



## LOTI Assistive Technology Research - Smart Water Bottles

Research conducted for the London Office of Technology and Innovation  
by [Anneliese Levy](#), [Thoughtful Content](#), 9 Oct 2020.

### Objective

To help inform a specific pilot being proposed by LOTI boroughs on the use of smart water bottles (those which include a mechanism to remind users to drink) to improve hydration and thereby help reduce hospital admissions of care home residents.

### Background

Dehydration can lead to severe long term health problems, particularly in the elderly.<sup>1</sup> Older people are at higher risk of dehydration, in part because of age-related physiological changes.<sup>2</sup> There may also be external factors and a 2018 study showed that 20% of older people living in UK care homes were dehydrated.<sup>3</sup>

### Smart water bottles

It's sometimes useful for staff to monitor the fluid intake of care home residents.<sup>4</sup> Simple methods such as charts designed by care home staff, can be effective interventions in themselves e.g. in reducing the amount of urinary tracts infections requiring hospital admission.<sup>5</sup> Technological solutions such as 'smart' bottles, wearables or smartphone apps have been proposed as alternative methods of recording fluid intake.

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<sup>1</sup> Hydration and Older People in the UK: Addressing the Problem, Understanding the Solutions Dr Lisa Wilson On behalf of the Parliamentary Hydration Forum November 2014

<https://ilcuk.org.uk/wp-content/uploads/2018/10/Hydration-and-older-people-in-the-UK-2.pdf>

<sup>2</sup> Volkert, D et al. ESPEN guideline on clinical nutrition and hydration in geriatrics. ESPEN GUIDELINE| VOLUME 38, ISSUE 1, P10-47, FEBRUARY 01,

2019[https://www.espen.org/files/ESPEN-Guidelines/ESPEN\\_GL\\_Geriatrics\\_ClinNutr2018ip.pdf](https://www.espen.org/files/ESPEN-Guidelines/ESPEN_GL_Geriatrics_ClinNutr2018ip.pdf)

<sup>3</sup> Hooper L., Bunn D.K., Downing A., Jimoh F., Groves J., Free C., Cowap V., Potter J.F., Hunter P.R., Shepstone L. Which frail older people are dehydrated? The UK DRIE study. J. Gerontol. A Biol. Sci. Med. Sci. 2016;71:1341–1347.

<sup>4</sup> The TOOLKIT Improving hydration among older people in care homes and the community. Developed through collaboration between Kent Surrey and Sussex Academic Health Science Network, Wessex Academic Health Science Network and NE Hants and Farnham CCG April 2016

<https://wessexahsn.org.uk/img/projects/Hydration%20toolkit%20V1.pdf>

<sup>5</sup> Reducing incidence of Urinary Tract Infections by promoting hydration in care homes. East Berkshire Clinical Commissioning Group (CCG). April 2018

<https://www.nice.org.uk/sharedlearning/reducing-incidence-of-urinary-tract-infections-by-promoting-hydration-in-care-homes>

Older people may have problems remembering to drink and accessing drinks,<sup>6</sup> smart devices and mobile apps can prompt the user to drink and provide them with information about their required and actual fluid intake.

## Research Findings

In general there is a lack of evidence about the efficacy of hydration interventions for older people.<sup>7</sup> Existing research tends to be only descriptive in nature, although some 'no-tech' or 'low tech' interventions such as high contrast red drinking jugs,<sup>8</sup> social settings for drinking<sup>9</sup> or use of a specialised 'hands free' bottle (Hydrate For Health)<sup>10</sup> have some evidence base.

In particular multicomponent interventions are recommended as the most effective especially ones including "high availability/varied choice/frequent offering of drinks, staff awareness of the need for adequate fluid intake, staff support for drinking and staff support in taking older adults to the toilet quickly and when they need it."<sup>11</sup>

Despite a fairly broad searching process only 4 studies of smart water bottles have been included in this review. Unfortunately, these studies do not explore the efficacy of smart water bottles in decreasing dehydration. Instead they provide only basic information for example that there are different systems/methods for operating the bottles (e.g. cloud or smart phone based)<sup>12</sup> and that there appears to be some

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<sup>6</sup> Citation: Bunn D et al (2019) Effective hydration care for older people living in care homes. *Nursing Times* [online]; 115: 9, 54-58. <https://www.nursingtimes.net/clinical-archive/nutrition/effective-hydration-care-older-people-living-care-homes-18-09-2019/>

<sup>7</sup> Bunn D., Jimoh F., Wilsher SH., Hooper L. (2015) Increasing Fluid Intake and Reducing Dehydration Risk in Older People Living in Long-Term Care: A Systematic Review. *Journal of the American Medical Directors Association*, 16, 101-113 13p.

<sup>8</sup> Dunne TE., Neargarder SA., Cipolloni PB., et al. (2004) Visual contrast enhances food and liquid intake in advanced Alzheimer's disease. *Clinical Nutrition*. 23, 533e538.

<sup>9</sup> Clearly S., Hopper T., Forseth M. (2008) Using routine seating plans to improve mealtimes for residents with dementia. *Canadian Nursing Home*. 19, 4-10

<sup>10</sup> Hydration and Older People in the UK: Addressing the Problem, Understanding the Solutions Dr Lisa Wilson On behalf of the Parliamentary Hydration Forum November 2014 <https://ilcuk.org.uk/wp-content/uploads/2018/10/Hydration-and-older-people-in-the-UK-2.pdf>

<sup>11</sup> Volkert, D et al. ESPEN guideline on clinical nutrition and hydration in geriatrics. *ESPEN GUIDELINE* VOLUME 38, ISSUE 1, P10-47, FEBRUARY 01, 2019 [https://www.espen.org/files/ESPEN-Guidelines/ESPEN\\_GL\\_Geriatrics\\_ClinNutr2018ip.pdf](https://www.espen.org/files/ESPEN-Guidelines/ESPEN_GL_Geriatrics_ClinNutr2018ip.pdf)

<sup>12</sup> SmartStuff: A case study of a smart water bottle Conference Paper in Conference proceedings: ... Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Conference · August 2016

demand for them,<sup>13</sup> and that adults do ‘interact; with them.<sup>14</sup> Whilst it is possible that relevant evidence may be found with a more extensive and systematic review over a longer time period, at present there is no strong evidence that smart water bottles increase hydration for older people living in care homes.

However, one ongoing study of smart water bottles in people at risk of kidney stones, showed promising results. This is a randomised control trial, that showed evidence of increased fluid intake for people in the intervention arm.<sup>15</sup> It is worth noting that the participants were on average in their 40s, so the results are unlikely to be transferable to a care home setting, as cognitive and physical effects of ageing are likely to impact on smart water bottle use.

There is some recent and ongoing research exploring the use of ‘hydration apps’ in care home settings. One qualitative study looked at implementing an app that care workers could use to monitor resident’s fluid intake, in 5 care home settings in England.<sup>16</sup> While the app was generally well received, there were some technical glitches and issues with fitting the app into the routine of the care home. Again, this study did not measure the effect of the intervention on hydration amongst residents.

North Somerset Council report on prototype testing of different tech to encourage hydration include cups and bottles that use visual and sound reminders, but with very small sample sizes (n=2) and with no measurement of increases in hydration.<sup>17</sup> They are currently rolling out a hydration app by use for care workers – this will include resident’s ‘hydration story’ (drinking preferences and needs), to enable care workers to better support them with hydration. There are plans to include a hydration monitoring feature, such as a cup if the initial phase is successful.

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<sup>13</sup> A Smart Water Bottle for New Seniors: Internet of Things (IoT) and Health Care Services. *International Journal of Bio-Science and Bio-Technology* Vol.7, No.4 (2015), pp.305-314

<http://dx.doi.org/10.14257/ijbsbt.2015.7.4.30>

<sup>14</sup> Jovanov E. Wearables Meet IoT: Synergistic Personal Area Networks (SPANs). *Sensors* (Basel). 2019;19(19):4295. Published 2019 Oct 3.

doi:10.3390/s19194295 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6806600/>

<sup>15</sup> Stout, T et al. Utilization of a smart water bottle to increase fluid intake in stone formers *The Journal of Urology*, Volume 201 Issue Supplement 4 April 2019

<https://www.auajournals.org/doi/10.1097/01.JU.0000555198.85152.f6>

<sup>16</sup> Steven A, Wilson G, Young-Murphy L. The Implementation of an Innovative Hydration Monitoring App in Care Home Settings: A Qualitative Study. *JMIR Mhealth Uhealth*. 2019;7(1):e9892. Published 2019 Jan 29. doi:10.2196/mhealth.9892 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6371068/>

<sup>17</sup> Social Care Digital Innovation Programme Implementation Phase Application Discovery Phase Review Hydration Innovation North Somerset Council. <https://www.local.gov.uk/sites/default/files/documents/North%20Somerset%20Discovery%20Phase%20Review.pdf>

Finally, two studies of technology to improve hydration in other populations showed mixed results. A content analysis of 'water apps' to reduce urological disease, concluded that they can be helpful in reminding people to drink, but need to include more educational content<sup>18</sup>. Again, this study was not measuring the efficacy of these apps on fluid intake and may not be applicable to care home setting, as no data was analysed in terms of demographics of app users.

More relevant, is a study of people with mild cognitive impairment/dementia in a lab-based setting, which found that a smartphone reminder app led to greater completion of a drinking task than in a control group.<sup>19</sup> This was a very small sample and needs repeating in a real-world context.

In conclusion, it appears that there is currently limited evidence based for any technology interventions to support older people in care homes with hydration. Based on the evidence for kidney-stone formers, it seems possible that smart water bottles could have a positive impact but this would need to be validated by further research, preferably with a control group. Some limited research shows that hydration apps may have promise – particularly ones that involve care workers. However, again this needs further testing in control studies to explore efficacy. It seems that reasons for dehydration are complex, for example many elderly people may be physically capable of drinking, but may fail to drink because of multiple cognitive problems, including poor initiation, decreased motivation, and impaired memory.<sup>20</sup>. Therefore any intervention needs to be designed and tested with the complex needs in mind.

## Methodology

The following resources were searched:

- Cochrane Database of Systematic Reviews (CDSR)
- MEDLINE PubMed.gov ([pubmed.ncbi.nlm.nih.gov/](http://pubmed.ncbi.nlm.nih.gov/))
- National Institute for Health and Care Excellence (NICE Evidence Search; [www.evidence.nhs.uk/](http://www.evidence.nhs.uk/))
- Social Care Online <https://www.scie-socialcareonline.org.uk/>

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<sup>18</sup> Philip-McKenzie Y, Jamnadass E, Hameed BZ, et al. A content analysis of 'Water Apps' and prevention of urological diseases: Do apps really help?. *Cent European J Urol.* 2020;73(2):187-192. doi:10.5173/ceju.2020.0136

<sup>19</sup> Katherine Hackett, Sarah Lehman, Ross Divers, Matthew Ambrogi, Likhon Gomes, Chiu C. Tan & Tania Giovannetti (2020) Remind Me To Remember: A pilot study of a novel smartphone reminder application for older adults with dementia and mild cognitive impairment, *Neuropsychological Rehabilitation*

<sup>20</sup> Menten, J.C.: A typology of oral hydration: problems exhibited by frail nursing home residents. *J. Gerontol. Nurs.* 32(1), 13–19 (2006)

To look for 'grey literature' GoogleScholar and a number of relevant websites were also searched (see Appendix 1). The primary search strategy was designed using the MEDLINE PubMed platform, using a combination of keywords and MeSH terms, and then adapted for use in the additional databases and websites. Searching was iterative as new keywords and possible sources were discovered during the process.

An initial 182 papers were screened for relevance, duplicates were removed and papers were excluded if they did not focus on an intervention to improve hydration and were not published in English. A final 9 papers were read in full, abstracts were read where no full text was available.

Papers were rapidly assessed as per quality standards for realist synthesis. For example whether they helped answer the research question; and their rigour – whether the method used to generate that particular piece of data is credible and trustworthy.<sup>21</sup> They are briefly described in terms of study type, sample size and context:

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<sup>21</sup>QUALITY STANDARDS FOR REALIST SYNTHESIS, 2014  
[https://www.ramesesproject.org/media/RS\\_qual\\_standards\\_researchers.pdf](https://www.ramesesproject.org/media/RS_qual_standards_researchers.pdf)

## The use of smart water bottles

<b>Title</b>	<b>A Smart Water Bottle for New Seniors: Internet of Things (IoT) and Health Care Services</b>
<b>Summary</b>	Korean study that involved a survey exploring water intake behaviours and attitudes of 60 people aged 50-60 years. Based on findings the authors designed a smart water device, The bottle was synched to an app and could also automatically detect water volume and had an alarm function to alert users when it is time to consume water. The alarm offered a planning function, which enables the recording and management of water intake details, then rewards users with membership points. The authors also propose a business model, which involves hospitals purchasing the bottle and prescribing it to clients.
<b>Source type and quality</b>	It is difficult to ascertain from this paper whether a prototype was actually made/tested. This is not an intervention study and the efficacy of the proposed water bottle for increasing hydration is not tested.
<b>Source</b>	International Journal of Bio-Science and Bio-Technology Vol.7, No.4 (2015), pp.305-314 <a href="http://dx.doi.org/10.14257/ijbsbt.2015.7.4.30">http://dx.doi.org/10.14257/ijbsbt.2015.7.4.30</a>

<b>Title</b>	<b>SmartStuff: A Case Study of a Smart Water Bottle</b>
<b>Summary</b>	Conference paper describing a sensor-enabled smart water bottle. Testing different ways to implement use - via 'a personal body area network' which authors conclude is more power efficient, but means a smartphone has to be near the bottle throughout the day. A cloud-based solution allows access for a large number of users, but requires higher power consumption and significantly decreases battery life of the system.
<b>Source type and quality</b>	Case-study published as a conference paper Descriptive study - did not test impact of smart water bottle systems on hydration.

<b>Source</b>	SmartStuff: A case study of a smart water bottle Conference Paper in Conference proceedings: ... Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Conference · August 2016 <a href="https://www.researchgate.net/publication/309327285">https://www.researchgate.net/publication/309327285</a>
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<b>Title</b>	<b>Wearables Meet IoT: Synergistic Personal Area Networks (SPANs)</b>
<b>Summary</b>	A smart water bottle was tested on 11 people in Alabama , USA, aged 27 to 78 years. Users interacted with the bottle on average 15.3 times/day. Authors conclude that this would allow detection of physiological measures such as heartbeats.
<b>Source type and quality</b>	Pilot usability study, no control group, described as part of a broader review paper. Did not test the impact of smart water bottle systems on hydration.
<b>Source</b>	Jovanov E. Wearables Meet IoT: Synergistic Personal Area Networks (SPANs). Sensors (Basel). 2019;19(19):4295. Published 2019 Oct 3. doi:10.3390/s19194295 <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6806600/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6806600/</a>

<b>Title</b>	<b>Smart bottle work design using waterflow sensor based on Raspberry Pi and Android</b>
<b>Summary</b>	Indonesian case study of a smart water bottle design that is linked to an app with push reminders to drink. Technical study that describes the design e.g. the system used.
<b>Source type and quality</b>	Not an intervention study, only a technical description.
<b>Source</b>	A F Akbar and P Oktivasari 2019 J. Phys.: Conf. Ser. 1193 012007 <a href="https://iopscience.iop.org/article/10.1088/1742-6596/1193/1/012007/pdf">https://iopscience.iop.org/article/10.1088/1742-6596/1193/1/012007/pdf</a>

<b>Title</b>	<b>Utilization of a smart water bottle to increase fluid intake in stone formers</b>
<b>Summary</b>	<p>Prospective randomized controlled trial comparing the effect of standard advice about fluid intake to standard advice with a smart water bottle (<a href="#">HidrateSpark</a>). Reporting preliminary data on 77 participants aged 18+ with a history of kidney stones. Data on 42 participants show a mean age of 49.6 years in the intervention group and 45.7 years in the control group. HidrateSpark smart water bottle includes a sensor that records daily fluid intake, synced to the user's smartphone, to provide drinking reminders. Measures include a survey to assess barriers to achieving adequate fluid intake at baseline and 12 weeks. Plus a 24hr urine volume at baseline and 6 weeks. There was a greater 24 urine volume increase in the smart water bottle group (1.3L vs 0.8L). both groups report subjective increases in fluid intake (cups/day) (0.75 SB vs 1.11 DR). Fewer patients in the SB arm report not remembering to drink as the main factor limiting sufficient fluid intake compared to the DR arm (38 vs. 76%).</p>
<b>Source type and quality</b>	<p>Description of preliminary results of an ongoing randomised control trial. High quality study but results not yet analysed for statistical significance because research not completed. Possible COI/bias due to HidrateSpark funding.</p>
<b>Source</b>	<p>Conference abstract  Stout, T et al. The Journal of Urology, Volume 201Issue Supplement 4April 2019  <a href="https://www.auajournals.org/doi/10.1097/01.JU.0000555198.85152.f6">https://www.auajournals.org/doi/10.1097/01.JU.0000555198.85152.f6</a></p>



## The use of other tech for hydration reminders in care home settings

<b>Title</b>	<b>Hydration App – North Somerset Council</b>
<b>Summary</b>	Stakeholder engagement research indicated that a hydration management app would be a viable solution to improving hydration in care homes. This app would include a digitised version of a resident’s hydration story, which would be completed when an individual is admitted to the care home and updated at appropriate intervals. This would provide carers with all necessary information to support them in their caring role. If successful in the implementation phase, the project would like to develop the app further, to include a hydration monitoring feature, such as a cup. To monitor hydration levels of residents, and convey this data via Bluetooth to the app, eliminating the need for hydration records. From July to September 2020 the application will be fully tried and tested in one 78 bed care home in North Somerset. This work will focus on user experiences to ensure the application is usable and well received by both carers and residents.
<b>Source type and quality</b>	Descriptive/case study of a proposed solution, rather than an intervention or efficacy study.
<b>Source</b>	Social Care Digital Innovation Programme Implementation Phase Application Discovery Phase Review Hydration Innovation North Somerset Council. <a href="https://www.local.gov.uk/sites/default/files/documents/North%20Somerset%20Discovery%20Phase%20Review.pdf">https://www.local.gov.uk/sites/default/files/documents/North%20Somerset%20Discovery%20Phase%20Review.pdf</a> <a href="https://www.local.gov.uk/sites/default/files/documents/SCDIP%20North%20Somerset%20implementation%20phase%20update.pdf">https://www.local.gov.uk/sites/default/files/documents/SCDIP%20North%20Somerset%20implementation%20phase%20update.pdf</a> <a href="https://www.local.gov.uk/sites/default/files/documents/Laura%20Cresser.pdf">https://www.local.gov.uk/sites/default/files/documents/Laura%20Cresser.pdf</a>

<b>Title</b>	<b>Prototype hydration reminder testing in North Somerset care homes</b>
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<p><b>Summary</b></p>	<p>A number of prototype activities to increase hydration were tested out in care homes in North Somerset:</p> <ul style="list-style-type: none"> <li>• <a href="#">Droplet smart hydration reminder</a>, flashes and speaks to prompt hydration To test if visual and auditory prompts remind people to drink. Care staff reported that residents engaged and reacted well to the flashing light which successfully prompted them to drink. The light also prompted carers to remind residents to drink. They reported they would use the cup</li> <li>• <a href="#">Ulla hydration reminder</a>, flashes to prompt an individual to drink To test if a visual prompt reminds people to drink Feedback questionnaire about the light from users and staff. The resident was annoyed by the light and didn't like it on her cup.</li> <li>• Smart Cup which connects to an app and records how much water is consumed. To understand if a visual prompt is successful in reminding an individual to drink and to record the volume. Unfortunately care staff haven't succeeded in setting up the app to correspond with the cup, although they reported resident engagement with the flashing light which pro</li> </ul>
<p><b>Source type and quality</b></p>	<p>Very limited prototype testing, only conducted on 2 participants.</p>
<p><b>Source</b></p>	<p>Social Care Digital Innovation Programme Implementation Phase Application Discovery Phase Review Hydration Innovation North Somerset Council.  <a href="https://www.local.gov.uk/sites/default/files/documents/North%20Somerset%20Discovery%20Phase%20Review.pdf">https://www.local.gov.uk/sites/default/files/documents/North%20Somerset%20Discovery%20Phase%20Review.pdf</a>  <a href="https://www.local.gov.uk/sites/default/files/documents/SCDIP%20North%20Somerset%20implementation%20phase%20update.pdf">https://www.local.gov.uk/sites/default/files/documents/SCDIP%20North%20Somerset%20implementation%20phase%20update.pdf</a>  <a href="https://www.local.gov.uk/sites/default/files/documents/Laura%20Cresser.pdf">https://www.local.gov.uk/sites/default/files/documents/Laura%20Cresser.pdf</a></p>

<p><b>Title</b></p>	<p><b>The Implementation of an Innovative Hydration Monitoring App in Care Home Settings: A Qualitative Study</b></p>
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<p><b>Summary</b></p>	<p>Looking at the use of an app called 'Hydr8' in 5 care homes in England. The app can be used to input care home resident's hydration data. The app was generally positively received by staff, authors concluded that it increased person-centred care, communication and staff knowledge about hydration. However, there were problems with technical glitches and with fitting use into the daily routine of the care homes.</p>
<p><b>Source type and quality</b></p>	<p>Qualitative implementation study. Small study, specific geographical area. Did not actually measure impact of the app on resident's fluid intake</p>
<p><b>Source</b></p>	<p>Steven A, Wilson G, Young-Murphy L. The Implementation of an Innovative Hydration Monitoring App in Care Home Settings: A Qualitative Study. <i>JMIR Mhealth Uhealth</i>. 2019;7(1):e9892. Published 2019 Jan 29. doi:10.2196/mhealth.9892  <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6371068/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6371068/</a>  <a href="https://www.kingsfund.org.uk/sites/default/files/media/T2A_Gemma_Wilson.pdf">https://www.kingsfund.org.uk/sites/default/files/media/T2A_Gemma_Wilson.pdf</a></p>

## The use of other tech for hydration reminders in other settings

<b>Title</b>	<b>A content analysis of 'Water Apps' and prevention of urological diseases: Do apps really help?</b>
<b>Summary</b>	Content analysis of 51 mobile phone apps that aim to increase hydration e.g. through reminders and motivational cues. Authors conclude that while the apps may be useful in terms of prompting users to increase fluid intake, but lack information provision about hydration and health.
<b>Source type and quality</b>	Content analysis study - but used no framework/theory to systematically analyze the impact of the apps, just based on author's judgement. Did not measure the actual impact of the apps on fluid intake/behaviour.
<b>Source</b>	Philip-McKenzie Y, Jamnadass E, Hameed BZ, et al. A content analysis of 'Water Apps' and prevention of urological diseases: Do apps really help?. <i>Cent European J Urol.</i> 2020;73(2):187-192. doi:10.5173/cej.2020.0136 <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7407778/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7407778/</a>

<b>Title</b>	<b>Remind Me To Remember: A pilot study of a novel smartphone reminder application for older adults with dementia and mild cognitive impairment</b>
<b>Summary</b>	10 participants with mild cognitive impairment/dementia took part in a lab-based study to test the effectiveness of a smartphone reminder app. Participants were asked to make themselves a drink of water 4 times in two conditions, one where they received visual reminders/alarms from a smartphone and one without. Participants prepared themselves more glasses of water in the smartphone condition (93%) than in the unprompted condition (56%). Usability ratings were 'fair' among participants.
<b>Source type and quality</b>	Lab-based pilot study, within-participant, counterbalanced, cross-over design. Very small sample size and not 'real world' context. (Abstract only)

<b>Source</b>	Katherine Hackett, Sarah Lehman, Ross Divers, Matthew Ambroggi, Likhon Gomes, Chiu C. Tan & Tania Giovannetti (2020) Remind Me To Remember: A pilot study of a novel smartphone reminder application for older adults with dementia and mild cognitive impairment, <i>Neuropsychological Rehabilitation</i> . <a href="https://www.tandfonline.com/doi/abs/10.1080/09602011.2020.1794909">https://www.tandfonline.com/doi/abs/10.1080/09602011.2020.1794909</a>
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## Appendix 1: Search Strategy

Key/MeSH terms used:

- Smart water bottles, wearables, technology, smart watches
- Elderly, geriatric, care home, residential home
- Hydration/water/drinking reminders, alerts, sensor, Apps, voice assistants  
Assistive devices/technologies/device, assistive
- Hydration/dehydration

Databases/websites/other sources	Hits	Limits applied	Relevant
PubMed <a href="http://www.ncbi.nlm.nih.gov/pubmed/">http://www.ncbi.nlm.nih.gov/pubmed/</a>	2,200	Clinical Trial, Meta-Analysis, Randomized Controlled Trial, Review, Systematic Review, in the last 5 years.	44
Cochrane Database of Systematic Reviews	28	n/a	2
National Institute for Health and Care Excellence (NICE Evidence Search; <a href="http://www.evidence.nhs.uk/">www.evidence.nhs.uk/</a> )	1427	n/a	16
Social Care Online <a href="https://www.scie-socialcareonline.org.uk/">https://www.scie-socialcareonline.org.uk/</a>	73	n/a	26
GoogleScholar	2105	Since 2015	79
Kings Fund <a href="https://www.kingsfund.org.uk/">https://www.kingsfund.org.uk/</a>	37	n/a	2
Care Quality Commission <a href="https://www.cqc.org.uk/">https://www.cqc.org.uk/</a>	36	n/a	0
Royal College of Occupational Therapists <a href="https://www.rcot.co.uk/">https://www.rcot.co.uk/</a>	3	n/a	0
Royal College of Speech and Language Therapists <a href="https://www.rcslt.org/">https://www.rcslt.org/</a>	121	n/a	0

British Nutrition Foundation <a href="https://www.nutrition.org.uk/">https://www.nutrition.org.uk/</a>	22	n/a	2
British Assistive Technology Association <a href="https://bataonline.org.uk/">https://bataonline.org.uk/</a>	0	n/a	0
International Longevity Centre UK <a href="https://ilcuk.org.uk/">https://ilcuk.org.uk/</a>	4	n/a	2
Chartered Society of Physiotherapy <a href="https://www.csp.org.uk/">https://www.csp.org.uk/</a>	47	n/a	0
British Geriatrics Society <a href="https://www.bgs.org.uk/">https://www.bgs.org.uk/</a>	30	n/a	0
British Society of Gerontology <a href="https://www.britishgerontology.org/">https://www.britishgerontology.org/</a>	8	n/a	2
iiCUHTec: <a href="http://icuhtec.org/">http://icuhtec.org/</a>	0	n/a	0
Local Government Association <a href="https://www.local.gov.uk/">https://www.local.gov.uk/</a>	10	n/a	5
TEC Services Association <a href="https://www.tsa-voice.org.uk/">https://www.tsa-voice.org.uk/</a>	3	n/a	2
Global Disability Innovation (GDI) Hub <a href="https://www.disabilityinnovation.com/">https://www.disabilityinnovation.com/</a>	0	n/a	0
<a href="#">Digital Boomers</a> programme, Essex	0	n/a	0
Care England <a href="http://www.careengland.org.uk/">http://www.careengland.org.uk/</a>	4	n/a	1
National Care Forum <a href="https://www.nationalcareforum.org.uk/">https://www.nationalcareforum.org.uk/</a>	0	n/a	0
Digital Social Care <a href="https://www.digitalsocialcare.co.uk/">https://www.digitalsocialcare.co.uk/</a>	0	n/a	0
Tech for Care <a href="https://techforcare.co.uk/">https://techforcare.co.uk/</a>	2	n/a	0
NHS digital <a href="https://digital.nhs.uk/">https://digital.nhs.uk/</a>	14	n/a	1