was the most frequently isolated species (58.4%). The most common control measures were the disinfection of the water system (73.7%), mostly through thermal shock (37.4%) and chlorine dioxide (34.4%), and the replacement (69.7%) or cleaning (70.4%) of faucets and showerheads.

A dedicated multidisciplinary team was present in 52.8% of the hospitals, and 73% of the hospitals performed risk assessment. Targeted training courses were organized in 36.5% of the hospitals, involving nurses (30.7%), physicians (28.8%), biologists (21.5%), technicians (26.4%), and cleaners (11%).

Control and prevention measures for legionellosis are present in Italian hospitals, but some critical aspects should be improved. More appropriate risk assessment is necessary, especially in large facilities with a high number of hospitalizations. Moreover, more sensitive diagnostic tests should be used, and dedicated training courses should be implemented.

1. Introduction

The genus *Legionella* includes Gram-negative microorganisms living in natural and artificial water systems. These microorganisms are able to grow at 25–50°C, especially in backwater systems. Infected sources (e.g., faucets, showerheads, or cooling towers) can spread spray or droplets of water containing *Legionella*, leaving airborne particles of less than 5 µm in diameter that can be deeply inhaled.

These microorganisms can cause a severe form of pneumonia, known as Legionnaires' disease (LD), or a flu-like illness, the Pontiac fever, which is normally acquired by inhaling contaminated particles suspended in air (Montagna et al., 2006, 2014, 2017a; Rota et al., 2013). To date, about 60 species of *Legionella* are known. *Legionella pneumophila* (Lpn) is the species most frequently associated with human disease and includes 16 serogroups (sg). Though the literature states that Lpn sg 1 is the most common isolate in humans, an increasing number of cases are being attributed to other *Legionella* species and serogroups (ECDC, 2015; Napoli et al., 2010).

The association between potable water and nosocomial legionellosis was described for the first time approximately 40 years ago (Tobin et al., 1980). The complexity of hospitals' water systems and the vulnerability of hospitalized patients increase the risk for *Legionella* transmission and severe outcomes. A review of 27 LD outbreaks investigated by the Centers for Disease Control and Prevention from 2000 to 2014 indicated that health care-associated LD accounted for 33% of the outbreaks, 57% of the outbreak-associated cases, and 85% of the outbreak-associated deaths (Garrison et al., 2016; Soda et al., 2017). Only one case of probable person-to-person transmission has been reported (Correia et al., 2016). Currently, the hot water system is thought to be the most frequent source of cases or outbreaks of LD in hospitals (Borella et al., 2008; Montagna et al., 2017b; Napoli et al., 2010).

In Italy, according to the National Surveillance System for LD, the

number of cases has been steadily increasing, from 192 cases in 2000 to 1710 cases in 2016. Most of these cases are community-acquired, followed by those that are travel-associated and then those that are associated with health care (5.3% in 2015). Overall, the case fatality rate in Italy ranges from 8% to 17% (ISS, 2016; Rota et al., 2013). Clinical outcomes are affected by comorbidities, with mortality ranging from 40% to 80% among untreated immunocompromised patients, and from 5% to 30% with appropriate therapy (ISS, 2016; Rota et al., 2013).

In 2000, the Italian Institute of Health issued its first guidelines for the prevention and control of legionellosis. These were followed by instructions for laboratories involved in microbiological diagnosis, environmental control, tourist accommodation, and spas in 2005. In 2015, all of the national recommendations, including those for hospitals, were incorporated in a single updated document (Linee, 2015). These instructions list risk assessment evaluation as one of the most effective prevention measures to manage *Legionella* spp. contamination in water systems. This is particularly relevant in hospitals because, in addition to the water system, health practices concerning the airways (e.g., ventilation, aspiration, devices for artificial respiration and oxygen therapy, and dental tools) can increase the risk of infection (Castiglia et al., 2008; Pasquarella et al., 2010, 2012; Montagna and De Giglio, 2018). Nevertheless, the control and prevention of legionellosis remain critical issues in Italian health care settings. These guidelines are considered reference documents and not compulsory protocol for prevention, and very little is known about their implementation.

In light of this situation, the Italian Study Group of Hospital Hygiene of the Italian Society of Hygiene, Preventive Medicine, and Public Health (GISIO-SIH) and the Italian Multidisciplinary Society for the Prevention of Health Care-Associated Infections (SIMPRIOS) conducted a national survey to i) collect information about specific measures for legionellosis control and prevention adopted in Italian hospitals; ii) identify the critical aspects of LD control and prevention; and iii) plan

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