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*Published in:*  
Journal of Frailty, Sarcopenia and Falls

*DOI:*  
[10.22540/JFSF-04-036](https://doi.org/10.22540/JFSF-04-036)

*Publication date:*  
2019

*Document Version*  
Publisher's PDF, also known as Version of record

[Link to publication in ResearchOnline](#)

*Citation for published version (Harvard):*  
Booth, J & Agnew, R 2019, 'Evaluating a hydration intervention (DRInK Up) to prevent urinary tract infection in care home residents: A mixed methods exploratory study', *Journal of Frailty, Sarcopenia and Falls*, vol. 4, no. 2, pp. 36-44. <https://doi.org/10.22540/JFSF-04-036>

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## Original Article

# Evaluating a hydration intervention (DRInK Up) to prevent urinary tract infection in care home residents: A mixed methods exploratory study

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**Objectives:** To investigate potential effects and acceptability of a theoretically driven hydration intervention (DRInK-Up), on the prevalence of urinary tract infections (UTIs), falls and emergency admissions in care home residents. **Methods:** A single group pre-post evaluation design to test the DRInK-Up intervention, to increase fluid intake by 200-400ml daily. The number of UTIs, falls and emergency hospital admissions for each resident recorded over the DRInK-Up intervention period were compared to rates in the 24 weeks prior. A qualitative investigation of experiences of DRInK-Up was undertaken using focus group interviews with care home staff to determine acceptability. **Results:** 24 care home residents took part in the intervention. There was a clinically meaningful, but non-statistically significant reduction in number of treated UTIs during the intervention period from 51 UTIs pre-DRInK-Up to 37 post-DRInK-Up ( $t = .498$ , 18df,  $p = 0.625$ ). The volume of fluid intake recorded was not correlated with number of UTIs ( $r = 0.103$ ,  $p = .676$ ). Falls reported dropped from 52 pre- to 28 post-intervention ( $t = 3.148$ , df 19,  $p = 0.005$ ). Emergency admissions did not change. Focus group interviews suggested goal setting was uncommon and took the form of externally generated targets for fluid intake rather than negotiated goals. Barriers to increasing fluid intake included resident-related factors or arose from the care home context. A range of facilitators included verbal persuasion, praise and reward. **Conclusion:** The DRInK-Up study provides preliminary evidence suggesting that increasing daily fluid intake by small amounts may have a potentially positive effect on number of UTIs experienced and number of falls in frail older care home residents. Further research is needed.

**Keywords:** Care homes, Fluids, Hydration, Urinary tract infection, Falls

**Introduction**

Urinary tract infection (UTI) is the most prevalent healthcare associated infection (HCAI) globally accounting for more than 40% of all bacterial nosocomial infections<sup>1</sup>. Among residents of nursing and residential care homes UTI is the most common HCAI and is the origin of the majority of antimicrobial prescriptions in these settings<sup>2,3</sup>. National prevalence surveys have shown 40-59% of all diagnosed care home HACIs to be UTIs, compared with 12-28% respiratory tract infections and 6-20% skin infections<sup>4-6</sup>. In particular, recurrent and complicated UTI, is common in frail older adults, of both genders<sup>4</sup>. Not only is there a higher prevalence of UTI with ageing but in the vulnerable care home population the individual clinical significance is higher<sup>7</sup>. Urinary infections cause increased morbidity and

mortality in the older population and are a major source of distress, discomfort and negative impact on quality of life<sup>7,8</sup>. Furthermore, for care home residents, UTI is associated with a number of serious potential consequences including increased rates of falls, delirium, emergency admissions to

*The authors have no conflict of interest.*

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**Edited by:** Dawn Skelton

**Accepted 31 May 2019**

hospital and an associated increased risk of death<sup>9,10</sup>.

Up to one third of so-called UTIs in nursing home residents are actually asymptomatic bacteriuria, which should not be treated with antimicrobial drugs<sup>11,12</sup>. Treating bacteriuria as a UTI is a form of misdiagnosis with potentially serious consequences as the widespread and indiscriminate use of antimicrobial therapy for treatment and prevention of UTIs has contributed to the emergence of progressively drug resistant organisms<sup>13</sup>. In turn this increases the risks for older adults of both adverse drug events and vulnerability to multi-drug resistant infections<sup>14</sup>. Thus UTI represents a significant issue for frail older adults and for wider health and care services and society as a whole.

Increased susceptibility to UTI in care home residents may be a direct result of increasing age, immobility and increasing levels of physical and mental impairment requiring higher levels of care by others<sup>15</sup>. There are also a number of urological risk factors including urinary retention and incomplete bladder emptying, atrophic urethritis/vaginitis, use of absorbent pads<sup>9</sup>, indwelling urinary catheters<sup>10</sup>, pelvic organ prolapse, urolithiasis and genitourinary tract malignancy<sup>9,16</sup>. However a risk factor for UTIs that is often overlooked is low fluid intake or chronic underhydration<sup>17</sup>. This may be described as a subclinical state of dehydration and occurs when an older adult does not adequately replenish fluids<sup>18</sup>. It is the most commonly occurring form of dehydration in care homes; prevalence of 50-92% of residents has been reported<sup>19-21</sup>. Inadequate fluid intake can result in concentrated, high osmolality urine and infrequent voiding, both of which are believed to encourage bacterial growth. This study hypothesised that increasing fluid intake may prevent UTI in frail older adults. The proposed mechanism of prophylaxis is that larger fluid volumes cause increased bladder activity overall as the bladder fills more rapidly and fully. The resulting mechanical 'flushing' of the urinary tract, with larger voided volumes at a potentially faster flow rate, will reduce the bacterial load. Furthermore, regular and frequent voiding will reduce urinary stasis and proliferation of bacteria in the residual urine in the bladder<sup>17</sup>. Dilution of urine, decreased osmolality and a reduced urinary bacterial count is a beneficial consequence of good hydration, allowing the older person's natural defence mechanisms to function effectively<sup>17</sup>. Directly addressing the common risk factor of chronic underhydration as a method to prevent recurrent UTI in care home residents is a novel, non-antimicrobial and potentially simple intervention, which has not been previously investigated. Therefore, the aim of this study was to establish potential effects of a hydration intervention (DRInK-Up) on the prevalence of UTI and falls in older care home residents and determine the acceptability of the intervention to residents, family carers and staff.

## Methods

This study was a single group pre-post intervention evaluation using a sequential explanatory mixed methods design.

## Participants

Care home residents aged 65 and over were recruited who had received antimicrobial treatment for a UTI in the previous six months and were able and willing to consent to participate, or for whom proxy consent was obtained. Residents were excluded if they had a medically prescribed restricted fluid intake, had heart failure or renal impairment where increased fluid intake was contraindicated, were 'Nil By Mouth' or their fluids were provided via enteral feeding tubes.

## Outcome measures

Prevalence of UTI (including separately identified catheter associated UTI), falls and emergency admissions to acute hospital during the previous six months were identified retrospectively from care home records (T-1). Demographic and clinical information was recorded at baseline (TO), including age, sex, primary medical condition, co-morbidities, clinical frailty scale<sup>23</sup> and cognitive status<sup>24</sup>.

A baseline 72-hour fluid intake chart was commenced for each participant and daily fluid balance charts were recorded by the care home staff. These detailed the amount, type and number of drinks taken and any fluid from foods such as soup or jelly. A urine sample was dipstick tested for specific gravity on each day of baseline and outcome monitoring (a total of 12 samples for each participant). The specific gravity of urine is a clinical indicator of hydration status and increases are an early warning of underhydration in frail older adults<sup>18</sup>.

The DRInK-Up hydration intervention was implemented (TO) and thereafter number of treated UTIs, falls and hospital admissions were recorded at three follow-up timepoints: 8 weeks (T1), 16 weeks (T2) and 24 weeks (T3). Care home monitoring data and individual resident medical and drug records were the data sources. Between 16 and 24 weeks after commencing the DRInK-Up intervention care home staff were invited to participate in a focus group interview to explore their experiences with DRInK-Up, their suggestions for improvements or alternative methods to increase resident fluid intake, their insights on supporting older adults to self-manage their fluids and their views on use of DRInK-Up in the longer term.

## The DRInK-Up hydration intervention

Supporting frail older care home residents to increase their fluid intake presents many challenges. To increase the likelihood of effectiveness the hydration intervention was theoretically-driven to address multiple known, and as yet undetermined, factors affecting drinking behaviour in this environment. A hydration framework was constructed, based on evidence from research literature, clinical expertise, (care home and Care Regulator) and Regulator reports, to address resident, staff, environmental and organisational factors identified as potentially influential. This formed the basis of the DRInK-Up hydration intervention (Table 1), which was developed using Social Cognitive Theory; in particular, Self-

The DRInK-Up intervention comprised:	
• Resident and family/carer education on hydration and fluid intake	
• An individually targeted daily fluid intake goal, set at 200-400mls above the older resident's baseline mean daily intake	
• An agreed minimum daily total fluid intake for each resident	
• Care home staff education programme	
• Care home staff ongoing support for positive fluid management	
• Organisational support to implement and embed the DRInK-Up intervention	

**Table 1.** Components of the DRInK-Up Intervention.

Self-efficacy was anticipated to be positively influenced through four different mechanisms in the DRInK-Up intervention:	
<b>Mastery experience</b>	Success in meeting fluid intake targets by residents. Staff knowledge about hydration, consequences of dehydration and understanding the importance of their input to hydration management.
<b>Verbal persuasion</b>	Encouragement of resident to drink more by care home staff, family and other residents.
<b>Vicarious experience</b>	Residents observing others drinking in social situations and learning to emulate this behaviour. Staff observing hydration care practices role modelled by others.
<b>Physiological and psychological responses</b>	Checking colour of urine and results of urine specific gravity measurements to indicate hydration status. Staff observations of residents' skin condition and oral status. Praise and positive reinforcement for drinking and meeting agreed goals.

**Table 2.** Social cognitive theoretical components of the DRInK-Up hydration intervention.

Efficacy Theory<sup>22</sup>, where the stronger a person's confidence that they can perform a specific activity, the more motivated the person is to do that activity. In this study, self-efficacy was the older adult's perceived ability to drink and maintain their own hydration status. It also encompassed the care staff confidence that they could effectively support frail older adults to drink and maintain hydration.

The DRInK-Up intervention components are described in Table 1 and how these components are informed by Social Cognitive Theory is shown in Table 2.

## Data processing and analysis

Baseline characteristics were summarized using descriptive statistics of means and SDs or medians and interquartile range (IQR) as appropriate. Categorical data are reported as frequencies and percentages. Mean differences in fluid intake between baseline and the total DRInK-Up study period were compared using Student t tests for paired samples, as were differences in UTI and falls rates between the pre-DRInK-Up and DRInK-Up periods. Pearson correlation was used to measure the association of fluid intakes across the four measurement timepoints and also to investigate correlation between the volume of fluid intake

and the number of UTIs. The level of significance was set at  $p > .05$  throughout.

Focus group interview data were transcribed verbatim and analysed using the Framework method of content analysis<sup>26</sup>. Key themes were identified by the lead author (JB) and confirmed by the other (RA) in relation to a pre-set analytic grid derived from the theoretical constructs underpinning the study. This framework was used to explain the residents and staff experiences of DRInK-Up, its acceptability and factors that may influence its implementation into practice.

## Ethics

Research Ethics approval to undertake the study was obtained from Glasgow Caledonian University School of Health & Life Sciences Research Ethics Committee (HLS12/91) prior to commencement.

## Results

### Resident outcomes

A total of 24 residents were recruited to the study: 20 females and 4 males, mean age 85.6 years (SD 8.4). The primary medical diagnosis in two thirds of the sample (16 residents) was dementia with the primary diagnosis

Pt ID	T0 mean 24 hour fluid intake (ml)	T1 mean 24 hour fluid intake (ml)	T2 mean 24 hour fluid intake (ml)	T3 mean 24 hour fluid intake (ml)	Mean DRInK-Up phase 24 hour fluid intake (ml)	Change in 24 hour fluid intake (ml)	UTI rates in DRInK-Up phase
1	2117	1656	2006	1707	1790	-327	Decreased
2	1455	1473	Died				Unknown
3	2333	2433	2516	2266	2405	+72	Increased
4	1917	1618	2033	2167	1940	+22	Decreased
5	2117	2000	2333	1468	1934	-183	Decreased
6	1852	1710	1600	1842	1717	-135	Increased
7	1682	1461	1553	1630	1548	-134	Decreased
8	2033	1491	Died				Unknown
9	1217	1203	1338	1800	1447	+230	Decreased
10	1173	1303	1108	1342	1251	+78	No change
11	1662	1470	1661	2140	1757	+95	Increased
12	1640	1501	Died				Unknown
13	1225	1242	1486	1137	1288	+63	Decreased
14	1800	1926	1900	1867	1898	+98	Increased
15	1632	1533	1536	1130	1400	-232	Increased
16	1245	1986	1690	1555	1744	+499	Increased
17	1600	1740	1750	1420	1637	+37	Increased
18	1400	1453	1783	1383	1540	+140	Increased
19	2223	2070	2517	1750	2112	+42	Decreased
20	2233	2373	2137	1828	2113	-260	Decreased
21	1348	1583	1817	1662	1687	+339	Decreased
22	1320	1516	1500	1517	1511	+191	Decreased
23	1830	1500	1650	1777	1642	-188	No change
24	1370	1550	Died				Unknown

**Table 3.** Recorded fluid intake across timepoints and relationship with UTI rates.

in the other third a mixture of cardiac conditions, diabetes, stroke, prostate cancer, epilepsy and Parkinson's disease. However as would be expected in a care home population multimorbidity and frailty were prevalent. All residents were assessed as 'severely frail' (grade 7) on the Clinical Frailty Scale<sup>23</sup>. Data was available for 20 residents for the three timepoints as 4 residents died within 8 weeks of commencing the intervention, between T0 and T1.

The average fluid intake at baseline (T0) and across the three study outcome time points (T1, T2, T3) are shown in Table 3. Fluid intake increased in 13 residents by an average of 147ml (less than the minimum planned fluid increase of 200-400 mls). Fluid intake decreased in 7 residents by an average of 208 ml. There was no consistent relationship between reported resident fluid intake and frequency of UTI ( $r=0.008$ ,  $p=.974$ ). Fluid intake was strongly correlated at

each measurement time point ( $r=0.845$ ,  $p<.000$ ) indicating that residents with a low intake at baseline had a low intake at each outcome measurement point and those with a high intake at baseline had a high intake across the time points. Volume of fluid intake was not associated with the age of the resident ( $r=-0.233$ ,  $p=.322$ ).

There was a reduction in the number of UTIs from 51 in the pre-DRInK-Up period to 37 during the DRInK-Up hydration intervention period (Table 4). This was a clinically meaningful reduction in the number of treated UTIs but was not statistically significant ( $t=.498$ , 18df,  $p=.625$ ). Of the 20 residents who completed the DRInK-Up intervention treated UTIs reduced in 10 (50%): 5 (25%) residents had no treated UTIs and 5 (25%) had one treated UTI during the 24-week intervention. The number of recorded falls reduced from 52 pre-study to 28 during the 24-week intervention



	Intervention Period				
	T0 (baseline 26 weeks)	T1 (8 weeks)	T2 (8 weeks)	T3 (8 weeks)	Total (study period 24 weeks)
Total number UTIs (Number of residents)	51 (24)	18 (14)	9 (7)	10 (8)	37 p=0.625
Total number falls (Number of residents)	52 (18)	12 (8)	7 (4)	9 (5)	28 p=0.005
Total number admissions to hospital (Number of residents)	4 (3)	2 (2)	0	1 (1)	3

**Table 4.** Number of UTIs, falls and hospital admissions across the DRInK-Up time points.

period. This clinically meaningful reduction in recorded falls was statistically significant ( $t=3.148$ ,  $df 19$ ,  $p=0.005$ ). The number of admissions to hospital did not change during the DRInK-Up intervention and was consistently low, with a total of 7 for the entire group of residents over the 12-month study period, 4 in the pre-intervention period and 3 during the DRInK-Up intervention period.

The specific gravity of residents' urine was measured at each of the data collection time points. The results indicated that the increase in reported fluid intake had no measurable effect on specific gravity, which suggested there was no change in urine concentration with the DRInK-Up intervention, or alternatively that the specific gravity measure lacks sensitivity as a bio-indicator of hydration.

### **Staff views on resident hydration and acceptability of DRInK Up**

The predefined analytic framework for the focus group interviews was constructed using the theoretical features of self-efficacy that underpin the intervention (Table 1). Views and experiences were expressed by staff on: information provision about the purpose and benefits of an increased fluid intake; goal setting; barriers to increasing fluid intake; facilitators of an increased fluid intake and ways to overcome barriers.

### **Information provision about reasons to increase fluid intake**

This was seen as an important part of routine daily hydration care and was reinforced on a regular basis to encourage residents to drink. Although staff recognised that those with severe memory impairment would not retain information, their motivation to explain the need for fluids and the potential benefits remained high.

*FG1 C: In the dementia unit we are always trying to give fluids and we try to explain no matter whether dementia or not, you are explaining, this is when you have to start taking more, this is the reason why. ... in the Dementia unit although you are explaining they might understand it when you are saying it, but later on ..... But you are still following them about and you are still trying to get whoever it is to take drinks.*

An increased awareness of the importance of fluid intake as a direct result of the DRInK-Up project was reported and an increase in fluid intake for all residents attributed to the effects of the project.

*FG2 B: Well they have now because of the way they are doing the Drink up project and they are getting an extra 400mls, they are drinking more. Definitely .... there is an awareness now. ... these 4 people are on and it makes you go round and do it with everybody and not just the 4 people that are on the Drink up project.*

### **Goal setting**

Despite the efforts of staff to discuss and agree fluid intake goals with residents, in reality the majority of actual goals were the individual targets calculated for each resident by the senior nurse, based on a standardised formula. The residents and staff were 'told' what the residents' targets were however, for many residents this information was not retained due to cognitive and memory impairment. There was generally a good understanding among staff of the need for residents to have a high fluid intake but there was some debate about the actual volume of fluid that was needed, or considered optimal. Discussion about whether targets could or should be achieved took place in the focus groups. The tension between feeling responsible for ensuring fluid intake targets were met and not forcing residents to drink was a source of concern for some staff.

*FG3 E: They (the senior nurses) don't realise that sometimes they (the residents) don't want to drink, but we have got to reach our targets so we are all..... you are all stressed out yourself trying to reach this target.*

The need to 'push fluids' was associated specifically with identifying an individual resident as being at risk of infection. There was a clearly articulated process between recognising a potential UTI/chest infection and staff making robust efforts to ensure the resident had an increased fluid intake beyond their norm.

*FG1 C: and that's the first thing you say - she is heading for a UTI or ..... and then we need to get more fluids into them.*

However, the deliberate use of increased fluid intake as routine clinical care for all residents specifically to prevent the occurrence of UTI was not discussed in any focus group.

## Barriers to increasing fluid intake

**Resident-related barriers:** A number of reasons why residents, in particular those with dementia, do not help themselves to drinks and why their fluid intake can be low, were described by staff. These included: they don't realise or forget they are thirsty; they cannot communicate their thirst; they are too shy to ask or do not want to annoy busy staff; they do not realise that staff are there to help them; they may be unwell and 'can't be bothered to drink'; they have physical difficulties such as mobility problems or pain that prevents them accessing drinks themselves. The DRInK-Up project increased understanding and awareness of the challenges for people in a care home context trying to access drinks and the potential consequences.

*FG1 C: It does kinda bring back to home that a lot of the residents in here don't think to go and get a drink ..... or are able to go and get a drink ..... especially those with dementia .....they are going without and are maybe getting agitated and this is maybe what it is.*

Two key barriers to drinking were identified in the focus groups: i) residents refusing fluids to avoid needing to use the toilet.

*FG2 E: A lot of them are scared to drink too much in case they need to go to the toilet.*

ii) the residents' mood, which was unpredictable and led to fluctuations and variability in daily fluid intake

*FG3 E: It all depends on their mood as well, some days they will drink and some days they will just not drink.*

**Contextual barriers:** The care home context was believed to create barriers to increasing individual drinking. Care home routines and the focus on ensuring safety of residents with high levels of disability and care needs, meant that very few residents could be independent with drinks. Choice of drink was seen to be of great importance and is linked to knowing the residents likes and dislikes. Where the choice was limited this was considered a barrier to increasing intake.

*FG3 D: I think it depends on the drinks that they are given because when you look back what did the elderly drink most of the time - it was always hot drinks. Most of the time when we are pushing fluids it is diluting drinks and stuff like that.*

*FG3 A: She drinks juice and sometimes I think 'she is thirsty', but I think I am the only one that gives her juice or milk or water, because it is always tea when we are assisting her and she doesn't drink her tea, no. She does drink tea but I found out that I can give her two cups of juice for just one tea.*

Enabling the resident to drink and encouraging fluid intake was considered to be very time consuming:

*FG2 B: If you are really really busy and the staff are under pressure for whatever reason in the unit it is not easy to go round and give that extra drink and offer it.... especially if Mary is sitting in the corner and she is really quiet ....*

*FG3 E : If you can sit and give them the time that they*

*should have to let them have a drink they probably would benefit from it but you only have a short time. You can't it's impossible.*

There are also competing demands to be dealt with which were frustrating for staff:

*FG3 B: At breakfast you have to do everything and we have many residents to feed. So someone may say "sorry mam" so you need to put her into the toilet so the one who you are giving food to you have to leave it so that you can take her to the toilet.*

## Facilitators to overcome barriers

A pre-requisite for success in helping residents to meet drinking targets was 'knowing the resident'.

*FG2 B: ... you really have to get to know your residents inside out to know whether or not they want a drink and what they will drink. Are their mouths dry?*

*C: Or their skin*

*B: Their lips, they lick their lips as well when they are thirsty as well, or they just bow their heads you know if no one is paying any attention. We have a wee lady and she just puts her head down, it is quite strange.*

*A: Or they will try and catch your eye....*

*B: Uh huh or try to say something .....*

*A: And try to make eye contact or something, as if 'I need something', do you know what I mean?*

*B: Some of them just make noises, some of them rock back and forwards, that can mean two things.... Do they want the toilet or do they want a drink?*

*A: That's where knowing your residents comes into it, basically to spot the signs like that.*

When asked 'if given infinite resources what would you do to increase fluid intake with residents?' participants in all three focus groups stated they would provide more staff. However, there were a number of more practical suggestions to facilitate increased fluid intake such as asking all residents on a regular basis if they would like a drink.

*FG1 C: But there are more than that if you say 'would you like a drink?' They will say yes I would like a drink ... but you have to ask them!*

Staff also described methods to incorporate drinking into the residents' normal daily activities.

*FG2 D: We will usually just GIVE them drinks, some of our residents walk about and we just give them a drink on passing, we just lift it, we have a jug and a couple of glasses... "here you are".*

A novel idea was to increase the length of 'the drinking day'. Enabling residents to drink upwards of 1500 ml in less than 12 hours was recognised as particularly challenging. In the care home it was not unusual for a resident to be in bed from 6 pm until 8 am the following day, which is 14 hours or more lying down, leaving only 10 hours in which to reach the fluid intake target. The suggestion was made to prioritise the residents at risk of underhydration and UTI, for earlier rising

or later retiring to bed to provide more opportunity and time to drink. It was acknowledged that night staff rarely provide residents with drinks.

*FG3 E: But I do think that the ones that really don't get a lot to drink should be up earlier in the morning. If they are not getting a drink through the night then they should be up, they should be the priority ones to get up and give a drink.*

The consistency of the fluid was important for some residents:

*FG3 E: it is amazing how they can take it better from a spoon rather than you try to assist them with a beaker or a cup. So if you sit them up and give it to them with a wee spoon they will take it no problem.*

Evidence for the influence of vicarious experience was reported in all units in relation to tea. Participants stated that they commonly did a 'tea round' once a single cup of tea had been requested, which was a positive method of increasing intake.

*FG1 A: Yeh yep. Somebody just needs to hear the word 'tea' and that's it.*

*B: And you actually get like in my unit someone coming up and saying 'excuse me they want a cup of tea' and you go "do you want a cup of tea?" and they will say 'no, but I will just have one'. And I never go to make just a couple of cups because you might as well set up the trolley and do a tea round. Do you know what I mean?*

### **Praise and reward to increase fluid intake**

All staff were acutely aware of the need to encourage and praise residents in order to increase or maintain their fluid intake and this was common practice throughout.

*FG1 A: Because they will just sit the glass in front of them they won't do anything unless you give them that bit of encouragement.*

*FG3 C: I think there is about five people in our unit who can drink themselves the others, it's like "come on" and you have to push them.*

There was general consensus that 'encouraging' was important but that 'forcing' a person to drink was unacceptable.

*FG1 B: .... say I have sat with one resident and have encouraged them and prompted them to drink and they have not drunk well I have done my job, do you know what I mean? That is their choice, do you know what I mean? and I won't let ... anyone ... make me feel guilty because that person has not wanted to drink.*

## **Discussion**

The DRInK-Up study was an exploratory study designed to establish the potential impact of increasing fluid intake on care home residents' urinary tract infection rates, rates of falls and admission to hospital, as well as assessing the overall acceptability of the intervention to residents,

families and staff. The findings indicate that it is feasible to increase fluid intake in frail older care home residents but that measuring the increase accurately and determining the effects on individual residents is challenging and open to a range of threats and potential biases. In particular, the process and outcome measures used in this study were reliant on staff recording the data accurately in the resident records: for example, the occurrence of UTIs, falls and urinary incontinence. These are dependent on human observation, interpretation and action and therefore involve a level of subjectivity which cannot be avoided unless more objective measurement methods are developed. In a busy care home there was inconsistent recording of information, which was reflected in the quality of the data available for analysis.

The major challenge for this study was the accurate recording of actual fluid intake. Fluid balance charts and bladder diaries are known to be fraught with difficulties, especially if completed by staff and it is very difficult to obtain accurate 24-hour intake figures on a consistent basis in a care situation involving a number of staff working shifts. Informal comments made to the researchers implied that night staff often completed the fluid charts for all the residents at the end of the day, using standardised volumes and drink times to document that the resident had met their daily fluid intake target, whether this had actually happened or not. For this reason, the reliability of the fluid charts was considered questionable. Furthermore, assessing the actual fluid intake of an elderly person is unreliable because the volume drunk may be very different to the volume offered. This is a reason why frail older people are at higher risk of hydration imbalances<sup>21,25</sup>.

Collecting urine samples to dipstick test for specific gravity measurement in a tightly scheduled time frame proved unachievable in this population and therefore for any future study the data collection time-points should be reconsidered. Challenges arose because staff were busy with other activities and often did not have time to take the resident to the toilet when they requested, but residents were usually unable to provide urine samples on demand. The suitability of urine specific gravity measurement to determine hydration status in frail older adults has been questioned<sup>27</sup>. Urine specific gravity is known to be a challenge to interpret in the frail older population as its validity is dependent on adequate renal function. Currently there is no gold standard measure of hydration and sub-clinical underhydration is particularly difficult to detect with any degree of accuracy<sup>27</sup>. Newer methods include the measurement of salivary osmolality, using small drops of saliva provided by the older person<sup>27</sup>. The challenges encountered in this study obtaining urine samples for analysis suggest alternative non-invasive methods such as this should be explored in future studies.

Despite the methodological difficulties described, the results indicated a trend towards increased fluid intake among the participating residents with indications of beneficial effect on prevalence of UTI and reduction in falls. This suggests



that the hypothesis of increasing fluids to prevent infection and falls is worthy of further consideration for future, larger scale studies, albeit using alternative outcome measures. This study was not powered to determine DRInK-Up effectiveness. The theoretically driven intervention has merit with regard to its structure and components: the education package for staff, the focus on goal setting and praise for success. Staff related to the theory underpinning the idea of increasing fluid intake and there was a good understanding in general of the need for older adults to have a high fluid intake. However, there was also some debate about the actual level of intake required and whether high targets were achievable, particularly for small, frail women. Staff felt there was a managerial emphasis on fluid intake/hydration and that they were 'blamed' if a resident became dehydrated, even though they recognised that it was very challenging to encourage some residents to drink. Future research should focus on the impact of educating staff to enable them to understand not only dehydration, its antecedents and consequences (which was a feature of the DRInK-Up intervention), but also to explore their role and responsibilities in relation to drinking and hydration, to clarify what is within their remit and capability and what is not. The purpose should be to enable staff to feel more confident and comfortable with their role in hydration care and to enable discussion of all the associated challenges, including the ethical issues.

## Conclusion

The DRInK-Up study provides indicative evidence to suggest that increasing daily fluid intake by small amounts may have a positive effect on the number of urinary tract infections and number of falls experienced by frail older people living in care homes. This is the first study to test these relationships and the results are promising. The potential for benefit endorses the need to develop and test interventions and care approaches to enable frail older people to drink independently, to train and empower care home staff to effectively support residents to drink and to improve techniques to accurately measure fluid intake and hydration status in the future.

### Research funder

*The DRInK-Up study was funded by the Burdett Trust for Nursing via the Queens Nursing Institute Scotland, Delivering Dignity Programme.*

### Acknowledgements

*The authors wish to acknowledge the contribution of Rosaleen McKeating, SPHERE Bladder and Bowel Service, NHS Glasgow & Clyde and Margaret Tannahill, Consultant Infection Prevention and Control, Care Inspectorate Scotland. They would also like to thank BUPA Care Homes Scotland and the residents, family members and staff who participated in this study.*

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