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Inclusion of drinking water source and testing questions into electronic medical records: advancing environmental medicine and public health outreach in New Jersey

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Abstract

Chronic arsenic exposure is associated with adverse health outcomes, and early life exposure is particularly damaging. Households with pregnant people and young children drinking from unregulated wells in arsenic-prevalent regions are therefore a public health priority for outreach and intervention. A partnership between Columbia University, New Jersey government partners, and Hunterdon Healthcare has informed Hunterdon County residents of the risks faced from drinking arsenic-contaminated water and offered free well testing through a practice-based water test kit distribution and an online patient portal outreach. Encouraged by those successes, Hunterdon Healthcare incorporated questions about drinking water source and arsenic testing history into the electronic medical record (EMR) template used by most primary care practices in Hunterdon County. The new EMR fields allow for additional targeting of risk-based outreach

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Supplemental Digital Content
Infographic, fact sheet, baby brochure

and water test kit distribution, offering promising new opportunities for public health and environmental medicine outreach, surveillance, and research.

Keywords

private well; domestic well; water testing; drinking water; arsenic; healthcare providers; environmental medicine; public health outreach; environmental public health

Introduction

Domestic well water in the United States remains excluded from protections under the federal Safe Drinking Water Act. A thin patchwork of local and state laws have emerged to fill this longstanding regulatory gap, although most of the 45 million Americans relying on private wells for drinking water remains unprotected.¹ Consequently, residents relying on domestic wells in most places must be aware, willing, and able to take the range of protective actions required – from testing to treatment to maintenance of treatment systems – to ensure their water is safe from common microbiological and chemical contaminants.²⁻⁴ Arsenic is frequently naturally occurring in groundwater⁵ and chronic exposure is of particular public health concern because of its strong associations with numerous adverse cardiovascular, cancer, and developmental effects.^{6,7} Early life exposure can be particularly damaging and households with pregnancies and young children are a priority group for public health outreach about well testing, the first step towards reducing exposure.

In New Jersey, a pioneering state law requiring testing during real estate transactions since 2002 has identified arsenic as one of the most frequent contaminants of domestic well water.⁸ In Hunterdon County, NJ, this is a serious public health concern as high dependence on domestic wells for drinking water coincides with widespread contamination due to local geology.⁹ Over 16% of wells in the county exceed the state standard (5 µg/L), including up to 70% in some municipalities.¹⁰

Public-private collaboration for environmental public health

Through a Superfund Research Program (SRP) on the health effects and geochemistry of arsenic, Columbia University developed strong ties to New Jersey government partners through longstanding collaborations investigating barriers to private well testing and treatment and testing community outreach strategies. This partnership expanded in 2016 to include Hunterdon Healthcare, the primary medical system in the county, to leverage healthcare providers as trusted messengers and offer patients with private wells free drinking water tests for arsenic. The original effort included offering free water test kits through medical practice-based distribution and online through patient portal messages, promoted by a public multimedia campaign to reach families with pregnant individuals and children in areas most at risk of arsenic contamination.¹¹

Encouraged by these successes in reaching households at risk, Hunterdon Healthcare has since incorporated two questions about drinking water source and well arsenic testing history into the pediatric and adult templates of the electronic medical record (EMR) used

by most primary care practices in the county. When patients report having a private well that has not been tested for arsenic, clinicians now have the option to print off copies of an “Arsenic in New Jersey” infographic, key facts sheet, or a “baby brochure” about the health effects of water contaminants and the importance of testing drinking water (see supplemental content). The new EMR fields also allow for more targeted risk-based outreach to Hunterdon Healthcare patients without relying on clinicians to independently identify households at risk and were the impetus for the latest effort reported here.

Patient portal outreach

Similar to the patient portal message campaign reported previously,¹¹ a new arsenic testing offer was sent out to 546 Hunterdon Healthcare patients through the online portal in April 2021, again to coincide with Earth Day. This time patients were selected specifically based on the new EMR fields about drinking source and arsenic testing history. Eligibility for the testing offer was determined based on individuals in the EMR who reported having a private well that has not been tested for arsenic and lived in a zip code with known arsenic contamination based on available state data.¹⁰ Eligible recipients received a generic email notification to check their portal inbox; they had to actively log in to the platform to see the subject and content of the message, which included brief information about the local risks of arsenic in well water, the opportunity for free and confidential testing, and that affordable treatment systems are available in the case their water has elevated levels of arsenic. Less than 20% of recipients (n=101) actually opened the message to see the testing offer, which is consistent with the original portal message blast from 2018.¹¹ Patients who read the message were provided with a link to request a free test kit by mail. All test kits included two small sampling vials, gloves, and a pre-paid return package to Columbia University’s lab. Participants received full test results for their samples including additional guidance on next steps if their water exceeded the drinking water standard for arsenic or any other tested parameter.

Direct mail outreach

Given the low opening rate of portal messages, test kits were provided in bulk to Hunterdon Healthcare to be directly mailed to the remaining 445 patients that had not seen the portal message but were known from the EMR to have an untested private well at home. The kits mailed by Hunterdon Healthcare included a note on their letterhead explaining the water testing collaboration and why the package was mailed to them unsolicited. The Columbia University researchers did not have access to patient identity information during the outreach process and so were not able to conduct any follow up with those who were mailed a test kit but did not submit water samples.

Results

Of 101 portal messages opened within the first month (Figure 1), 51 (50%) requests for test kits were submitted through the online form. Of the 51 test kits mailed out, 35 (69%) were returned to the laboratory within the requested time period, resulting in a participation rate of 35% among message recipients. Of the approximately 445 kits mailed out directly to

patients, 117 were returned with samples within the requested period, a participation rate of over 26%.

In total, 152 of the 546 targeted private wells previously untested for arsenic were screened through this outreach effort, an overall participation rate of 28%. Among screened wells, 17 (11.2%) were found to have concentrations of arsenic exceeding 5 µg/L, with a maximum concentration measured of 20.4 µg/L. Another 9% of wells had arsenic concentrations between 3 and 5 µg/L, levels at which annual testing for arsenic is recommended given temporal variability.¹²

Implications for Policy and Practice

- Environmental health risks such as drinking water contamination can be easily overlooked by primary health care systems that lack insight into individual vulnerability and exposure.
- Partnerships with medical systems allow for targeting public health messaging to individuals and families based on known geographic (e.g., residence in a high-arsenic zip code), and biological (e.g., pregnancy or young children) vulnerabilities.
- Incorporating fields on drinking water source and testing history into electronic medical records in areas of high reliance on private water supply facilitates ongoing risk-targeted outreach, both in-person by healthcare providers and through online patient portals.

Discussion and Conclusion

The new EMR records allowed for targeting outreach to households at high risk of drinking arsenic-contaminated water – based on their location, water source, and testing history, and alerted 31 families of arsenic levels that exceed or are at risk of exceeding the state maximum contaminant level. Whereas our original large-scale portal campaign had resulted in about 12% of opened messages converting into a kit request,¹¹ targeting based on specific private well and testing status resulted in a 50% conversion rate to a kit request, suggesting this may be a promising outreach strategy once more patients have completed these fields in the EMR. However, the low opening rate is a limitation of the portal message system, since by design patients are not able to tell from their email notification what they are being contacted for. As this platform is leveraged more widely for communication purposes it is possible that engagement increases as people are more comfortable with the system, but it is also possible that such notifications are more easily ignored unless they become more specific.

Given the small remaining sample of eligible participants for this project, we were able to boost testing participation by directly mailing test kits to those who were otherwise unaware of this opportunity due to missing the portal message. Although overall engagement with the testing offer was lower than desired, the combination of targeting based on relevance (have an untested well, live in an at risk area) and a trusted messenger (healthcare provider)

likely helped to boost participation to more than double that of alternative cold outreach strategies,¹³ and can be more cost-effective for screening wells than blanket outreach when resources are limited. Recommendation by a clinician during an in-person meeting could be more effective for the distribution of water sampling kits and effective screening.¹⁴ However, we previously observed that competing priorities for attention during brief patient interactions makes it difficult to rely on healthcare providers to be the primary screeners and messengers of risk.¹¹ An updated EMR system that makes it easier for clinicians and health systems to identify patients at risk and that reminds and gives clear guidance, including how to link patients to relevant public testing programs, should help to reduce some of those obstacles and improve the sustainability of such efforts going forward.

Despite ongoing interest to integrate environmental health and electronic information for public health work,¹⁵ EMR systems that capture individual environmental health risk factors are still rare. Yet they can provide the foundation for many other promising public health research, surveillance, and outreach opportunities relevant to persistent challenges in environmental medicine as well as the growing challenges for communities posed by climate change.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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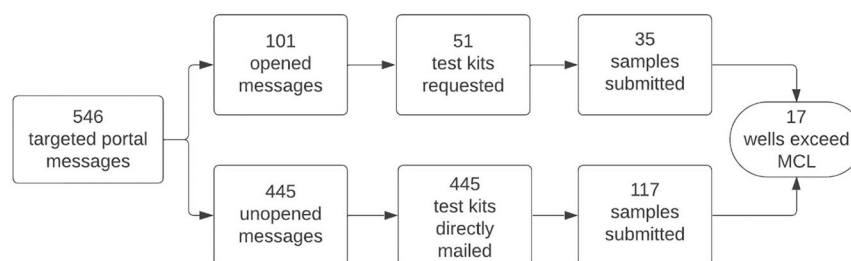


Figure 1:
Overview of outreach efforts and participation. MCL=Maximum Contaminant Level (5 µg/L arsenic)