Utilities Policy 53 (2018) 15–24

Contents lists available at ScienceDirect

Utilities Policy

journal homepage: www.elsevier.com/locate/jup

Water safety plans by utilities: A review of research on implementation

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ARTICLE INFO

Keywords:
Drinking water quality
Risk assessment
Water safety plans
Water utilities

ABSTRACT

Water supply is essential to public health, quality of life, environmental protection, economic activity, and sustainable development. In this context, it is imperative to assure the continuous improvement of all processes and practices conducive to guarantee water quality and safety. Water Safety Plans (WSPs) by water utilities are an important public policy tool to accomplish these goals. This manuscript reviews the international evidence of the adoption and implementation of water safety planning and reports the current situation in Portugal, as part of the necessary adjustment of the national legal framework to the publication of the Directive (EU) 2015/1787, October 6th, on water quality for human consumption. The aim is to draw lessons from several successful WSP experiments around the world and extract lessons from these cases when drafting new legislation in Portugal and elsewhere. Findings suggest there are four critical dimensions and key elements of success in developing and implementing WSPs: leadership commitment, technical knowledge, governance, and interagency collaboration.

1. Introduction

Water supply is essential to public health, quality of life, environmental protection, economic activity, and sustainable development. Typically, water supply is a service provided by natural monopolies regulated by states to conform to several principles, namely universality, continuity, efficiency, equity in pricing, and adequacy in quantity and quality (ERSAR, 2017).

In this context, it is imperative to design and implement all water safety requirements and use the most efficient and effective methods to achieve the continuous improvement of water quality. The development of technical knowledge and growing concerns about public health and the environment have combined and contributed to positive recent developments in the water sector in many countries (WHO, 2011).

Water Safety Plans (WSPs) are an important public policy tool in this scenario, as it is possible to observe the existence of successful experiments documented in several case studies around the world. This review aims to contribute to a better understanding of this tool in the context of the water policy sector by discussing the methodology proposed by the World Health Organization (WHO) for the development and implementation of WSPs. We draw on the lessons learned from case studies in the literature to suggest four common dimensions: 1) the systematic identification of risks and the definition and formalization of procedures and activities to minimize/mitigate them; 2) a focus on monitoring and reporting, improved document management and increased technical understanding of the water supply system as a whole; 3) external communication, translated into an increase in stakeholder satisfaction, especially end users, as well as the improvement of internal communication in the utility organization; and, 4) the involvement of working teams, commitment of management bodies and interagency collaboration. All these aspects are to be considered when drafting new legislation concerning water safety.

In this paper, we review the international experience with water safety planning, and investigate and report the case of the Portuguese water sector. Following the transposition of the Directive (EU) 2015/1787, October 6th, on water quality for human consumption into the national legal framework, the expectation is that the legislation will require the mandatory implementation of WSPs and/or risk assessment procedures by all Portuguese water utilities. The description of the case is preceded by the characterization of the water sector and water policy in Portugal. This case description contributes to an improved understanding of the national circumstances and the country's standing in this new paradigm of risk management in water supply. The strategic approach to the implementation of water safety planning at the national level should allow policymakers, and especially water utility management bodies, to develop a more effective risk assessment process and management of water supply systems.

The lessons learned and the recommendations gathered from this study, will surely be of use to other countries that, like Portugal, are still in the process of implementing this risk assessment methodology. This methodology is expected to constitute a future mandatory requirement for all water utilities, in Europe and worldwide.

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https://doi.org/10.1016/j.jup.2018.06.001
Received 3 October 2017; Received in revised form 1 June 2018; Accepted 1 June 2018

The paper proceeds as follows. The second section provides a historical background of the water safety policy problem. Next, we review the empirical literature on water safety planning by separately focusing on developed and developing countries and identifying the main factors affecting implementation. The fourth section presents a description of the water sector in Portugal and provides an illustration of the introduction of WSPs as the initial response of water utilities to European and national level legislation. Section five proposes a set of recommendations and section six concludes and suggests avenues for future research.

2. Background

Ensuring the quality of drinking water from a public water supply system is an essential component of public health policies (Vieira and Morais, 2005), as well as of a wide range of environmental policies.

Until the early twentieth century, drinking water quality was assessed primarily through its organoleptic characteristics. However, due to the inherent unreliability of this process, parametric rules were implemented to secure water intended for human consumption. It is in this context that technical and legal means have been developed to ensure the disinfection of water in public supply systems. The control of diseases caused by microbiological contamination transmitted by water was improved in a large scale (Vieira and Morais, 2005).

In 1958 the WHO publishes the first International Standards for Drinking Water, specifically dedicated to the quality of water for human consumption. Subsequent revisions were published in the 1980s, namely the three volumes of the first edition of the Guidelines for Drinking Water Quality (GDWQ): Vol 1 - Recommendations; Vol. 2 - Health criteria and other supporting information; and Vol. 3 - Surveillance and control of community supplies.

This approach was a breakthrough in public health protection, providing an assessment of health risks originated in microorganisms, chemicals, and radionuclides. Furthermore, this methodology was the basis for setting public policies and regulatory procedures in many countries, and it remains, in most of them, the basis for quality control of water for human consumption.

In the European Union, the first Directive focusing on this subject was published in 1980 (Directive 80/778/EEC of the Council, July 15th). Subsequently, Directive 98/83/EC of the Council, November 3rd, incorporated the technical and scientific advances at the time, focusing on the obligation of compliance with key quality parameters. In Portugal, Law-Decree No. 243/2001, September 5th, transposed into national law the Directive 98/83/EC, and established that water quality for public supply should rely on the detection of microbiological, physical, chemical and radiological undesirable constituents, potentially dangerous to human health. This is accomplished through the analysis of the compliance of results with the standard parametric values established by law. However, this “end of the line” approach had many serious limitations, and the evidence supported the conclusion that there was no certainty regarding the quality of water supplied to the final consumer (Vieira and Morais, 2005).

These limitations justified the introduction of technical management methodologies based on risk assessment and risk control at critical points of the supply system. The application of principles of risk assessment and risk management in the production and distribution of water for human consumption complements “end of the line” compliance monitoring, enhancing water quality assurance and public health protection (Fewtrell and Bartram, 2001). The provision of safe water for human consumption requires concerted action and structured control throughout the supply system, from the source of raw water to the consumer's tap (Vieira and Morais, 2005).

Despite the overall positive results achieved over the past years, several issues were raised and became the foundation for legislative changes, namely the repeal of Law-Decree No. 243/2001, September 5th, and the publication of Law-Decree No. 306/2007, August 27th. This legal change reformulated the framework of water quality for human consumption based on diagnosed improvement needs and the experience of the previous framework.

However, the recent amendment to Directive 98/83/EC – Directive (EU) 2015/1787, of October 6th, introduced significant changes and generated a critical reflection by the Administration and the scientific community regarding water quality and the strategies to promote concerted control and structured action throughout the water supply system.

In fact, while risk assessment was already included in the previously Directive, it is the 2015 Directive that explicitly mentions WSPs for the first time. The concept of a WSP appears in 2004 following the Berlin Conference on Water Resources Law. It is part of the WHO recommendations for drinking water quality, specifically in the GDWQ publication, introducing a new approach to risk management of water supply for human consumption. Similarly to what happened in the past with other WHO recommendations, there is a gradual trend to incorporate this methodology in national and international legal norms addressing safe drinking water supply.

In the international framework, standards EN 15975-1:2011 + A1:2015 (E) and standard EN 15975-2:2013 are fundamental building blocks in the preparation of water supply policies, particularly in terms of water safety. These standards incorporate key elements of the WHO approach concerning water safety planning. Since WSPs are based on a risk management approach, they help to avoid potential damage to supply levels. The aim is to support water utilities in actively addressing security issues in the context of routine management and operation of the water supply system.

Lastly, the Hazard Analysis and Critical Control Points (HACCP) is an internationally recognized methodology that helps the food and beverage industry to identify risks and legal compliance. The principles and guidelines for the implementation of HACCP were adopted by the *Codex Alimentarius Commission* and became the scientific basis for identifying specific hazards and measures to control them in order to ensure water safety. In fact, as stated by Hamilton et al. (2006), the majority of WSPs published are based on adapted HACCP procedure forms.

3. Risk management and water safety plans

Risk management is a key activity in utility sectors. The effort to understand and evaluate risk and to design and enforce preventive measures to improve risk control is a fundamental requirement (Pollard et al., 2004, cited by Hrudey et al., 2006). If the goal of risk management in the water supply sector is to ensure water safety, then it becomes crucial to understand the concept of water safety in relation to the goals underlying water safety planning. The first subsection addresses these concepts and goals, the second and third review existing literature in developed and developing countries, respectively, and the fourth discusses the key factors affecting the adoption and implementation of WSPs.

3.1. Water safety: concepts and goals

Hrudey et al. (2006) introduced the concept of safety as “a level of risk so negligible that a reasonable, well-informed individual need not be concerned about it, nor find any rational basis to change his/her behavior to avoid such a small, but non-zero risk.” (p. 949). In practice, water safety means that it does not represent a risk to human consumption in the form of death or serious illness. While affluent nations already have reached the highest standards in this regard, the achievement of such goals in developing countries still represents a significant challenge (Hrudey et al., 2006).

From the perspective of drinking water, and given our current capability for reducing risk, this notion of safe drinking water should mean that we do not expect to die or become seriously ill from drinking