



# Drivers and barriers among householders to managing domestic wastewater treatment systems in the Republic of Ireland; implications for risk prevention behaviour



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## SUMMARY

Septic systems that are malfunctioning, improperly sited or designed, present a contamination risk to drinking water sources, and subsequently, to human health. However, the international literature identifies gaps in householder knowledge regarding the function and maintenance requirements of septic systems, and also the potential health and environmental risk implications. Allied with householder fears related to the financial cost of risk management, these factors tend to reduce concern to recognise a malfunctioning system. In the Republic of Ireland, three-quarters of households in rural areas utilise an individual domestic wastewater treatment system (or septic system). Consequently, a significant portion of rural households that rely on groundwater sources via private-well use are at risk. Ireland reports one of the highest crude incidence rates of Verotoxigenic *Escherichia coli* (VTEC) infection in the European Union, and waterborne transmission related to contact with untreated or poorly treated water from private water sources is a factor in its transmission. Following recent Irish legislative change that places a duty of care on individual householders to ensure a proper system functioning, this exploratory study examines perceptions towards the risk management of septic systems among Irish householders. Using qualitative research methods, four focus groups selected on the basis of geographical variation, and two semi-structured interviews were conducted. While most householders agreed that poorly maintained septic systems represented a threat to the environment and to public health, none reported to having a regular maintenance routine in place. Thematic analysis revealed the drivers and barriers to septic system maintenance, and preferences of householders pertaining to communication on septic systems. The Health Belief Model is employed to help understand results. Results suggest that householder capacity to engage in regular risk management is reduced by limited perceptions of risk susceptibility and severity, impeding cues to action and barrier concerns. Understanding societal perceptions is central to effectively engaging with the public, and informing an improved approach to future pro-environmental engagement and behaviour.

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## 1. Introduction

Domestic wastewater treatment systems (DWWTS) (referred to as septic systems from hereon) are commonly used around the world as collection systems for the treatment and disposal of domestic wastewater. Because connection to a main sewerage system is unavailable, costly or impractical, septic systems are predominantly located in rural areas. Figures from Australia, for example, show that an estimated 20% of Australian householders utilise septic systems for their wastewater management (Gunady

et al., 2015), and this figure rises to approximately 25% for American households (Mallin, 2013). In Ireland, one-third of households rely on septic systems (Central Statistics Office, 2012).

Septic systems that are poorly functioning, improperly sited or designed, present a contamination risk to aquatic ecosystems, drinking water sources, and subsequently, human health (Hynds et al., 2012; Dubber and Gill, 2014; Withers et al., 2013). Malfunctioning septic systems can be attributed to sagging inlet drains due to system design and undersized system tanks, and blockages in, or inadequate drainage fields. In addition, however, failure to regularly de-sludge the system tank, is often the most common reason for malfunctioning (Butler and Payne, 1995; Moelants et al., 2008). Although domestic septic systems pose less risk of eutrophication

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than point source pollution from municipal sewerage systems and diffuse pollution from agriculture; their impacts can cause localised problems including elevated risk of waterborne disease. Indeed, a number of studies link disease outbreaks to the contamination of drinking water from septic system effluent (Birkhead and Vogt, 1989; Karanis et al., 2007; Borchardt et al., 2012).

### 1.1. Domestic wastewater treatment systems in Ireland

One-third of the Irish population (29.5%/418,033 households) utilise an individual septic system (Central Statistics Office, 2012), although owing to Ireland's dispersed settlement pattern, this figure rises to over three-quarters of households in rural areas (Scott, 2005). Considering over 200,000 rural households in Ireland rely on groundwater sources, via private wells, for drinking water supply (Central Statistics Office, 2012), a considerable portion of the rural population is at risk from contaminated groundwater. Indeed, Ireland reports one of the highest crude incidence rates of verotoxigenic *Escherichia coli* (VTEC) infection in the European Union, with infections most common in rural locations (Health Service Executive, 2013). Waterborne transmission related to contact with untreated or poorly treated water from private water sources is a dominant factor in transmission of VTEC in Ireland (O'Sullivan et al., 2008; Garvey et al., 2010; Health Protection Surveillance Centre, 2013). VTEC can result in severe diarrhoea and abdominal cramps, with children, older adults and individuals with prior illnesses most at risk, and severe cases can result in kidney problems (Health Protection Surveillance Centre, 2013).

### 1.2. Household-level barriers for failing to maintain septic systems

In general, there exists a limited body of both quantitative and qualitative research internationally on householder perceptions and understanding of the risks associated with malfunctioning septic systems, and the need for system maintenance. A small number of studies have highlighted gaps in householder knowledge concerning the function of their system and related maintenance requirements (Nunn and Ross, 2006; Alexander et al., 2008; Naughton and Hynds, 2013), the potential health and environmental risk implications (Arnold and Gallasch, 2001; Campbell and Foy, 2008), an inability to recognise a malfunctioning system (Arnold and Gallasch, 2001) and householder concerns related to the financial cost of risk management (Butler and Payne, 1995; Alexander et al., 2008; Naughton and Hynds, 2013). Indeed, Naughton and Hynds (2013) identified that 15% of respondents to their household survey of septic system users in Ireland inaccurately believed that rainwater, and/or surface water, should be discharged into their system. There is often a disconnection between what householders perceive in terms of their septic system, and the actual extent to which their system is functioning adequately. Additionally, householders are often only concerned about their system when there is an obvious breakdown (Alexander et al., 2008). Butler and Payne (1995, 422) report how 'ignorance or negligence on the part of the owner' contributes to systems not being desludged. The contention is also put forward that householders may choose to avoid the expense of desludging until indicators emerge that suggest a malfunction (Butler and Payne, 1995).

### 1.3. A National Inspection Plan

In 2012, Ireland was brought before the European Court of Justice for failing to implement and comply with aspects of the Waste Framework Directive. In response, the Irish government introduced legislative provisions (Water Services (Amendment) Act 2012) to provide for a new risk-based approach towards the registration and inspection of septic systems in Ireland, thereby placing a duty

of care on individual householders to ensure the proper functioning of their system through the carrying out of self-inspections. Arising from this, Ireland's Environmental Protection Agency launched a National Inspection Plan (NIP) for Domestic Waste Water Treatment Systems (Environmental Protection Agency, 2013). The Plan includes an inspection regime that prioritises targeting septic systems in high risk areas (i.e. geographical areas of hydro-geological vulnerability based on the EPA's risk ranking methodology), and a public engagement strategy aimed at advising, educating, and assisting householders on septic system related risks, maintenance requirements and their responsibilities as owners (Environmental Protection Agency, 2013). The inspection regime set out to conduct 1000 inspections annually; however, all owners of septic systems nationwide were required to register their system. Though no formal co-ordinated communications or engagement strategy was developed at a nationwide level, each local authority in the country was charged with the responsibility of implementing engagement activities.

In the first year of inspection, nearly half ( $n = 476$ ) of the 987 inspections carried out failed the inspection, with de-sludging the main contributing reason for failure, followed by operation and maintenance issues (Environmental Protection Agency, 2015). Just over half (52%) of sites with private wells failed inspection – these householders thus form a particularly at-risk group, especially those located in high risk areas (Environmental Protection Agency, 2015). As of June 2014, some 1.7 million leaflets were distributed, in efforts to increase public awareness. Nevertheless, there was no nationwide, uniform approach to information dissemination and public engagement, as different methods and forms of householder engagement were being implemented in each of the 31 local authorities. These approaches ranged from information articles and adverts in newspapers and on local authority websites, radio interviews, and leaflet distribution, to social media campaigns, the provision of information packs, and the circulation of email/letters to system owners.

### 1.4. Understanding risk perception

The limited body of evidence on householders' perception of their septic system suggest an underlying lack of awareness of the health and environmental risks associated with malfunctioning septic systems. A risk can be broadly defined as a "probabilistic event of various magnitudes that can be augmented or mitigated by various actions or circumstances" (Palenchar and Heath, 2007, 120). Although definitions of risk generally encompass risk calculability, probability and the consequences of that risk, there are often significant discrepancies between expert and lay risk perspectives (Slovic, 1987; Black and Baldwin, 2012). Expert perceptions of risk are influenced by quantitative risk assessments (Slovic, 1987; Slovic and Peters, 2006). Lay risk perception, however, is shaped by how people evaluate and interpret probable exposure to threats, and the potential consequences that may occur (Slovic, 1987, 2000; Aven and Renn, 2009), while drawing on personal emotions and experiences, prevailing social norms and values. Indeed, the perceived nature of the risk can influence how that risk is perceived and responded to (emotionally, cognitively and behaviourally), by lay individuals (Slovic, 1987; Bennett, 1998; Covelto and Sandman, 2001). For example, Sandman (1987) and Aakko (2004) point out that risks which are seen to be voluntary, domestic, random, familiar, and of natural origin are perceived as lower risks, while risks regarded as involuntary/forced upon the population, exotic, direct, unfamiliar, and of human origin, or an industrial source, are perceived as higher risks. Further, Sandman (1987) contends that when approaches to risk management are perceived as unfair, or the source of the risk is regarded as untrustworthy, risk perceptions are heightened. A number of theoretical explanations

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