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Evaluating support stroke survivors get with medicines and unmet needs in primary care: A survey

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Evaluating support stroke survivors get with medicines and unmet needs in primary care: A survey

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Abstract

Objectives

To design a questionnaire and use it to explore unmet needs with practical aspects of medicines taking after stroke, predictors of medicine taking and to estimate the proportion of survivors who get support with daily medication taking.

Design

Four workshops with stroke survivors and caregivers to design the questionnaire.

A cross-sectional postal questionnaire in primary care.

Setting

18 GP practices in the East of England and London. Questionnaires posted between September 2016 and

February 2017.

Participants

1687 stroke survivors living in the community outside institutional long term care.

Primary Outcome measures

The proportion of community stroke survivors receiving help from caregivers for practical aspects of medicine taking; the proportion with unmet needs in this respect; the predictors of experiencing unmet needs and missing taking medications.

Results

A 5-item questionnaire was developed to cover the different aspects of medicine taking. 596/1687 (35%) questionnaires were returned. 56% reported getting help in at least one aspect of taking medication and 11% needing more help. 33% reported missing taking their medicines. Unmet needs were associated with receiving help with medications (OR: 5.6, p<0.001), being on a higher number of medications (OR: 1.2, p<0.001) and being dependent for activities of daily living (ADL) (OR: 4.9, p=0.001). Missing medication was associated with having unmet needs (OR: 5.1, p<0.001), receiving help with medications (OR: 2.1, p<0.001), being on a higher number of medications (OR: 2.1, p<0.001), being on a higher number of medications (OR: 2.1, p<0.001), being on a higher number of medications (OR: 2.1, p<0.001), being on a higher number of medications (OR: 2.1, p<0.001), being on a higher number of medications (OR: 2.1, p<0.001), being on a higher number of medications (OR: 2.1, p<0.001), being on a higher number of medications (OR: 2.1, p<0.001), being on a higher number of medications (OR: 2.1, p<0.001), being on a higher number of medications (OR: 2.1, p<0.001), being on a higher number of medications (OR: 1.1, p=0.008) and being older than 70 years (OR: 0.6, p=0.006).

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Conclusions

More than half of patients who replied needed help with taking medication and 1 in 10 had unmet needs in this regard. Stroke survivors dependent on others have more unmet needs, more likely to miss medicines and might benefit from focused clinical and research attention. Novel primary care interventions focusing on the practicalities of taking medicines are warranted.

Abstract word count- 298

Keywords: Stroke, Medication Adherence, Caregivers, Barthel

Article summary

Strengths and Limitations

- A 5-item questionnaire was developed to evaluate the help stroke survivors get with daily medication taking, based on patients' and caregivers' own views gathered through workshops.
- The questionnaire was sent to 1,687 stroke survivors in 18 GP practices across two UK regions.
- This work identified issues from a population that includes patients severely affected by stroke, who are often excluded from research. Results shed light on the effect of stroke related impairments on practical domains and predictors of medicine taking, which have significant effects on overall adherence and call for new primary care interventions.
- The low response rate reported is a limitation of this study and stroke survivors who are harder to reach may have been missed.

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Data sharing statement: No additional data available.

Introduction

For many older adults remaining independent at home may depend on how well they can manage complex medication regimens.¹² Around half of stroke survivors are dependent on others for everyday activities.³ Stroke is the leading cause of disability in developed countries, with an estimated that 25-74% of the 50 million stroke survivors worldwide requiring some assistance or being fully dependent on caregivers for activities of daily living (ADL's).⁴⁻⁶

There is evidence that being dependent for ADL's and impairment in mobility and communication decrease medication adherence in patients suffering from hypertension.⁷ Deficits in attention, cognition or working memory have been linked with non-adherence to medications in other patient groups.⁸ In a recent systematic review of medication adherence among patients with cognitive impairment, one third of studies showed that such patients were likely to have a caregiver to assist with medications and there was an association between taking four or more medicines and nonadherence.⁹ In patients taking cardiovascular medicines, multiple factors including cognitive problems, lack of social support, dosing regimen, as well as practical problems and difficulties accessing services, contribute to poor medication adherence.^{10 11} Low adherence to secondary prevention medication is associated with poor cardiovascular health.^{12 13}

Stroke survivors have previously reported difficulties in the handing of medication as a barrier to adherence to secondary prevention medication after stroke.¹⁴ Research on medication adherence in stroke has identified multiple barriers to medication taking among stroke survivors.¹⁴⁻¹⁶ However interventions developed to improve adherence have mainly concentrated on patients responsible for their own medicine taking.^{17 18}

In elderly patients in particular, cognitive deficits, taking large number of medicines and the complexity of medication regimens have been identified as barriers to medication adherence. ^{19 20} Caregivers are known to play a key role in providing assistance to older people in a range of daily activities including medication taking and physician visits,²¹ and can help improve adherence in cardiac patients with memory

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problems.²² However, the proportion of community stroke survivors relying on caregivers for some, or all aspects of medicine taking, is not known.

Survivors of stroke have previously reported unmet needs including physical difficulties, cognitive and emotional difficulties, information needs and other unmet needs.^{23 24} However we know little about factors that influence medication taking among stroke survivors with disabilities living in the community (i.e. not in nursing homes), their unmet needs around the use of medicines or the proportion relying on caregivers for some or all aspects of medicines taking.

To date, survey instruments examining the unmet needs of stroke survivors have not focused on aspects of medication taking.

The aims of this investigation were to design an instrument to evaluate the help stroke survivors get with taking their medicines, characterise patients receiving help with medications, estimate the proportion who have unmet needs with daily medicine taking and who miss medications. We additionally aimed to identify the predictors of missing medicines and of experiencing unmet needs with medications. This knowledge can inform the development of primary care interventions aimed at improving medication

taking in this patients' group. Methods

Questionnaire development workshops

To develop the questionnaire, three workshops were conducted with 26 stroke survivors and 12 caregivers in the East of England (St John's College, Cambridge 2009²⁵: 7 patients, 1 caregiver; Different Stroke, Cambridge 2012: 9 patients, 3 caregivers; Peterborough, 2012: 10 patients, 8 caregivers). Recruitment was opportunistic and no purposive sampling was applied.

The survey questions were developed through thematic analysis ²⁶ of workshops field notes.

A fourth workshop was conducted to gather feedback on the questionnaire using a PPI (Patient and Public Involvement) exercise with 11 stroke survivors and 3 caregivers recruited through a local stroke group (Different Strokes, East of England). Two stroke survivors from this group took part in subsequent 'thinkaloud' interviews, which involved talking out loud as they read the questionnaire, continually verbalising what they were thinking.

Postal survey

General practices in primary care in the East of England and London were approached through the Clinical Research Network (CRN). CRN Eastern contacted 20 GP practices, of which 11 replied and took part in the study. CRN North London contacted 140 GP East London practices by email (Tower Hamlets, Newham and City & Hackney CCGs), of which only two replied and participated in the study. Five of the eight GP practices contacted in North London (Barnet CCG) through a research coordinator took part in the study. Patients with stroke and their caregivers were sent the postal questionnaire according to the following criteria

Inclusion Criteria

Patients:

All patients aged > 18 on the practice stroke register with documented history of stroke.

Caregivers:

Anyone identified by the patient as being a caregiver and having a role helping with medicine taking.

Exclusion Criteria

- Patients who suffered a Transient ischaemic attack (TIA) but not a stroke.
- Palliative or end of life patients.
- Patients receiving institutional long term care (receiving total care in residential homes or living in nursing homes).

Survey participant identification

A list of prospective patients was compiled from the stroke register of each surgery by the practice staff. No restriction was placed on the recruitment of survivors experiencing who were dependent for ADL's or lacking capacity. The list was screened by a practice GP and anyone not meeting the inclusion criteria or whom the GP considered unsuitable for the study (e.g. terminally ill) was excluded.

Survey participant recruitment

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Eligible participants were sent a study survey pack by practice staff between September 2016 and February 2017. Study recruitment packs included two invitation letters, patient information sheets, questionnaires and postal version of Barthel Index²⁷, one of which was for completion by the patient and the other by the caregiver. The Barthel Index provides a measure of functional independence and physical functioning and has been used in stroke research previously.²⁸ Patients with Barthel score <20 were categorised as dependent for ADLs/disabled. If receiving help with medications, the patient was asked to pass to their caregiver the invitation letter and information sheet and invite him/her to complete their copy of the questionnaire, providing answers on the patient's medicine taking. Family members, friends or paid caregivers of stroke survivors who were severely disabled and/or lacked mental capacity were invited to fill and return the caregivers' questionnaires only on behalf of patients. The information sheets stated that consent was implied by returning the completed questionnaire. Participants were asked to return completed questionnaires to the research centre in the FREEPOST envelopes provided. A second mail out of the study invitation pack was sent to all patients as a reminder, 2 weeks after the first one.

Ethical approval

This study has received ethical approval from Cambridge Central Research Ethics Committee (REC reference: 16/EE/0182) and from the Health Research Authority (IRAS project ID:170931)

Survey Analysis

Survey data entry was performed by Document Capture Company.²⁹ Individual patients' characteristics (age, gender, time since stoke, number of daily medicines) were collected from the questionnaires themselves. Practice population, number of patients on stroke registers, deprivation score and ethnicity were taken from the National General Practice profiles (https://fingertips.phe.org.uk/profile/general-practice). The proportions of patients in each sociodemographic category, needing help taking medication, missing any medication in the previous 30 days, and reporting the need for more help taking medication, were estimated. When the survivor and caregiver questionnaires were both returned together, study data were collected from the patient's questionnaire only.

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Multivariable logistic regression analysis was fitted to estimate associations between 'Unmet needs' and the variables: age < or \geq 70 years, gender, total number of medicines taken, dependence for ADL, years since stroke, and receiving help with medicines. In the model each domain of help with medicine was estimated individually and then combined. A second multivariable logistic regression examined the association between 'Missed medicines in the previous 30 days' and the variables: age < or > 70 years, gender, total number of medicines taken, dependent for ADL, years since stroke, help with medicines and unmet needs. Regression models were adjusted for age, gender and variable of interest. All statistical analysis have been conducted with Stata (version 14, StataCorp LP, College Station, TX, USA, 2013).

Results

Questionnaire development

Taking medications emerged as an important issue in all three workshops: nearly half of patients stated that a family member or friend was supporting them with daily medicine routines especially in relation to prompting medicine taking. This was put down to effects of the stroke itself on memory retention rather than general memory problems that people without stroke also experience. They admitted missing doses due to forgetting. Only a small proportion of survivors were actually handling their own prescriptions and were relying on support from family and/or community services. In one workshop almost all survivors had Dosette medication boxes and agreed that taking medications out of safety bottles and blister packs was a problem due to physical disabilities.

Thematic analysis of workshop data revealed five main practical domains of support needed with medication taking: 1) Dealing with prescriptions and collection of medicines; 2) Getting medicines out of the box, blister packs of bottles; 3) Prompting 'It's time to take your medicine'; 4) Swallowing medicines; and 5) Checking whether medicines have been taken. The final study questionnaire (see Supplementary file 1) included questions relating to each of these five domains, one item related to adherence (missed medicine in the last 30 days) and an assessment of disabilities through completion of the validated postal version of the Barthel Index.²⁷ The questionnaire was adapted for caregivers (see Supplementary file 2).

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Questionnaire finalisation

On the basis of the fourth workshop and two 'think-aloud' interviews, we reworded the survey questions (e.g. from 'Do you get help with' was changed into 'Is somebody helping you with') and used a scale response 'All the time', 'Often', 'Sometimes', 'Rarely', 'Never' for the first question of each of the five survey domains, which was originally conceived as a 'yes' or 'no' answer (see table 2 for text of questions).

Survey

Practice characteristics

18 GP practices agreed to take part in the study, of which just over 1/3 were in London (n=7). GP practices were relatively large with an average population of 11,904 patients (SD = 4010) and a low to moderate level of deprivation (Index of Multiple Deprivation³⁰ (IMD): Mean-7.05: SD-3.19). Out of 3066 patients on the stroke registers, 1687 stroke patients (55%) were considered eligible for the study and received the postal questionnaire. The average response rate of East of England and London practices was 42% and 27% respectively. The response rate varied between 16% and 53% across practices.

Participant characteristics

596 participants returned a completed questionnaire [549 (92.4%) from patients, 45 (7.6%) from caregivers] showing a mean response rate of 35% (0.33-0.37). Participants were on average 72.7yrs old. 37.8% (n=210) of the sample were female and 62.2% male (n=346), see table 1. The mean number of years since stroke was 7.7 and participants took an average of 6 different medicines a day. There were a high proportion of white patients in the recruited practices which were on average 21% of mixed or ethnic minority background. Approximately 23% of study participants were completely independent for ADL.

Participants getting any kind of help with medicines were on average 73.6 years old, two thirds were male, had a stroke approximately 8 years previously and were taking on average 1 extra medication a day. Only 19% of this group were completely independent for ADL, see second part of table 1.

Table 1 here

Support with daily medication taking

Table 2 shows the mean responses to the survey questions quantifying the help participants receive with medicines and unmet needs. Overall, 55.7% (95% CI: 51.7-59.7) of the participants received help in at least one aspect of taking medication, in that they ticked one of the options from 'all the time' to 'rarely' on one or more of the five questions related to medicine taking. 11.4% (95% CI: 8.8-13.9) of patients reported experiencing unmet needs and needing more help with at least one of the aspects of taking medication, in that they ticked 'yes' to the question "do you feel you need more help", on one or more of the five questions related to medicine taking.

Among participants help was needed to some degree with prescriptions and collection of medicines (49.7%), getting medicines out of the box or packet (27.9%), reminding to take medicines (36.4%), swallowing medicines (20.2%) and checking that medicines have been taken (34.2%). Being reminded to take medicines, dealing with prescriptions and collection of medicines and getting medicines out of a pack or bottle were the most commonly reported areas of unmet needs. Almost two thirds of participants (65.3%) reported never missing medicines in the last 30 days. Out of the 34.7% of patients who said they missed taking medicine at any point in the previous 30 days, 23.9% said rarely, 9.3% sometimes, 0.8% often and 0.7% all the time.

Table 2 here

Factors associated with unmet needs

Being on a higher total number of daily medications (OR: 1.2, (1.1-1.3), p<0.001), dependent for ADL (OR: 4.9, (1.9-13.0), p=0.001) and receiving any kind of help (OR: 5.6, (2.7-11.63), p<0.001) in relation to taking medication was associated with experiencing unmet needs. Getting help with swallowing medicines (OR: 6.8, (3.8-12.02), p<0.001), getting medicines out of a box, blister packs or bottles (OR: 6.5,

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(3.6-11.8), p<0.001) showed the strongest associations with experiencing unmet needs. However age, gender, and number of years since stroke showed no significant association with unmet needs (see table 3).

Table 3 here

Factors associated with missing medications

Being older (age \geq 70) was associated with a lower probability of missing medication (OR: 0.59) (0.41-0.86) p=0.006). Being on a higher number of daily medicines (polypharmacy) (OR:1.07 (1.02-1.12), p=0.008) and getting any kind of help with medicine taking (OR:2.08 (1.43-3.03) p<0.001) was associated with higher probability of missing medicines. The more unmet needs stroke survivors had with taking medication, the more likely they were to miss their medicines (OR:5.3 (2.9-9.5), p<0.001). Gender, dependence for ADL's and number of years since stroke showed no significant association with missing Table 4 here Discussion medicines (see table 4).

Summary of findings

From workshops we identified 5 key issues that patients regarded as important with medication taking after stroke. We converted these into a five item questionnaire that we distributed to people on stroke registers in 18 general practices. We obtained a response rate of 35%. Among respondents, 56% of survivors in the community were receiving help in some aspect of daily medication taking, 11% reported needing more help in at least one domain of medicine taking and 33% missed taking their medicines at some point in the previous 30 days.

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A higher total number of daily medicines, being dependent for ADLs and receiving help with medication were predictors of experiencing at least one unmet need in respect of medication taking. Stroke survivors who were younger, taking a higher number of daily medicines and experiencing a greater number of unmet needs were more likely to miss medications.

This work identified issues from a population that includes patients severely affected by stroke, who are often excluded from research.¹⁷ Results presented here shed light on the effect of stroke related impairments on practical domains and predictors of medicine taking, which are shown to have significant effects on overall adherence.

Strengths and limitations

A strength of this study is that the questionnaire was developed from patients' and caregivers' own views gathered through workshops. Although not recruited through purposive sampling, workshop participants suffered from a range of stroke related impairments, as highlighted by the reported use of Dossette boxes, dependence on others for aspects of medicine taking like prompting medication times, and dependence for ADL's such as collecting prescriptions and taking tablets out of boxes. In the actual postal survey, the inclusion of stroke survivors regardless of level of dependence for ADL's permitted investigating a population who are understudied,¹⁷ yet may have significant unmet needs that can affect their adherence to medications. This investigation highlights caregivers' role in managing medicines in survivors dependent for ADLs.

However, study limitations should also be considered. The response rate across recruited GP practices was low and harder to reach stroke survivors may have been missed. This is a source of bias that might affects our estimates. Through the Barthel score, we did not assess cognition directly, although low cognitive function is associated with poor adherence.³¹ We did not collect information on the use of blister packaged medication or devices to aid compliance, which could have influenced medication taking practices. Finally this study examined all medicine taking and did not differentiate between stroke secondary prevention medications and other drug categories.

Comparisons with existing research

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To our knowledge this is the first study that shows that more than half of all stroke survivors get help with some aspect of medicine taking and that those receiving help are more likely to have unmet needs. This provides some insight in to why adherence to medication in stroke survivors may be poor.³²

Moreover, the greater the number of medicines, the more likely stroke survivors were to miss medications. Addressing pill burden by simplifying drug regimens may be an important focus for future interventions. Indeed the polypill approach to medication taking has been shown to reduce cardiovascular as well as total pill burden in a primary care setting.³³ Simpler dosing regimens, are known to be associated with better medication adherence ³⁴ while fewer medicines has been shown to be an independent predictor of long term medication persistence among stroke survivors.^{35 36} A recent trial incorporating a fixed-dose combination polypill approach to taking cardiovascular medicine demonstrated better adherence among patients receiving a single pill.³⁷

Receiving help with prescriptions and collecting medicines was identified as the area where most help was received (49.7% of respondents). Stroke survivors who are dependent for activities of daily living may face considerable practical challenges accessing health care resources at the pharmacy and the GP practice. A recent study in the USA found that around 2/3 of caregivers were involved in at least 1 medication management activity of elderly patients and that high involvement in Instrumental Activities of Daily Living (IADLs) was associated with the caregiver providing the patient with assistance in ordering medicines.³⁸ Filling prescriptions is also known to be an important factor influencing medication adherence.^{39 40} Indeed caregivers can play a significant role in ensuring appropriate medication taking. A recent interview study exploring potential barriers and facilitators of medication adherence in stroke identified the central role of the caregiver in medication adherence.⁴¹ Our evaluation of an online stroke forum also confirmed the important role of the caregiver in facilitating medication adherence.¹⁴ Monitoring prescription collections, liaising with the GP and pharmacy, increasing the time between prescriptions or arranging medication deliveries, may help to address prescription needs.

Around 11% of stroke survivors reported unmet medication needs. We found that stroke survivors dependent for ADLs and receiving help with medicines were more likely to report unmet needs, which is in line with a recent study investigating stroke/TIA survivors in Australia, where greater functional ability was associated with fewer unmet needs, including those related to secondary prevention.⁴² In previous research on

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unmet needs among stroke survivors, a 44 item survey study by McKevitt and colleagues (2011) reported that 49% of stroke survivors had at least one unmet need ²⁴, while in a study of Australian survivors who completed a 58 item survey, the percentage was 84%.²³ Both these studies however examined unmet needs over a variety of domains including health, work, leisure and everyday living, social support and finances, whereas our study focused on medication needs only.

Getting help to take medicines out of a box, packet or bottle was the area where the greatest proportion of stroke survivors needed help all of the time. We previously found that the use of pill boxes and blister packed medication to be both a facilitator ³⁵ and a barrier ¹⁴ to adherence among stroke survivors¹⁵, while interventions using blister packaging and pill boxes have been found to be associated with improved adherence.⁴³ Although electronic medication devices were considered potentially effective in improving medication taking behaviour among patients with cognitive impairments, success in using such devices was dependent on the patient having a good level of dexterity, while removing the medication from these devices was also found to be challenging. ^{44 45 46}

The need for further support in this domain, as reported in the current study, suggests that handling medications remains problematic for stroke survivors.

An interesting finding from this survey study is that stroke survivors who missed medicines were younger. This is consistent with other research on adherence in stroke that found that younger age was predictive of poor adherence⁴⁷, and has also been described in patients taking medication for cardiovascular disease.⁴⁸ The finding in the present study contrasts with the view that older patients are more likely to face difficulties taking medication^{49 50} which is frequently attributed to higher number of pre-existing comorbidities resulting in polypharmacy and increased complexity of medication taking regimens. The fact that older patients may be less likely miss medicine might be down to the support they receive from caregivers. Our findings suggests that support needed with medications may be overlooked in younger stroke survivors.⁵¹

In this study a significant proportion of patients admitted missing medications occasionally. There is evidence that improving adherence by one anti-hypertensive pill/week for a once-a-day regimen reduces the hazard of stroke by 8–9 % and death by 7 %.⁵² Each incremental 25% increase in proportion of days covered with statin medications is associated with a 0.10 mmol/L reduction in LDL-C cholesterol.^{53 54} Non-adherence to cardiovascular medications is associated with increased risk of morbidity and mortality.⁵⁵

Implications for clinical practice

A significant proportion of patients, particularly those who take large numbers of tablets, are disabled or receive help to take medication, have unmet needs and miss their tablets, which can increase risk of recurrent cardiovascular events. These particularly vulnerable groups of patients might benefit from focused clinical attention. Through understanding the needs of survivors and caregivers in different aspects of daily medication taking, we can help direct future resources to the areas of greatest need. For example, further exploration of medication packaging is warranted to understand the difficulties stroke survivors face handling medicines. Polypharmacy remains a difficulty for older patients. Therefore, exploring the use of combination pills and further efforts to reduce the burden of multiple medications among stroke survivors is warranted.

The questionnaire we have developed could be used to understand the challenges around medication faced by other patient groups Unmet medication needs among UK stroke survivors have not been previously explored in the context of activities both survivors and caregivers consider important for taking medicines. Through understanding the extent of unmet needs as well as the areas in which these are greatest, strategies can be developed which address poor medication taking practices and therefore improve medication adherence.

Future research

Novel interventions focussing on the practicalities of taking medicines and aimed at improving stroke survivors' adherence to treatment are needed. The findings reported here may inform the development of such interventions. Advances in technology have the potential to facilitate delivery of such interventions, e.g. electronic devices prompting medication taking times.^{56 57} Efforts to improve medication taking among survivors of stroke using technology are already underway and have shown promise.⁵⁸

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Competing interests

None declared

Data sharing statement

No additional data are available

Author/s contribution

ADS is the Chief Investigator, contributed to the study design, data analysis and commented on the manuscript. JJ contributed to the study design, data collection, data analysis and prepared the manuscript for submission. JM is a co-investigator on the study, wrote and commented on the manuscript. SS is a co-investigator on the study, wrote and commented on the manuscript. LA contributed to the data analysis and commented on the manuscript. GDiT contributed to the data analysis and commented on the manuscript. All authors agreed on the final draft of the submitted manuscript.

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		Age (years)	Female	Male	Time since stroke (Years)	N of daily medicines	Independent for ADLs (BI=20)
	N	588	210	346	535	557	139
All	%		37.77	62.23			28.31
patients	Mean	72.69			7.65	6.38	
	SD	11.57	5		7.58	4.00	
	N	331	112	197	295	312	53
Patients	%		36.25	63.25			18.93
who receive help of	Mean	73.57		Ľ	7.97	7.33	
any kind	SD	12.23			8.50	4.45	

Table 1. Characteristics of study participants *(mean scores reported unless otherwise stated)*.N represent the number of participants who completed the survey in respect to the different variables.

	N	All the Time N (%)	Often N (%)	Sometimes N (%)	Rarely N (%)	Never N (%)	Yes N (%)	No N (%)
Question 1 Is somebody helping with prescriptions and collection of your medicines?	583	186 <i>(31.9)</i>	19 (3.3)	40 (6.9)	45 (7.7)	293 (50.2)	(70)	(79
Question 1a Do you feel you need more help with prescriptions and collection of your medicines?	551						33 (6.0)	518 (94.)
Question 2 Is somebody helping you getting the medicines out of the box, bottle or blister pack?	578	85 (14.7)	15 (2.6)	31 (5.4)	30 (5.2)	417 (72.1)		
Question 2a Do you feel you need more help with getting the medicines out of the box, bottle or blister pack?	553	2					33 (6.0)	520 (94.)
Question 3 Is somebody helping with reminding you when is the time to take your medicine?	577	78 (13.6)	22 (3.8)	59 (10.2)	51 (8.8)	367 (63.6)		
Question 3a Do you feel you need more help with reminding when is the time to take your medicine?			(0)				35 (6.2)	529 (93.
Question4 Is somebody helping you with swallowing your medicine?	579	56 (9.7)	11 (1.9)	29 (5.0)	21 (3.6)	462 (79.8)		
Question 4a Do you feel you need more help with swallowing your medicine?					0		9 (1.6)	551 (98
Question 5 I somebody helping you with checking that you have taken your medicines	576	76 (13.2)	23 (4.0)	58 (10.0)	40 (6.9)	379 (65.9)		
Question 5 a Do you feel you need more help with checking that you have taken your medicine							20 (3.6)	538 (96.
Thinking of the last 30 days, how often did you miss taking your regular medicines?	594	4 (0.7)	5 (0.8)	55 (9.3)	142 <i>(23.9)</i>	388 (65.3)		

Table 2. Responses to the survey questions.

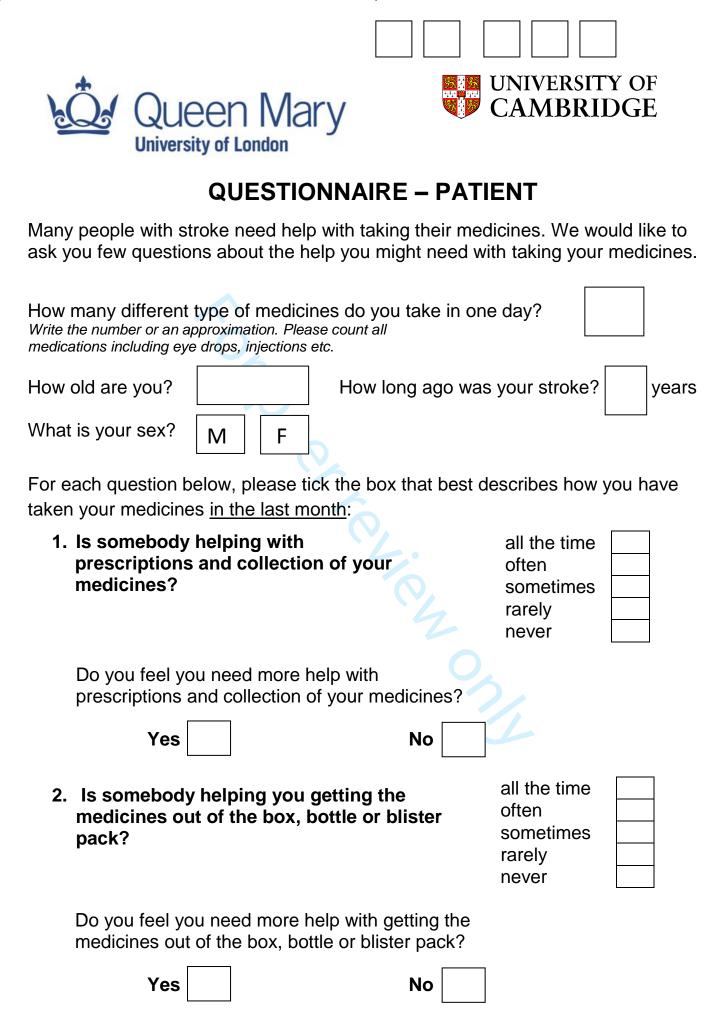
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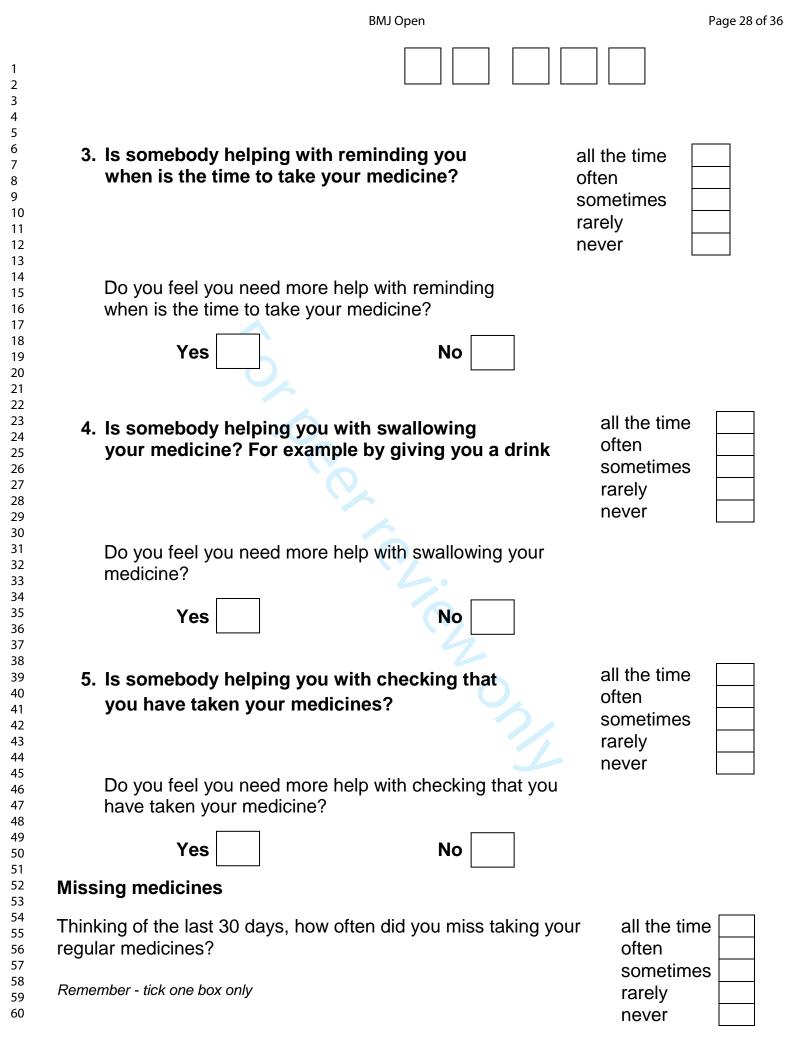
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Univariable analysis	Multivariable analysis
Odds ratio (95% CI)	Odds ratio (95% CI)
p value	p value
0.63 (0.37-1.06) p=0.084	0.69 (0.40-1.19) p=0.180
0.65 (0.36-1.15) p=0.137	0.65 (0.36-1.17) p=0.147
1.20 (1.12-1.28) p<0.001	1.22 (1.14-1.31) p<0.001
4.10 (1.59-10.56) p=0.003	4.91 (1.86-12.97) p=0.00
1.03 (1.00-1.06) p=0.078	1.02 (0.99-1.05) p=0.160
4.67 (2.48-8.79) p<0.001	4.55 (2.38-8.67) p<0.001
6.70 (3.81-11.77) p<0.001	6.53 (3.63-11.75) p<0.00
4.70 (2.68-8.21) p<0.001	4.25 (2.39-7.56) p<0.001
6.72 (3.89-11.59) p<0.001	6.75 (3.79-12.02) p<0.00
4.89 (2.81-8.52) p<0.001	5.58 (3.08-10.09) p<0.00
5.86 (2.84-12.08) p<0.001	5.58 (2.68-11.63) p<0.00
0	
	Odds ratio (95% CI) p value 0.63 (0.37-1.06) p=0.084 0.65 (0.36-1.15) p=0.137 1.20 (1.12-1.28) p<0.001

	Univariable analysis	Multivariable analysis
Variable	Odds Ratio (95% CI) p value	Odds Ratio (95% CI) p value
Age ≥70	0.59 (0.42-0.84) p=0.003	0.59 (0.41-0.86) p=0.006
Gender (female)	0.86 (0.59-1.23) p=0.401	0.88 (0.61-1.28) p=0.498
Number of different medicines	1.04 (1.00-1.09) p=0.040	1.07 (1.02-1.12) p=0.008
Dependence for ADLs (BI<20)	1.21 (0.80-1.84) p=0.362	1.30 (0.83-2.04) p=0.248
Years since stroke	1.00 (0.98-1.02) p=0.950	1.00 (0.98-1.02) p=0.971
Getting help with prescriptions and collection of medication	2.04 (1.45-2.90) p<0.001	2.29 (1.58-3.32) p<0.001
Getting help to have the medicines out of the box, bottle or blister pack	1.39 (0.95-2.02) p=0.089	1.49 (1.00-2.21) p=0.051
Getting help with reminding you when is the time to take your medicine?	2.48 (1.74-3.55) p<0.001	2.67 (1.83-3.90) p<0.001
Getting help to swallow the medication	1.53 (1.01-2.32) p=0.045	1.68 (1.08-2.61) p=0.022
Getting help by checking that you have taken your medicines	2.37 (1.66-3.39) p<0.001	2.50 (1.70-3.66) p<0.001
Getting any kind of help	2.06 (1.44-2.93) p<0.001	2.08 (1.43-3.03) p<0.001
Unmet needs (participant reported more help needed)	5.27 (3.02-9.22) p<0.000	5.09 (2.84-9.11) p<0.001

Table 4. Variables associated with missing medicines.





Bar	thel Questionnaire
These are some questions abou	it your ability to look after yourself.
They may not seem to apply to	you.
Please answer them all.	
Tick one box in each section.	
Bathing	
In the bath or shower do you:	manage on your own?
	need help getting in and out?
Remember - tick one box only	need other help?
	never have a bath or shower?
Stairs	need to be washed in bed?
Do you climb stairs at home:	without any help?
	with someone carrying your frame?
Remember - tick one box only	with someone encouraging you?
	with physical help?
	not at all?
	don't have stairs?
Dressing	
Do you get dressed:	without any help?
	just with help with buttons?
Remember - tick one box only	with someone helping you most of the time?
Mobility	
Do you walk indoors:	without any help apart from a frame?
	with one person watching over you?
Remember - tick one box only	with one person helping you?
	with more than one person helping?
	not at all?
	Or do you use a wheelchair independently?
Transfer	(e.g. round corners)
Do you move from bed to chair:	on your own?
	with a little help from one person?
Remember - tick one box only	with a lot of help from one or more people?

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Feeding		
Do you eat food:	without any help?	
Remember - tick one box only	with help cutting food or spreading butter? with more help?	
Toilet use		
Do you use a toilet or commo		
Remember - tick one box only	with some help but can do something? with quite a lot of help?	
Grooming		
_	5	
Do you brush your hair and te Wash your face and shave: Remember - tick one box only	eeth without help? with help?	
Bladder		
Are you incontinent of urine?	never	
Remember - tick one box only	less than once a week less than once a day	
	more often	
	Or do you have a catheter managed for you	
Bowels		
Do you soil yourself?	never	
Remember - tick one box only	Occasional accident all the time	
	or do you need someone to give you an enema?	







Help with taking tablets after stroke

FAMILY MEMBER/FRIEND OR PRIVATE CARER COPY

Many people with stroke need help with taking their medicines. We would like to ask you few questions about the help you might be offering to your family member/friend/ patient with stroke with taking medicines.

Relation with your family member/friend with stroke

Remember - tick one box only

partner
son or daughter
friend
carer from an agency
other
the state of the second second sector is a second s

if other, please specify

How many different types of medicines does your family member/friend/patient with stroke take in one day? <i>Write the number or an approximation. Please count all medications</i> <i>including eye drops, injections etc.</i>	
How old is your family member/friend/patient with stroke? (years)	
How many years ago was your family member/friend/patient's	

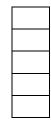
How many years ago was your family member/friend/patient's stroke?

What is your family member/friend/patient with stroke sex?

M F bes the help ne

For each question below, please tick the box that best describes the help needed by your family member/friend/patient with stroke with taking medicines in the last month.

 Is somebody helping your family member/friend/patient with stroke with prescriptions and collection of his/her medicines? all the time often sometimes rarely never



Do you feel your family member/friend/patient with stroke needs more help with prescriptions and collection of his/her medicines?

2.	member/frien	helping your family d/patient with stroke (t of the box, bottle or			often	etimes	
	stroke needs n	ur family member/friend nore help with getting th tle, or blister pack?			t		
	Yes		No				
3.	with stroke w	helping your family m ith reminding to take his/her medici		/friend/p	atient	all the time often sometimes rarely never	
		ur family member/friendelp with reminding when he?			oke		
4.	member/frien swallowing hi	helping your family d/patient with stroke is/her medicine? by giving a drink.	with			all the time often sometimes rarely never	
		u your family member/f swallowing his/her me		atient witl	h stroke nee	ed	
	Yes		No				
5.	stroke with cl	helping your family m necking that he/she ha	as take	n his/he	r medicine:	all the time often sometimes rarely never	
	5	ur family member/friend checking that he/she h					

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Missing medicines

Thinking of the last 30 days, how often did your family member/friend/patient with stroke miss taking his/her regular medicines?

Remember - tick one box only

all the time often sometimes rarely never



Barthel Questionnaire

These are some questions about the ability of your family member/friend/patient with stroke to look after him/herself.

Please answer them all.

Please fill this questionnaire even if you are not regularly caring for your family member/friend/patient with stroke, trying to answer questions in the way you think most accurately describes the disability of your family member/friend/patient with stroke.

Tick one box in each section.

Bathing

In the bath or shower do you:

Remember - tick one box only

Stairs

Do you climb stairs at home:

Remember - tick one box only

Dressing

Do you get dressed:

Remember - tick one box only

need to be washed in bed? without any help? with someone carrying your frame? with someone encouraging you? with physical help?

manage on your own?

need other help?

not at all?

don't have stairs?

without any help?

just with help with buttons?

with someone helping you most of the time?

need help getting in and out?

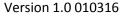
never have a bath or shower?

Mobility

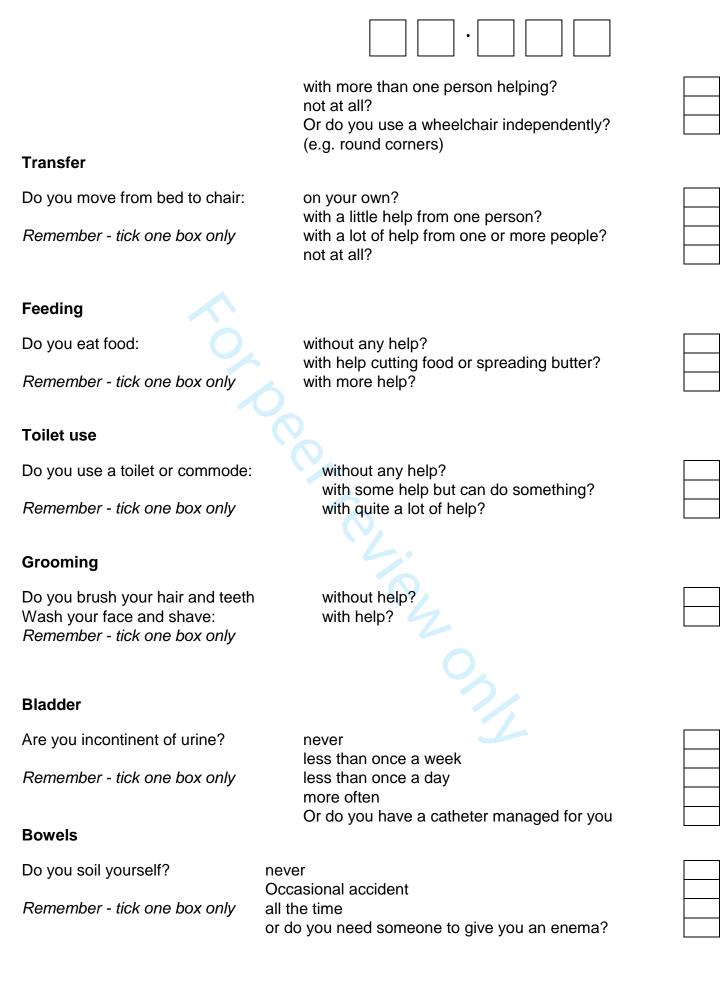
Do you walk indoors:	without any help apart from a frame?
	with one person watching over you?
Remember - tick one box only	with one person helping you?



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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of cross-sectional studies

Section/Topic	ltem #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7-8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe	6-7
measurement		comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8-9
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	-
		(d) If applicable, describe analytical methods taking account of sampling strategy	-
		(e) Describe any sensitivity analyses	-

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-11
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(<i>a</i>) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-12
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13-14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Evaluating practical support stroke survivors get with medicines and unmet needs in primary care: A survey

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3	1	Evaluating practical support stroke survivors get with medicines and unmet
4	2	needs in primary care: A survey
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2 3	1	Abstract
4 5	2	Objectives
6	2	
7 8	3	To design a questionnaire and use it to explore unmet needs with practical aspects of medicines taking after
9 10	4	stroke, predictors of medicine taking and to estimate the proportion of survivors who get support with daily
10 11 12	5	medication taking.
13	6	Design
14 15 16	7	Four workshops with stroke survivors and caregivers to design the questionnaire.
16 17 18	8	A cross-sectional postal questionnaire in primary care.
19	9	Setting
20 21 22	10	18 GP practices in the East of England and London. Questionnaires posted between September 2016 and
23	11	February 2017.
24 25	12	Participants
26 27 28	13	1687 stroke survivors living in the community outside institutional long term care.
28 29 20	14	Primary Outcome measures
30 31 32	15	The proportion of community stroke survivors receiving support from caregivers for practical aspects of
32 33	16	medicine taking; the proportion with unmet needs in this respect; the predictors of experiencing unmet needs
34 35	17	and missing taking medications.
36 37	18	Results
38 39	19	A 5-item questionnaire was developed to cover the different aspects of medicine taking. 596/1687 (35%)
40 41	20	questionnaires were returned. 56% reported getting help in at least one aspect of taking medication and 11%
42 43	21	needing more help. 33% reported missing taking their medicines. Unmet needs were associated with receiving
44 45	22	help with medications (OR: 5.6, p<0.001), being on a higher number of medications (OR: 1.2, p<0.001) and
46 47	23	being dependent for activities of daily living (ADLs) (OR: 4.9, p=0.001). Missing medication was associated
48 49	24	with having unmet needs (OR: 5.1, p<0.001), receiving help with medications (OR: 2.1, p<0.001), being on a
50 51	25	higher number of medicines (OR: 1.1, p=0.008) and being older than 70 years (OR: 0.6, p=0.006).
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1			
2 3	1	Conclusions	
4 5	2	More than half of patients who replied needed help with taking medication, and 1 in 10 had unmet needs in	
6 7	3	this regard. Stroke survivors dependent on others have more unmet needs, more likely to miss medicines and	
8 9	4	might benefit from focused clinical and research attention. Novel primary care interventions focusing on the	
10 11	5	practicalities of taking medicines are warranted.	
12 13	6	Abstract word count- 298	
14 15	7		
16 17	8	Keywords: Stroke, Medication Adherence, Caregivers, Barthel	
18	9		
19 20	10	Article summary	
21 22	11	Strengths and Limitations	
23 24	12	• Development of the questionnaire was based on patients' and caregivers' own views gathered throug	h
25 26	13	workshops.	
27 28	14	• Stroke survivors were recruited from two UK regions.	
29 30	15	• This work identified issues from a population that includes patients severely affected by stroke, who	
31 32	16	are often excluded from research.	
33 34	17	• Results shed light on the effect of stroke related impairments on practical domains and predictors of	
35 36	18	medicine taking, which have significant effects on medication adherence and call for new primary ca	re
37 38	19	interventions.	
39 40	20	• The low response rate reported is a limitation of this study and stroke survivors who are harder to	
41 42	21	reach may have been missed.	
43 44	22		
45 46	23	Funding: This study was funded by the RCGP SFB, Ref. SFB 2014 – 15 'Quantifying the support stroke	
47 48	24	survivors get with daily medication taking: a questionnaire survey'. Anna De Simoni and Luis Ayerbe are	
49 50	25	funded by a NIHR Academic Clinical Lectureships. This article therefore presents independent research	
51 52	26	funded by NIHR. The views expressed are those of the authors and not necessarily those of the NHS, the	
53 54	27	NIHR, or the Department of Health. James Jamison was supported by a research grant from The Stroke	
55 56	28	Association and the British Heart Foundation: TSA BHF 2011/01	
57 58			_
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2	Data sharing statement: No additional data available.
3	
4	Introduction
5	
6	Stroke is the leading cause of disability in developed countries, with an estimated that 25-74% of the
7	50 million stroke survivors worldwide requiring some assistance or being fully dependent on caregivers for
8	activities of daily living (ADLs). ¹⁻³ For many older adults remaining independent at home may depend on how
)	well they can manage complex medication regimens. ⁴⁵ Around half of stroke survivors are dependent on
.0	others for everyday activities. ⁶
1	There is evidence that being dependent for ADLs and impairment in mobility and communication
2	decrease medication adherence in patients suffering from hypertension. ⁷ Deficits in attention, cognition or
3	working memory have been linked with non-adherence to medications in other patient groups. ⁸ In a recent
4	systematic review of medication adherence among patients with cognitive impairment, one third of studies
5	showed that such patients were likely to have a caregiver to assist with medications and there was an
	association between taking four or more medicines and nonadherence.9 In patients taking cardiovascular
,	medicines, multiple factors including cognitive problems, lack of social support, dosing regimen, as well as
8	practical problems and difficulties accessing services, contribute to poor medication adherence. ^{10 11} Low
9	adherence to secondary prevention medication is associated with poor cardiovascular health. ^{12 13}
0	Stroke survivors have previously reported difficulties in the handling of medication as a barrier to
1	adherence to secondary prevention medication after stroke. ¹⁴ This was true irrespective of age at stroke, with
22	younger and older stroke survivors being similarly affected. ¹⁴ Research on medication adherence in stroke has
23	identified multiple barriers to medication taking among stroke survivors. ¹⁴⁻¹⁶ However interventions developed
4	to improve adherence have mainly concentrated on patients responsible for their own medicine taking. ^{17 18}
5	In England, the average age at stroke is 74 for men and 80 years for women. ¹⁹ In elderly patients in
6	particular, cognitive deficits, taking large number of medicines and the complexity of medication regimens
7	have been identified as barriers to medication adherence. ^{20 21} Caregivers are known to play a key role in
	4

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3	1	providing assistance to older people in a range of daily activities including medication taking and physician
4 5	2	visits, ²² and can help improve adherence in cardiac patients with memory problems. ²³
6		
7 8	3	
9	4	
10 11	5	Survivors of stroke have previously reported unmet needs including physical difficulties, cognitive
12 13	6	and emotional difficulties, information needs and other unmet needs. ^{24,25} However we know little about factors
14 15	7	that influence medication taking among stroke survivors with disabilities (i.e. physical or cognitive) living in
16 17	8	the community (i.e. not in nursing homes), their unmet needs around the use of medicines or the proportion
18 19	9	relying on caregivers for some or all aspects of medicine taking.
20 21	10	To date, survey instruments examining the unmet needs of stroke survivors have not focused on practical
22 23	11	aspects of medication taking such as how patients collect or handle their medicines.
24 25	12	The aims of this investigation were to design an instrument to evaluate the support stroke survivors get
26 27	13	with taking their medicines, characterise patients receiving help with medications, estimate the proportion who
28 29	14	have unmet needs with daily medicine taking and who miss medications. We additionally aimed to identify the
30 31	15	predictors of missing medicines and of experiencing unmet needs with medications.
32 33	16	This knowledge can inform the development of primary care interventions aimed at improving medication
34 35	17	taking in this patients' group. Methods
36 37	18	Methods
38 39	19	
40 41	20	Questionnaire development workshops
42 43	21	To develop the questionnaire, current literature evidence was evaluated ¹⁷ and three workshops were
44 45	22	conducted with 26 stroke survivors and 12 caregivers in the East of England (St John's College, Cambridge
46 47	23	2009 ²⁶ : 7 patients, 1 caregiver; Different Strokes, Cambridge 2012: 9 patients, 3 caregivers; Peterborough,
48 49	24	2012: 10 patients, 8 caregivers). Recruitment was opportunistic and no purposive sampling was applied. The
50 51	25	workshops were organised in the context of gathering Patient and Public Involvement (PPI) input into research
52 53	26	grant applications aimed at improving adherence to medication after stroke. ¹⁷
54 55	27	The survey questions were developed through thematic analysis ²⁷ of workshops field notes.
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3	1	A fourth workshop was conducted to gather feedback on the questionnaire using a PPI (Patient and
4 5	2	Public Involvement) exercise with 11 stroke survivors and 3 caregivers recruited through a local stroke group
6 7	3	(Different Strokes, East of England). Two stroke survivors from this group took part in subsequent 'think-
8 9	4	aloud' interviews, which involved talking out loud as they read the questionnaire, continually verbalising what
10 11	5	they were thinking.
12 13	6	Postal survey
14 15	7	In respect to sample size, 400 returned questionnaires would allow good precision for prevalence estimates.
16 17	8	The 95% confidence intervals on various proportions with this sample size were calculated using the Wilson
18 19	9	score method (with continuity correction) and are as follows: 50% (45.00-55.00%), 25% (20.89%-29.60%),
20 21	10	5% (3.16-7.74%). With 600 questionnaires, the improvement in the precision of the estimates would be as
22 23	11	follows: 45.93%-54.07%, 21.62-28.70% and 3.46%-7.14% respectively.
24 25	12	General practices in primary care in the East of England and London were approached through the Clinical
26 27	13	Research Network (CRN). CRN Eastern contacted 20 GP practices, of which 11 replied and took part in the
28 29	14	study. CRN North London contacted 140 GP East London practices by email (Tower Hamlets, Newham and
30 31	15	City & Hackney CCGs), of which only two replied and participated in the study. Five of the eight GP practices
32 33	16	contacted in North London (Barnet CCG) through a research coordinator took part in the study.
34 35	17	Patients with stroke and their caregivers were sent the postal questionnaire according to the following criteria
36 37	18	
38 39	19	Inclusion Criteria
40 41	20	Patients:
42 43	21	All patients aged > 18 on the practice stroke register with documented history of stroke.
44 45	22	Caregivers:
46 47		
48 49	23	• Anyone identified by the patient as having a role helping with medicine taking.
50 51	24	Exclusion Criteria
52	25	• Patients who suffered a Transient ischaemic attack (TIA) but not a stroke.
53 54	26	• Palliative or end of life patients.
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3 4	1	• Patients receiving institutional long term care (receiving total care in residential homes or living in
4 5	2	nursing homes).
6		
7	3	• Patients considered unsuitable to taking part in the study by their GP.
8		
9	4	
10 11	5	Survey participant identification
12	Ū	
13	6	A list of prospective patients was compiled from the stroke register of each surgery by the practice
14	-	
15 16	7	staff. No restriction was placed on the recruitment of survivors who were dependent for ADLs or lacking
17	8	capacity. The list was screened by a practice GP and anyone not meeting the inclusion criteria or who was
18		
19	9	considered unsuitable for the study was excluded.
20		
21 22	10	
23		
24	11	Survey participant recruitment
25		
26 27	12	Eligible participants were sent a study survey pack by practice staff between September 2016 and
27 28	40	
29	13	February 2017. Study recruitment packs included two invitation letters, information sheets, questionnaires and
30	14	postal version of Barthel Index ²⁸ , one of which was for completion by the patient and the other by the
31		
32 33	15	caregiver. The Barthel Index provides a measure of functional independence and physical functioning and has
34	16	been used in stroke research previously. ²⁹ Patients with Barthel score 20 were categorised as independent for
35	10	been used in stroke research previously. I attents with Darther score 20 were categorised as independent for
36	17	ADLs, those with score 15-19 moderately dependent for ADLs, and those with scores 0-14 severely
37 38		
30 39	18	dependent. ³⁰ If receiving help with medications, the patient was asked to pass to their caregiver the invitation
40	19	letter and information sheet and invite him/her to complete their copy of the questionnaire, providing answers
41	_0	
42	20	on the patient's medicine taking. Family members, friends or paid caregivers of stroke survivors who were
43 44	24	
45	21	severely disabled and/or lacked mental capacity were invited to fill and return the caregivers' questionnaires
46	22	only on behalf of patients. The information sheets stated that consent was implied by returning the completed
47		
48 49	23	questionnaire. Participants were asked to return completed questionnaires to the research centre in the
49 50	24	FREEPOST envelopes provided. A second mail out of the study invitation pack was sent to all patients as a
51	24	TREEFOST envelopes provided. A second man out of the study invitation pack was sent to an patients as a
52	25	reminder, 2 weeks after the first one.
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54 55	26	
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1 Ethical approval

2 This study has received ethical approval from Cambridge Central Research Ethics Committee (REC reference:
3 16/EE/0182) and from the Health Research Authority (IRAS project ID: 170931)

5 Survey Analysis

Survey data entry was performed by Document Capture Company.³¹ Individual patients' characteristics (age, gender, time since stoke, number of daily medicines) were collected from the questionnaires themselves. Practice population, number of patients on stroke registers, deprivation score and ethnicity were taken from the National General Practice profiles (https://fingertips.phe.org.uk/profile/general-practice). The proportions of patients in each sociodemographic category, needing help taking medication, missing any medication in the previous 30 days, and reporting the need for more help taking medication, were estimated. When the survivor and caregiver questionnaires were both returned together, study data were collected from the patient's questionnaire only. The associations between 'Unmet needs' and age ($\langle \text{ or } \geq 70 \rangle$ years), gender, total number of medicines taken, dependence for ADLs, years since stroke, and receiving help with medicines were investigated with individual logistic regression models (a different model per variable investigated), adjusted each and all of them for age and gender. Individual logistic regression models adjusted for age and gender were also used to estimate the association between 'Missed medicines in the previous 30 days' and age (< or > 70 years), gender, total number of medicines taken, dependent for ADLs, years since stroke, help with medicines and unmet needs (a different model adjusted for age and gender per variable investigated). Sensitivity analysis was conducted to investigate if predictors of missing medication or unmet needs vary when the analysis was done on the whole dataset *versus* on questionnaires filled by patients only. Chi squared tests were used to compare the responses on unmet needs and missing medication given by patients versus caregivers. All statistical analysis has been conducted with Stata (version 14, StataCorp LP, College Station, TX, USA, 2013).

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1 2 3 4	1	Results
5 6 7	2	Questionnaire development
, 8 9	3	Taking medications emerged as an important issue in all three workshops: nearly half of patients
10 11	4	stated that a family member or friend was supporting them with daily medicine routines especially in relation
12 13	5	to prompting medicine taking. This was put down to effects of the stroke itself on memory retention rather
14 15	6	than general memory problems that people without stroke also experience. They admitted missing doses due to
16 17	7	forgetting. Only a small proportion of survivors were actually handling their own prescriptions and were
18 19	8	relying on support from family and/or community services. In one workshop almost all survivors had Dosette
20 21	9	medication boxes and agreed that taking medications out of safety bottles and blister packs was a problem due
22 23	10	to physical disabilities.
24 25 26	11	Thematic analysis of workshop data revealed five main practical domains of support needed with
27 28	12	medication taking: 1) Dealing with prescriptions and collection of medicines; 2) Getting medicines out of the
29 30	13	box, blister packs of bottles; 3) Prompting 'It's time to take your medicine'; 4) Swallowing medicines; and 5)
31 32	14	Checking whether medicines have been taken. The final study questionnaire (see Supplementary file 1)
33 34	15	included questions relating to each of these five domains, one item related to adherence (missed medicine in
35 36	16	the last 30 days) and an assessment of disabilities through completion of the validated postal version of the
37 38	17	Barthel Index. ²⁸ The questionnaire was adapted for caregivers (see Supplementary file 2).
39 40 41	18	Questionnaire finalisation
42 43	19	On the basis of the fourth workshop and two 'think-aloud' interviews, we reworded the survey
44 45	20	questions (e.g. from 'Do you get help with' was changed into 'Is somebody helping you with') and used a
46 47	21	scale response 'All the time', 'Often', 'Sometimes', 'Rarely', 'Never' for the first question of each of the five
48 49	22	survey domains, which was originally conceived as a 'yes' or 'no' answer (see supplementary file for text of
50 51	23	questions).
52 53 54 55 56 57 58	24	9

2 3 4	1	Survey
5		
6 7 8	2	Practice characteristics
8 9 10	3	18 GP practices agreed to take part in the study, of which just over 1/3 were in London (n=7). GP
11 12	4	practices were relatively large with an average population of $11,904$ patients (SD = 4010) and a low to
13 14	5	moderate level of deprivation (Index of Multiple Deprivation ³² (IMD): Mean-7.05: SD-3.19). Out of 3066
15 16	6	patients on the stroke registers, 1687 stroke patients (55%) were considered eligible for the study and received
17 18	7	the postal questionnaire. The average response rate of East of England and London practices was 42% and
19 20	8	27% respectively. The response rate varied between 16% and 53% across practices.
21 22	9	Participant characteristics
23 24	10	Participant characteristics
25 26	11	
20 27 28	12	596 participants returned a completed questionnaire [549 (92.1 %) from patients, 47 (7.9 %) from
29 30	13	caregivers showing a mean response rate of 35% (0.33-0.37). Participants were on average 72.7 yrs old.
31 32	14	37.8% (n=210) of the sample were female, see table 1. There were a high proportion of white patients in the
33 34	15	recruited practices (79%), which were on average 21% of mixed or ethnic minority background.
35 36	16	Approximately 28% of study participants were completely independent for ADLs.
37 38	17	Participants getting any kind of help with medicines were on average 73.6 years old, two thirds were
39 40	18	male with only 19% of this group completely independent for ADLs.
41 42	19	
42 43 44	20	Patients with unmet needs were on average 69 years old, predominantly male (71%) and 56.86% were
45 46	21	severely dependent for ADLs. Patients who missed medications were on average 70 years old, 64% were male
47 48	22	and the majority (48%) were moderately dependent for ADLs.
49 50	23	
51 52	24	Table 1 here
53 54	25	
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Support with daily medication taking

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3 Overall, 55.5% (95% CI: 51.7-59.7) of the participants received help in at least one aspect of taking 4 medication, in that they ticked one of the options from 'all the time' to 'rarely' on one or more of the five 5 questions related to medicine taking. 11% (95% CI: 8.8-13.9) of patients reported experiencing unmet needs 6 and needing more help with at least one of the aspects of taking medication, in that they ticked 'yes' to the 7 question "do you feel you need more help", on one or more of the five questions related to medicine taking. 8 The proportion of questionnaires reporting unmet needs filled in by caregivers, 19.6% (n=9), and by patients, 10.7% (n=57), had no significant difference (p=0.068). 9

10 Among participants help was needed to some degree with prescriptions and collection of medicines (49.8 %), getting medicines out of the box or packet (27.9 %), reminding to take medicines (36.4 %), 11 12 swallowing medicines (20.2 %) and checking that medicines have been taken (34.1 %).(see Table 2). Being 13 reminded to take medicines, dealing with prescriptions and collection of medicines and getting medicines out 14 of a pack or bottle were the most commonly reported areas of unmet needs. Almost two thirds of participants (65.3%) reported never missing medicines in the last 30 days. Out of the 34.7% of patients who said they 15 missed taking medicine at any point in the previous 30 days, 23.9% said rarely, 9.3% sometimes, 0.8% often 16 17 and 0.7% all the time. The proportion of questionnaires reporting missing medication at some point, filled in by caregivers, 27.7% (n=13), and by patients 35.3% (n=193), had no significant difference (p=0.292). 18

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Table 2 here

Factors associated with unmet needs 20

21 Being on a higher total number of daily medications (OR: 1.2, (1.1-1.3), p<0.001), severe 22 dependence for ADLs (OR: 11.62 (4.16-32.43) p<0.001) and receiving any kind of help (OR: 5.6, (2.7-11.63), 23 p < 0.001) in relation to taking medication was associated with experiencing unmet needs. Getting help with 24 swallowing medicines (OR: 6.8, (3.8-12.02), p<0.001), getting medicines out of a box, blister packs or bottles (OR: 6.5, (3.6-11.8), p<0.001) showed the strongest associations with experiencing unmet needs (see table 3). 25

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1	When the analyses were conducted with data from questionnaires filled by patients only, the variables
2	significantly associated with unmet needs were the same, apart from years since stroke (Supplementary
3	Appendix 1).

4	Table 3 here
5	
6 7 8	Factors associated with missing medications
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9	Being older (age \geq 70) was associated with a lower probability of missing medication (OR: 0.59)
10	(0.41-0.86) p=0.006). Being on a higher number of daily medicines (polypharmacy) (OR:1.07 (1.02-1.12),
11	p=0.008) and getting any kind of help with medicine taking (OR:2.08 (1.43-3.03) p<0.001) was associated
12	with higher probability of missing medicines. The more unmet needs stroke survivors had with taking
13	medication, the more likely they were to miss their medicines (OR: 5.3 (3.0-9.5), p<0.001). (see Table 4).
14	When the analyses were conducted with data from questionnaires filled by patients only, the variables
15	significantly associated with missing medication were the same (Supplementary Appendix 1).

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18	Table 4 here
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20	Discussion

21 Summary of findings

From workshops we identified 5 key issues that patients regarded as important with medication taking after stroke. We converted these into a five item questionnaire that we distributed to people on stroke registers in 18 general practices. We obtained a response rate of 35%. Among respondents, 56% of survivors in the community were receiving help in some aspect of daily medication taking, 11% reported needing more help in

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at least one domain of medicine taking and 34% missed taking their medicines at some point in the previous
 30 days.

A higher total number of daily medicines, being severely dependent for ADLs and receiving help with medication were predictors of experiencing at least one unmet need in respect of medication taking. Stroke survivors who were younger, taking a higher number of daily medicines and experiencing a greater number of unmet needs were more likely to miss medications.

- 7 This work identified issues from a population that includes patients severely affected by stroke, who are often
 8 excluded from research.¹⁷ Results presented here shed light on the effect of stroke related impairments on
 9 practical domains and predictors of medicine taking, which are shown to have significant effects on overall
 10 adherence.

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13 Strengths and limitations

14 A strength of this study is that the questionnaire was developed from patients' and caregivers' own 15 views gathered through workshops. Although not recruited through purposive sampling, workshop participants 16 suffered from a range of stroke related impairments, as highlighted by the reported use of Dossette boxes, 17 dependence on others for aspects of medicine taking like prompting medication times, and dependence for ADLs such as collecting prescriptions and taking tablets out of boxes. In the postal survey, the inclusion of 18 19 stroke survivors regardless of level of dependence for ADLs permitted investigating a population who are understudied,¹⁷ yet may have significant unmet needs that can affect their adherence to medications. This 20 21 investigation highlights caregivers' role in managing medicines in survivors dependent for ADLs.

However, study limitations should also be considered. The response rate across recruited GP practices
 was low and harder to reach stroke survivors may have been missed. Poor response rate is a source of bias that
 might affect our estimates.

Interestingly, considering the average age at stroke in England (i.e. 74 for men and 80 years for women¹⁹), our
participants' population was slightly younger (73 years), perhaps reflecting the fact that patients receiving
institutional long term care were excluded from the study or that older people found harder taking part in a
postal survey. Through the Barthel score, we did not assess cognition directly, although low cognitive function

is associated with poor adherence.³³ As the Barthel focuses on physical disability it is not known to what
extent study participants were cognitively impaired or suffered from communication difficulties like aphasia.
In addition, dependency for ADLs could have been caused by existing co-morbidities other than stroke. We
did not collect information on the use of blister packaged medication or devices to aid compliance, which
could have influenced medication taking practices. Finally this study examined all medicine taking and did not
differentiate between stroke secondary prevention medications and other drug categories.

7 Comparisons with existing research

8 To our knowledge this is the first study that shows that more than half of all stroke survivors get help 9 with some aspect of medicine taking and that those receiving help are more likely to have unmet needs. This 10 provides some insight in to why adherence to medication in stroke survivors may be poor.³⁴

Moreover, the greater the number of medicines, the more likely stroke survivors were to miss medications. Addressing pill burden by simplifying drug regimens may be an important focus for future interventions. Indeed the polypill approach to medication taking has been shown to reduce cardiovascular as well as total pill burden in a primary care setting.³⁵ Simpler dosing regimens, are known to be associated with better medication adherence ³⁶ while fewer medicines has been shown to be an independent predictor of long term medication persistence among stroke survivors.^{37 38} A recent trial incorporating a fixed-dose combination polypill approach to taking cardiovascular medicine demonstrated better adherence among patients receiving a single pill.³⁹

Receiving help with prescriptions and collecting medicines was identified as the area where most help was received (49.7% of respondents). Stroke survivors who are dependent for activities of daily living may face considerable practical challenges accessing health care resources at the pharmacy and the GP practice. A recent study in the USA found that around 2/3 of caregivers were involved in at least 1 medication management activity of elderly patients and that high involvement in Instrumental Activities of Daily Living (IADLs) was associated with the caregiver providing the patient with assistance in ordering medicines.⁴⁰ Filling prescriptions is also known to be an important factor influencing medication adherence.^{41 42} Indeed caregivers can play a significant role in ensuring appropriate medication taking. A recent interview study exploring potential barriers and facilitators of medication adherence in stroke identified the central role of the caregiver in medication adherence.⁴³ Our evaluation of an online stroke forum also confirmed the important

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role of the caregiver in facilitating medication adherence.¹⁴ Monitoring prescription collections, liaising with
the GP and pharmacy, increasing the time between prescriptions or arranging medication deliveries, may help
to address prescription needs.

Around 11% of stroke survivors reported unmet medication needs. We found that stroke survivors severely dependent for ADLs and receiving help with medicines were more likely to report unmet needs, which is in line with a recent study investigating stroke/TIA survivors in Australia, where greater functional ability was associated with fewer unmet needs, including those related to secondary prevention.⁴⁴ In previous research on unmet needs among stroke survivors, a 44 item survey study by McKevitt and colleagues (2011) reported that 49% of stroke survivors had at least one unmet need ²⁵, while in a study of Australian survivors who completed a 58 item survey, the percentage was 84%.²⁴ Both these studies however examined unmet needs over a variety of domains including health, work, leisure and everyday living, social support and finances, whereas our study focused on medication needs only.

Getting help to take medicines out of a box, packet or bottle was the area where the greatest proportion of stroke survivors needed help all of the time. We previously found that the use of pill boxes and blister packed medication to be both a facilitator ³⁵ and a barrier ¹⁴ to adherence among stroke survivors¹⁵, while interventions using blister packaging and pill boxes have been found to be associated with improved adherence.⁴⁵ Although electronic medication devices were considered potentially effective in improving medication taking behaviour among patients with cognitive impairments, success in using such devices was dependent on the patient having a good level of dexterity, while removing the medication from these devices was also found to be challenging. 46 47 48

The need for further support in this domain, as reported in the current study, suggests that handlingmedications remains problematic for stroke survivors.

An interesting finding from this survey study is that stroke survivors who missed medicines were younger. This is consistent with other research on adherence in stroke that found that younger age was predictive of poor adherence⁴⁹, and has also been described in patients taking medication for cardiovascular disease.⁵⁰ The finding in the present study contrasts with the view that older patients are more likely to face difficulties taking medication^{51 52} which is frequently attributed to higher number of pre-existing comorbidities resulting in polypharmacy and increased complexity of medication taking regimens. The fact that older

patients may be less likely miss medicine might be down to the support they receive from caregivers. Our
 findings suggests that support needed with medications may be overlooked in younger stroke survivors.⁵³

In this study a significant proportion of patients admitted missing medications occasionally. There is evidence that improving adherence by one anti-hypertensive pill/week for a once-a-day regimen reduces the hazard of stroke by 8–9 % and death by 7 %.⁵⁴ Each incremental 25% increase in proportion of days covered with statin medications is associated with a 0.10 mmol/L reduction in LDL-C cholesterol.^{55 56} Non-adherence to cardiovascular medications is associated with increased risk of morbidity and mortality.⁵⁷

- 9 Implications for clinical practice

A significant proportion of patients, particularly those who take large numbers of tablets, are disabled or receive help to take medication, have unmet needs and miss their tablets, which can increase risk of recurrent cardiovascular events. These particularly vulnerable groups of patients might benefit from focused clinical attention. Through understanding the needs of survivors and caregivers in different aspects of daily medication taking, we can help direct future resources to the areas of greatest need. For example, further exploration of medication packaging is warranted to understand the difficulties stroke survivors face handling medicines. Polypharmacy remains a difficulty for older patients. Therefore, exploring the use of combination pills and further efforts to reduce the burden of multiple medications among stroke survivors is warranted. The questionnaire we have developed could be used to understand the challenges around medication faced by other patient groups. Unmet medication needs among UK stroke survivors have not been previously explored in the context of activities both survivors and caregivers consider important for taking medicines. Through understanding the extent of unmet needs as well as the areas in which these are greatest, strategies can be developed which address poor medication taking practices and therefore improve medication adherence. **Future research** Novel interventions focussing on the practicalities of taking medicines and aimed at improving stroke survivors' adherence to treatment are needed. The findings reported here may inform the development of such

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3	1	interventions. Advances in technology have the potential to facilitate delivery of such interventions, e.g.
4 5	2	electronic devices prompting medication taking times. ^{58 59} Efforts to improve medication taking among
6 7 8	3	survivors of stroke using technology are already underway and have shown promise. ⁶⁰ .
9 10	4	Acknowledgements
11 12	5	The authors wish to thank all the stroke survivors and caregivers who participated in this study.
13 14	6	Competing interests
15 16 17	7	None declared
18 19 20	8	Data sharing statement
21 22	9	No additional data are available
23 24 25	10	Author/s contribution
26 27	11	ADS is the Chief Investigator, contributed to the study design, data analysis and commented on the
28 29 30	12	manuscript. JJ contributed to the study design, data collection, data analysis and prepared the manuscript for
31 32	13	submission. JM is a co-investigator on the study, wrote and commented on the manuscript. SS is a co-
32 33 34	14	investigator on the study, wrote and commented on the manuscript. LA contributed to the data analysis and
35 36	15	commented on the manuscript. GDiT contributed to the data analysis and commented on the manuscript. All
37 38	16	authors agreed on the final draft of the submitted manuscript.
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Table 1. Characteristics of participants who took part in the survey study (mean scores reported unless otherwise stated). N represents the number of participants

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64

18

45

61

59

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17

29

Patients with unmet needs

Mean

68.8

9.3

9.7

SD

9.2

7.1

%

28.6

71.4

9.8

33.3

56.9

Patients who receive any kind of help

Mean

73.6

7.97

7.3

%

36.2

63.2

18.9

46.4

34.6

SD

13.0

8.5

4.1

Patients who miss medication

Mean

70.5

7.7

6.9

24

%

35.6

64.4

25.7

48.0

26.3

Ν

203

68

123

186

190

45

84

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All patients

Mean

72.7

7.7

6.4

SD

11.6

7.6

4

who completed the survey in respect to the different variables. BI: Barthel Index.

Ν

331

112

197

295

312

53

130

97

%

37.8

67.2

28.3

47.1

24.6

Ν

588

210

346

535

557

139

231

121

Age

Female

Male

Time since

stroke

N of daily

medicines

Independent

for ADLs

(BI=20)

Moderately dependent for

ADLs (BI=15-19)

Severely dependent for

ADLs (BI=0-14)

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		N	All the Time N (%)	Often N (%)	Sometimes N (%)	Rarely N (%)	Never N (%)	Yes N (%)	No N (%)
	Question 1 Is somebody helping with prescriptions and collection	583	186 <i>(31.9)</i>	19 (3.3)	40 (6.9)	45 (7.7)	293 (50.2)		
	of your medicines? Question 1a Do you feel you need more help with prescriptions and	551						33	518
-	collection of your medicines? Question 2							(6.0)	(94.0)
	Is somebody helping you getting the medicines out of the box, bottle or blister pack?	578	85 (14.7)	15 (2.6)	31 (5.4)	30 (5.2)	417 (72.1)		
-	Question 2a Do you feel you need more help with getting the medicines out of the box, bottle or blister pack?	553	5					33 (6.0)	520 (94.0)
	Question 3 Is somebody helping with reminding you when is the time to take your medicine?	577	78 (13.6)	22 (3.8)	59 (10.2)	51 (8.8)	367 (63.6)		
-	Question 3a Do you feel you need more help with reminding when is the time to take your medicine?	564			ē.			35 (6.2)	529 (93.8)
	Question4 Is somebody helping you with swallowing your medicine?	579	56 (9.7)	11 (1.9)	29 (5.0)	21 (3.6)	462 (79.8)		
	Question 4a Do you feel you need more help with swallowing your medicine?	560				C	5,	9 (1.6)	551 (98.4)
	Question 5 I somebody helping you with checking that you have taken your medicines	576	76 (13.2)	23 (4.0)	58 (10.0)	40 (6.9)	379 (65.9)		
	Question 5 a Do you feel you need more help with checking that you have taken your medicine	558						20 (3.6)	538 (96.4)
	Thinking of the last 30 days, how often did you miss taking your regular	594	4 (0.7)	5 (0.8)	55 (9.3)	142 (23.9)	388 (65.3)		

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		Univariable analysis		Multivariable analysis
Variable	N	Odds ratio (95% CI) p value	N	Odds ratio (95% CI) p value
Age≥70	581	0.6 (0.4-1.1) p=0.084	544	0.7 (0.4-1.2) p=0.180
Gender (female)	544	0.7 (0.4-1.2) p=0.137	544	0.7 (0.4-1.2) p=0.147
Number of different medicines	542	1.2 (1.1-1.3) p<0.001	509	1.2 (1.1-1.3) p<0.001
Moderate Dependence for ADLs (BI: 15-19)	479	2.2 (0.8-6.1) p=0.135	447	2.7 (1.0-7.5) p=0.068
Severe Dependence for ADLs (BI: 0- 14)	479	8.5 (3.2-22.8) p<0.001	447	11.6 (4.2-32.4) p<0.001
Years since stroke	522	1.0 (1.0-1.1) p=0.078	490	1.0 (1.0-1.1) p=0.160
Getting help with prescriptions and collection of medication	568	4.7 (2.5-8.8) p<0.001	533	4.6 (2.4-8.7) p<0.001
Getting help with taking medicines out of the box, bottle or blister pack	563	6.7 (3.8-11.8) p<0.001	527	6.6 (3.6-11.8) p<0.001
Getting help with reminding you when is the time to take your medicine?	562	4.7 (2.7-8.2) p<0.001	526	4.3 (2.4-7.6) p<0.001
Getting help to swallow the medication	565	6.7 (3.9-11.6) p<0.001	528	6.8 (3.8-12.0) p<0.001
Getting help by checking that you have taken your medicines	562	4.9 (2.8-8.6) p<0.001	526	5.9 (3.1-10.1) p<0.001
Getting any kind of help	574	5.9 (2.8-12.1) p<0.001	537	5.9 (2.7-11.6) p<0.001

 Table 3. Results of the multivariable analysis showing the variables associated with unmet needs.

 N: number of observations; ADLs: Activities of daily living; BI: Barthel Index.

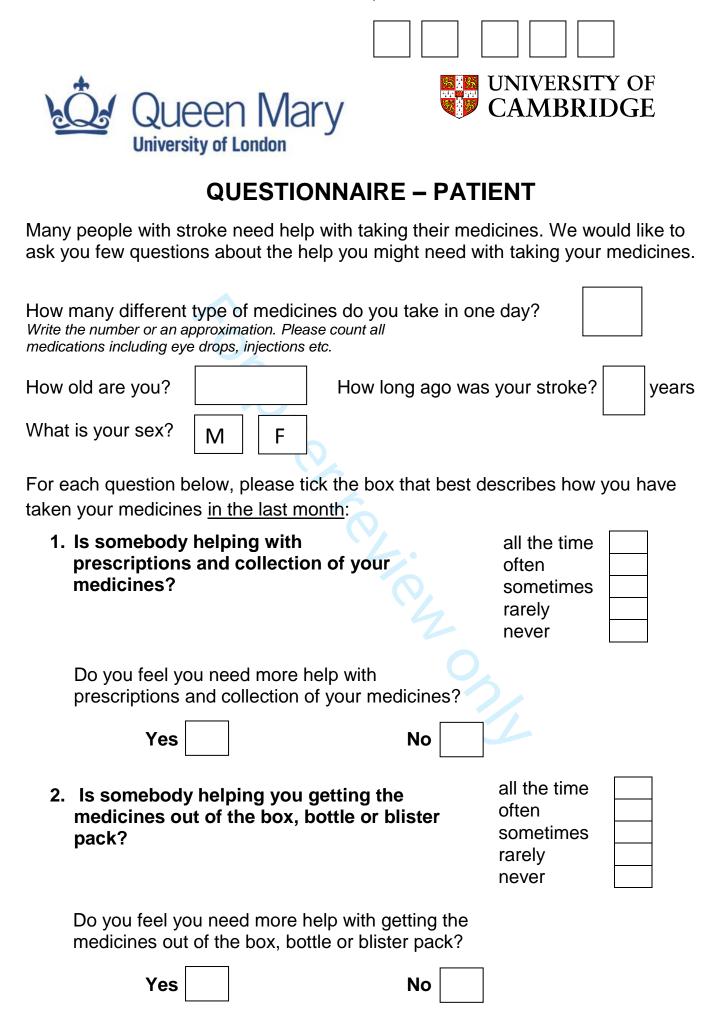
	τ	Jnivariable analysis	N	Iultivariable analysis
Variable	Ν	Odds Ratio (95% CI) p value	Ν	Odds Ratio (95% CI
Age ≥70	594	0.6 (0.4-0.8) p=0.003	555	0.6 (0.4-0.9) p=0.006
Gender (female)	555	0.9 (0.6-1.2) p=0.401	555	0.9 (0.6-1.3) p=0.498
Number of different medicines	555	1.0 (1.0-1.1) p=0.040	520	1.1 (1.0-1.1) p=0.008
Moderate Dependence for ADLs (BI: 15-19)	490	1.2 (0.8-1.8) p=0.468	456	1.3 (0.8-2.0) p=0.343
Severe dependence for ADLs (BI 0- 14)	490	1.3 (0.8-2.1) p=0.342	456	1.4 (0.8-2.4) p=0.239
Years since stroke	533	1.0 (0.9-1.0 p=0.950	499	1.0 (0.9-1.0) p=0.971
Getting help with prescriptions and collection of medication	581	2.0 (1.5-2.9) p<0.001	544	2.3 (1.6-3.3) p<0.001
Getting help to have the medicines out of the box, bottle or blister pack	576	1.4 (1.0-2.0) p=0.089	538	1.5 (1.0-2.2) p=0.051
Getting help with reminding you when is the time to take your medicine?	575	2.5 (1.7-3.6) p<0.001	537	2.7 (1.8-3.9) p<0.001
Getting help to swallow the medication	578	1.5 (1.0-2.3) p=0.045	539	1.7 (1.1-2.6) p=0.022
Getting help by checking that you have taken your medicines	576	2.4 (1.7-3.4) p<0.001	537	2.5 (1.7-3.7) p<0.001
Getting any kind of help	587	2.1 (1.4-3.0) p<0.001	548	2.1 (1.4-3.0) p<0.001
Unmet needs (participant reported more help needed)	580	5.3 (3.0-9.2) p<0.000	544	5.3 (3.0-9.4) p<0.001

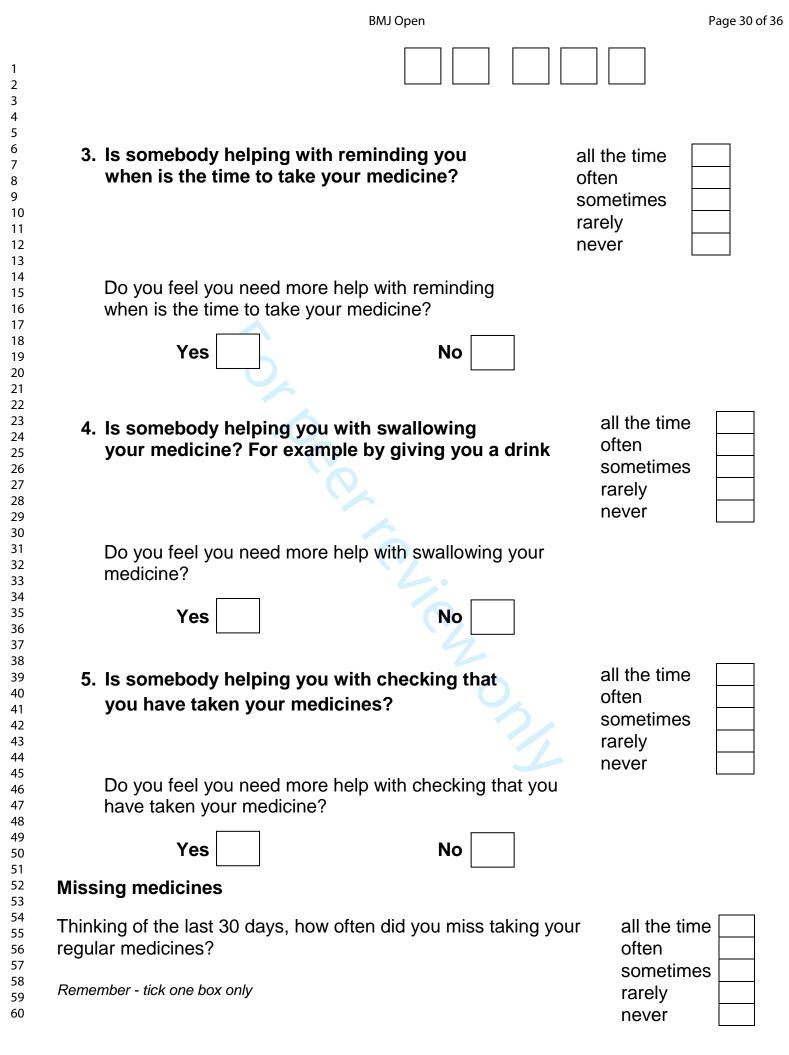
Table 4. Results of univariable and multivariable analysis showing associations with missing medicines.

N: number of observations; ADLs: Activities of daily living; BI: Barthel Index.

		Unmet needs		Missing medication
Variable	N	Odds ratio (95% CI) p value	N	Odds ratio (95%CI) p value
Age ≥70	498	0.7 (0.4-1.2) p=0.248	508	0.6 (0.4-0.9) p=0.009
Gender (female)	498	0.7 (0.4-1.3) p=0.262	508	0.9 (0.6-1.3) p=0.576
Number of different medicines	465	1.2 (1.1-1.3) p<0.001	475	1.1 (1.0-1.1) p=0.015
Moderate Dependence for ADLs (BI: 15-19)	408	2.6 (0.9-7.5) p<0.075	417	0.3 (-0.2-0.7) p=0.289
Severe Dependence for ADLs (BI: 0-14)	408	10.9 (3.8-31.0) p<0.001	417	0.5 (-0.1-1.0) p=0.119
Years since stroke	446	1.0 (1.0-1.1) p=0.036	454	1.0 (0.9-1.03) p=0.725
Getting help with prescriptions and collection of medication	487	4.6 (2.4-8.9) p<0.001	497	2.6 (1.8-3.8) p<0.001
Getting help with taking medicines out of the box, bottle or blister pack	481	6.6 (3.6-12.2) p<0.001	491	1.7 (1.1-2.6) p=0.20
Getting help with reminding you when is the time to take your medicine?	480	4.7 (2.6-8.5) p<0.001	490	3.0 (2.0-4.5) p<0.001
Getting help to swallow the medication	482	7.8 (4.2-14.8) p<0.001	492	2.1 (1.3-3.4) p=0.005
Getting help by checking that you have taken your medicines	480	5.9 (3.2-10.9) p<0.001	490	2.8 (1.8-4.2) p<0.001
Getting any kind of help	491	5.6 (2.7-11.9) p<0.001	501	2.3 (1.6-3.4) p<0.001

, anaryses, all models adjusted for age an Supplementary Appendix 1. Predictors of unmet needs and missing medication, responses given by patients only (i.e. caregivers' filled questionnaire excluded). Multivariable analyses, all models adjusted for age and gender. N: number of observations.





Bar	thel Questionnaire					
These are some questions abou	it your ability to look after yourself.					
They may not seem to apply to you.						
	you.					
Please answer them all.						
Tick one box in each section.						
Bathing						
In the bath or shower do you:	manage on your own?					
	need help getting in and out?					
Remember - tick one box only	need other help?					
	never have a bath or shower?					
	need to be washed in bed?					
Stairs						
Do you climb stairs at home: 🤇	without any help?					
ý	with someone carrying your frame?					
Remember - tick one box only	with someone encouraging you?					
	with physical help?					
	not at all?					
	don't have stairs?					
Dressing						
Do you get dressed:	without any help?					
	just with help with buttons?					
Remember - tick one box only	with someone helping you most of the time?					
Mobility						
-						
Do you walk indoors:	without any help apart from a frame?					
Remember - tick one box only	with one person watching over you?					
Comornisor - don one sox only	with one person helping you?					
	with more than one person helping? not at all?					
	Or do you use a wheelchair independently?					
	(e.g. round corners)					
Transfer	(0.9					
Do you move from bed to chair:	on your own?					
	with a little help from one person?					
Remember - tick one box only	with a lot of help from one or more people?					

Feeding		
Do you eat food:	without any help?	
Remember - tick one box only	with help cutting food or spreading butter? with more help?	
Toilet use		
Do you use a toilet or commo		
Remember - tick one box only	with some help but can do something? with quite a lot of help?	
Grooming		
_	ath without halp?	
Do you brush your hair and to Wash your face and shave: Remember - tick one box only	eeth without help? with help?	
Bladder		
Are you incontinent of urine?		
Remember - tick one box only	less than once a week less than once a day	
	more often	
	Or do you have a catheter managed for you	
Bowels		
Do you soil yourself?	never	
Remember - tick one box only	Occasional accident all the time	
nomen der der ene ber eng	or do you need someone to give you an enema?	







Help with taking tablets after stroke

FAMILY MEMBER/FRIEND OR PRIVATE CARER COPY

Many people with stroke need help with taking their medicines. We would like to ask you few questions about the help you might be offering to your family member/friend/ patient with stroke with taking medicines.

Relation with your family member/friend with stroke

Remember - tick one box only

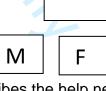
partner
son or daughter
friend
carer from an agency
other
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it other, please specify

How many different types of medicines does your family	
member/friend/patient with stroke take in one day?	
Write the number or an approximation. Please count all medications	
including eye drops, injections etc.	_
How old is your family member/friend/patient with stroke? (years)	

How many years ago was your family member/friend/patient's stroke?

What is your family member/friend/patient with stroke sex?



For each question below, please tick the box that best describes the help needed by your family member/friend/patient with stroke with taking medicines in the last month.

 Is somebody helping your family member/friend/patient with stroke with prescriptions and collection of his/her medicines? all the time often sometimes rarely never

Do you feel your family member/friend/patient with stroke needs more help with prescriptions and collection of his/her medicines?

Yes

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			•		
2.	Is somebody helping your fa member/friend/patient with s medicines out of the box, bo	stroke getting the	all the tir often sometim rarely never		
	Do you feel your family members stroke needs more help with go of the box, bottle, or blister page	etting the medicines out			
	Yes	Νο			
3.	Is somebody helping your fa with stroke with reminding when is time to take his/her		of sc ra	l the time ten ometimes rely ever	
	Do you feel your family member needs more help with remindin his/her medicine? Yes		Ke		
4.	Is somebody helping your fa member/friend/patient with s swallowing his/her medicine For example by giving a drin	stroke with		all the time often sometimes rarely never	
	Do you feel you your family me more help with swallowing his/	•	stroke need		
	Yes	No			
5.	Is somebody helping your fa stroke with checking that he	•		all the time often sometimes rarely never	
	Do you feel your family member more help with checking that h				Ĺ

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No

Version 1.0 010316

Yes

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Missing medicines

Thinking of the last 30 days, how often did your family member/friend/patient with stroke miss taking his/her regular medicines?

Remember - tick one box only

all the time often sometimes rarely never



Barthel Questionnaire

manage on your own?

need other help?

without any help?

need help getting in and out?

never have a bath or shower?

need to be washed in bed?

These are some questions about the ability of your family member/friend/patient with stroke to look after him/herself.

Please answer them all.

Please fill this questionnaire even if you are not regularly caring for your family member/friend/patient with stroke, trying to answer questions in the way you think most accurately describes the disability of your family member/friend/patient with stroke.

Tick one box in each section.

Bathing

In the bath or shower do you:

Remember - tick one box only

Stairs

Do you climb stairs at home:

Remember - tick one box only

Dressing

Do you get dressed:

Remember - tick one box only

with someone encouraging you? with physical help? not at all? don't have stairs?

with someone carrying your frame?

	i

without any help? just with help with buttons? with someone helping you most of the time?

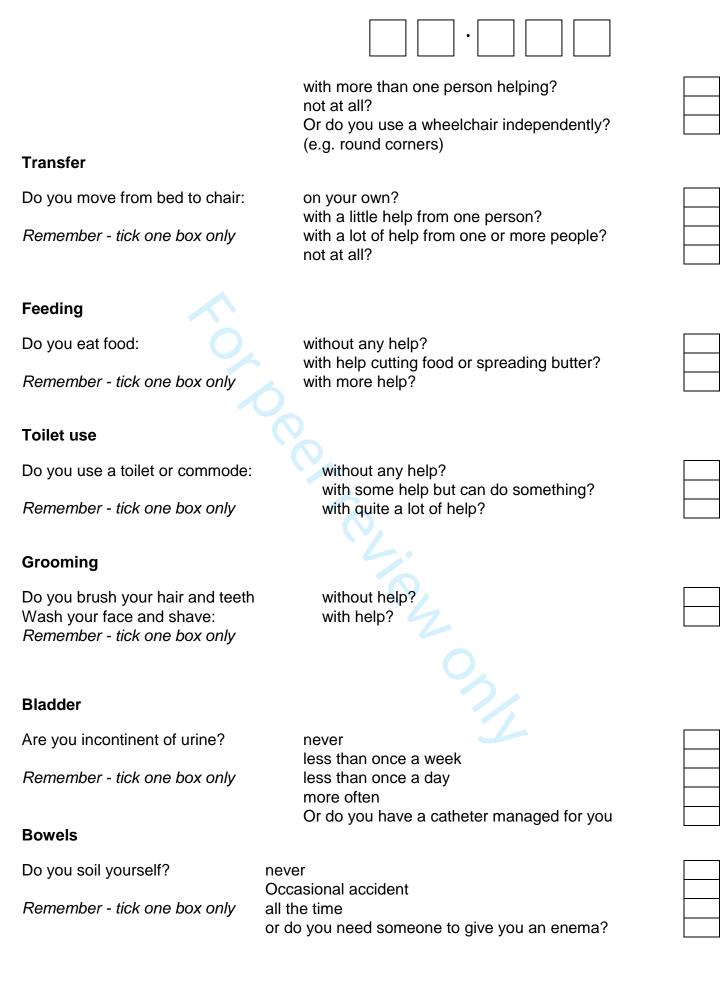
Mobility

Do you walk indoors:	without any help apart from a frame?
	with one person watching over you?
Remember - tick one box only	with one person helping you?









BMJ Open

Evaluating practical support stroke survivors get with medicines and unmet needs in primary care: A survey

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Manuscript ID	bmjopen-2017-019874.R2
Article Type:	Research
Date Submitted by the Author:	23-Jan-2018
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Primary Subject Heading :	Cardiovascular medicine
Secondary Subject Heading:	Cardiovascular medicine, Public health, General practice / Family practice
Keywords:	Medication adherence, Caregivers, Barthel, STROKE MEDICINE

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3	1	Evaluating practical support stroke survivors get with medicines and unmet
4	2	needs in primary care: A survey
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9	7	*James Jamison ¹ , MSc
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12	9	Luis Ayerbe ² , PhD
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14	11	Gian Luca Di Tanna ² PhD
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16	13	Stephen Sutton ¹ , PhD
17	14 15	Jonathan Mant ¹ , MD
18	15	Jonathan Maitt, MD
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1	Abstract
2	Objectives
3	To design a questionnaire and use it to explore unmet needs with practical aspects of medicines taking after
4	stroke, predictors of medicine taking and to estimate the proportion of survivors who get support with daily
5	medication taking.
6	Design
7	Four workshops with stroke survivors and caregivers to design the questionnaire.
8	A cross-sectional postal questionnaire in primary care.
9	Setting
10	18 GP practices in the East of England and London. Questionnaires posted between September 2016 and
11	February 2017.
12	Participants
13	1687 stroke survivors living in the community outside institutional long term care.
14	Primary Outcome measures
15	The proportion of community stroke survivors receiving support from caregivers for practical aspects of
16	medicine taking; the proportion with unmet needs in this respect; the predictors of experiencing unmet needs
17	and missing taking medications.
18	Results
19	A 5-item questionnaire was developed to cover the different aspects of medicine taking. 596/1687 (35%)
20	questionnaires were returned. 56% reported getting help in at least one aspect of taking medication and 11%
21	needing more help. 33% reported missing taking their medicines. Unmet needs were associated with receiving
22	help with medications (OR: 5.9, p<0.001), being on a higher number of medications (OR: 1.2, p<0.001) and
23	being dependent for activities of daily living (ADLs) (OR: 4.9, p=0.001). Missing medication was associated
24	with having unmet needs (OR: 5.3, p<0.001), receiving help with medications (OR: 2.1, p<0.001), being on a
25	higher number of medicines (OR: 1.1, p=0.008) and being older than 70 years (OR: 0.6, p=0.006).
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2 3	1	Conclusions	
4 5	2	More than half of patients who replied needed help with taking medication, and 1 in 10 had unmet needs in	
6 7	3	this regard. Stroke survivors dependent on others have more unmet needs, more likely to miss medicines and	
8 9	4	might benefit from focused clinical and research attention. Novel primary care interventions focusing on the	
10 11	5	practicalities of taking medicines are warranted.	
12 13	6	Abstract word count- 298	
14 15	7		
16 17	8	Keywords: Stroke, Medication Adherence, Caregivers, Barthel	
18	9		
19 20	10	Article summary	
21 22	11	Strengths and Limitations	
23 24	12	• Development of the questionnaire was based on patients' and caregivers' own views gathered throug	h
25 26	13	workshops.	
27 28	14	• Stroke survivors were recruited from two UK regions.	
29 30	15	• This work identified issues from a population that includes patients severely affected by stroke, who	
31 32	16	are often excluded from research.	
33 34	17	• Results shed light on the effect of stroke related impairments on practical domains and predictors of	
35 36	18	medicine taking, which have significant effects on medication adherence and call for new primary ca	re
37 38	19	interventions.	
39 40	20	• The low response rate reported is a limitation of this study and stroke survivors who are harder to	
41 42	21	reach may have been missed.	
43 44	22		
45 46	23	Funding: This study was funded by the RCGP SFB, Ref. SFB 2014 – 15 'Quantifying the support stroke	
47 48	24	survivors get with daily medication taking: a questionnaire survey'. Anna De Simoni and Luis Ayerbe are	
49 50	25	funded by a NIHR Academic Clinical Lectureships. This article therefore presents independent research	
51 52	26	funded by NIHR. The views expressed are those of the authors and not necessarily those of the NHS, the	
53 54	27	NIHR, or the Department of Health. James Jamison was supported by a research grant from The Stroke	
55 56	28	Association and the British Heart Foundation: TSA BHF 2011/01	
57 58			_
59		For peer review only - http://bmjopen.bmj.com/site/about/quidelines.xhtml	3
		For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml	3

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2	Data sharing statement: No additional data available.
3	
4	Introduction
5	
6	Stroke is the leading cause of disability in developed countries, with an estimated that 25-74% of the
7	50 million stroke survivors worldwide requiring some assistance or being fully dependent on caregivers for
8	activities of daily living (ADLs). ¹⁻³ For many older adults remaining independent at home may depend on how
9	well they can manage complex medication regimens. ⁴⁵ Around half of stroke survivors are dependent on
.0	others for everyday activities. ⁶
1	There is evidence that being dependent for ADLs and impairment in mobility and communication
2	decrease medication adherence in patients suffering from hypertension. ⁷ Deficits in attention, cognition or
3	working memory have been linked with non-adherence to medications in other patient groups. ⁸ In a recent
4	systematic review of medication adherence among patients with cognitive impairment, one third of studies
5	showed that such patients were likely to have a caregiver to assist with medications and there was an
5	association between taking four or more medicines and nonadherence.9 In patients taking cardiovascular
7	medicines, multiple factors including cognitive problems, lack of social support, dosing regimen, as well as
8	practical problems and difficulties accessing services, contribute to poor medication adherence. ^{10 11} Low
9	adherence to secondary prevention medication is associated with poor cardiovascular health. ^{12 13}
0	Stroke survivors have previously reported difficulties in the handling of medication as a barrier to
1	adherence to secondary prevention medication after stroke. ¹⁴ This was true irrespective of age at stroke, with
22	younger and older stroke survivors being similarly affected. ¹⁴ Research on medication adherence in stroke has
3	identified multiple barriers to medication taking among stroke survivors. ¹⁴⁻¹⁶ However interventions developed
4	to improve adherence have mainly concentrated on patients responsible for their own medicine taking. ^{17 18}
5	In England, the average age at stroke is 74 for men and 80 years for women. ¹⁹ In elderly patients in
26	particular, cognitive deficits, taking large number of medicines and the complexity of medication regimens
27	have been identified as barriers to medication adherence. ^{20 21} Caregivers are known to play a key role in

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3	1	providing assistance to older people in a range of daily activities including medication taking and physician		
4 5	2	visits, ²² and can help improve adherence in cardiac patients with memory problems. ²³		
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11	5	Survivors of stroke have previously reported unmet needs including physical difficulties, cognitive		
12 13	6	and emotional difficulties, information needs and other unmet needs. ^{24 25} However we know little about factors		
14 15	7	that influence medication taking among stroke survivors with disabilities (i.e. physical or cognitive) living in		
16 17	8	the community (i.e. not in nursing homes), their unmet needs around the use of medicines or the proportion		
18 19	9	relying on caregivers for some or all aspects of medicine taking.		
20 21	10	To date, survey instruments examining the unmet needs of stroke survivors have not focused on practical		
22 23	11	aspects of medication taking such as how patients collect or handle their medicines.		
24 25	12	The aims of this investigation were to design an instrument to evaluate the support stroke survivors get		
26	13	with taking their medicines, characterise patients receiving help with medications, estimate the proportion who		
27 28				
29	14	have unmet needs with daily medicine taking and who miss medications. We additionally aimed to identify the		
30 31	15	predictors of missing medicines and of experiencing unmet needs with medications.		
32 33	16	This knowledge can inform the development of primary care interventions aimed at improving medication		
34 35	17	taking in this patients' group. Methods		
36 37	18	Methods		
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39 40	19			
41 42	20	Questionnaire development workshops		
43	21	To develop the questionnaire, current literature evidence was evaluated ¹⁷ and three workshops were		
44 45	22	conducted with 26 stroke survivors and 12 caregivers in the East of England (St John's College, Cambridge		
46 47	23	2009 ²⁶ : 7 patients, 1 caregiver; Different Strokes, Cambridge 2012: 9 patients, 3 caregivers; Peterborough,		
48 49	24	2012: 10 patients, 8 caregivers). Recruitment was opportunistic and no purposive sampling was applied. The		
50 51	25	workshops were organised in the context of gathering Patient and Public Involvement (PPI) input into research		
52 53	26	grant applications aimed at improving adherence to medication after stroke. ¹⁷		
54 55	27	The survey questions were developed through thematic analysis ²⁷ of workshops field notes.		
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A fourth workshop was conducted to gather feedback on the questionnaire using a PPI (Patient and Public Involvement) exercise with 11 stroke survivors and 3 caregivers recruited through a local stroke group (Different Strokes, East of England). Two stroke survivors from this group took part in subsequent 'thinkaloud' interviews, which involved talking out loud as they read the questionnaire, continually verbalising what they were thinking.

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7 Postal survey

8 In respect to sample size, 400 returned questionnaires would allow good precision for prevalence estimates.

9 The 95% confidence intervals on various proportions with this sample size were calculated using the Wilson

10 score method (with continuity correction) and are as follows: 50% (45.00-55.00%), 25% (20.89%-29.60%),

11 5% (3.16-7.74%). With 600 questionnaires, the improvement in the precision of the estimates would be as

12 follows: 45.93%-54.07%, 21.62-28.70% and 3.46%-7.14% respectively.

13 General practices in primary care in the East of England and London were approached through the Clinical

14 Research Network (CRN). CRN Eastern contacted 20 GP practices, of which 11 replied and took part in the

15 study. CRN North London contacted 140 GP East London practices by email (Tower Hamlets, Newham and

16 City & Hackney CCGs), of which only two replied and participated in the study. Five of the eight GP practices

17 contacted in North London (Barnet CCG) through a research coordinator took part in the study.

18 Patients with stroke and their caregivers were sent the postal questionnaire according to the following criteria

19

20 <u>Inclusion Criteria</u>

21 Patients:

All patients aged > 18 on the practice stroke register with documented history of stroke.

23 Caregivers:

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• Anyone identified by the patient as having a role helping with medicine taking.

25 <u>Exclusion Criteria</u>

• Patients who suffered a Transient ischaemic attack (TIA) but not a stroke.

• Palliative or end of life patients.

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 Patients receiving institutional long term care (receiving total care in residential homes or living in nursing homes).

- Patients considered unsuitable to taking part in the study by their GP.
- Survey participant identification

A list of prospective patients was compiled from the stroke register of each surgery by the practice staff. No restriction was placed on the recruitment of survivors who were dependent for ADLs or lacking capacity. The list was screened by a practice GP and anyone not meeting the inclusion criteria or who was considered unsuitable for the study was excluded. Reasons for unsuitability were not collected for practical reasons.

12 Survey participant recruitment

Eligible participants were sent a study survey pack by practice staff between September 2016 and February 2017. Study recruitment packs included two invitation letters, information sheets, questionnaires and postal version of Barthel Index²⁸, one of which was for completion by the patient and the other by the 5 caregiver. The Barthel Index provides a measure of functional independence and physical functioning and has 5 been used in stroke research previously.²⁹ Patients with Barthel score 20 were categorised as independent for 7 ADLs, those with score 15-19 moderately dependent for ADLs, and those with scores 0-14 severely 3 dependent.³⁰ If receiving help with medications, the patient was asked to pass to their caregiver the invitation) letter and information sheet and invite him/her to complete their copy of the questionnaire, providing answers) on the patient's medicine taking. Family members, friends or paid caregivers of stroke survivors who were severely disabled and/or lacked mental capacity were invited to fill and return the caregivers' questionnaires only on behalf of patients. The information sheets stated that consent was implied by returning the completed 3 questionnaire. Participants were asked to return completed questionnaires to the research centre in the FREEPOST envelopes provided. A second mail out of the study invitation pack was sent to all patients as a reminder, 2 weeks after the first one.

Ethical approval This study has received ethical approval from Cambridge Central Research Ethics Committee (REC reference: 16/EE/0182) and from the Health Research Authority (IRAS project ID: 170931) **Survey Analysis** Survey data entry was performed by Document Capture Company.³¹ Individual patients' characteristics (age, gender, time since stoke, number of daily medicines) were collected from the questionnaires themselves. Practice population, number of patients on stroke registers, deprivation score and ethnicity were taken from the National General Practice profiles (https://fingertips.phe.org.uk/profile/general-practice). The proportions of patients in each sociodemographic category, needing help taking medication, missing any medication in the previous 30 days, and reporting the need for more help taking medication, were estimated. When the survivor and caregiver questionnaires were both returned together, study data were collected from the patient's questionnaire only. The associations between 'Unmet needs' and age (< or >70 years), gender, total number of medicines taken, dependence for ADLs, years since stroke, and receiving help with medicines were investigated with individual logistic regression models (a different model per variable investigated), adjusted each and all of them for age and gender. Individual logistic regression models adjusted for age and gender were also used to estimate the association between 'Missed medicines in the previous 30 days' and age (< or >70 years), gender, total number of medicines taken, dependent for ADLs, years since stroke, help with medicines and unmet needs (a different model adjusted for age and gender per variable investigated). Sensitivity analysis was conducted to investigate if predictors of missing medication or unmet needs vary when the analysis was done on the whole dataset versus on questionnaires filled by patients only. Chi squared tests were used to compare the responses on unmet needs and missing medication given by patients versus caregivers. All statistical analysis has been conducted with Stata (version 14, StataCorp LP, College Station, TX, USA, 2013). For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

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1 2 3 4	1	Results
5 6 7	2	Questionnaire development
, 8 9	3	Taking medications emerged as an important issue in all three workshops: nearly half of patients
10 11	4	stated that a family member or friend was supporting them with daily medicine routines especially in relation
12 13	5	to prompting medicine taking. This was put down to effects of the stroke itself on memory retention rather
14 15	6	than general memory problems that people without stroke also experience. They admitted missing doses due to
16 17	7	forgetting. Only a small proportion of survivors were actually handling their own prescriptions and were
18 19	8	relying on support from family and/or community services. In one workshop almost all survivors had Dosette
20 21	9	medication boxes and agreed that taking medications out of safety bottles and blister packs was a problem due
22 23	10	to physical disabilities.
24 25		
26	11	Thematic analysis of workshop data revealed five main practical domains of support needed with
27 28	12	medication taking: 1) Dealing with prescriptions and collection of medicines; 2) Getting medicines out of the
29 30	13	box, blister packs of bottles; 3) Prompting 'It's time to take your medicine'; 4) Swallowing medicines; and 5)
31 32	14	Checking whether medicines have been taken. The final study questionnaire (see Supplementary file 1)
33 34	15	included questions relating to each of these five domains, one item related to adherence (missed medicine in
35 36	16	the last 30 days) and an assessment of disabilities through completion of the validated postal version of the
37 38	17	Barthel Index. ²⁸ The questionnaire was adapted for caregivers (see Supplementary file 2).
39 40 41	18	Questionnaire finalisation
42 43	19	On the basis of the fourth workshop and two 'think-aloud' interviews, we reworded the survey
44 45	20	questions (e.g. from 'Do you get help with' was changed into 'Is somebody helping you with') and used a
46 47	21	scale response 'All the time', 'Often', 'Sometimes', 'Rarely', 'Never' for the first question of each of the five
48 49	22	survey domains, which was originally conceived as a 'yes' or 'no' answer (see supplementary file for text of
50 51	23	questions).
52 53 54 55 56 57 58	24	9

2	1	Survey
4 5 6	C	Practice characteristics
7 8	2	
9	3	18 GP practices agreed to take part in the study, of which just over 1/3 were in London (n=7). GP
10 11	4	practices were relatively large with an average population of 11,904 patients (SD = 4010) and a low to
12 13	5	moderate level of deprivation (Index of Multiple Deprivation ³² (IMD): Mean-7.05: SD-3.19). Out of 3066
14 15	6	patients on the stroke registers, 1687 stroke patients (55%) were considered eligible for the study and received
16 17	7	the postal questionnaire. The average response rate of East of England and London practices was 42% and
18 19	8	27% respectively. The response rate varied between 16% and 53% across practices.
20 21	9	
22 23	10	Participant characteristics
24 25	11	
26 27	12	596 participants returned a completed questionnaire [549 (92.1 %) from patients, 47 (7.9 %) from
28 29	13	caregivers showing a mean response rate of 35% (0.33-0.37). Participants were on average 72.7 yrs old.
30 31	14	37.8% (n=210) of the sample were female, see table 1. There were a high proportion of white patients in the
32 33	15	recruited practices (79%), which were on average 21% of mixed or ethnic minority background.
34 35	16	Approximately 28% of study participants were completely independent for ADLs.
36 37	17	Participants getting any kind of help with medicines were on average 73.6 years old, two thirds were
38 39	18	male with only 19% of this group completely independent for ADLs.
40 41	19	
42 43	20	Patients with unmet needs were on average 69 years old, predominantly male (71%) and 56.86% were
44 45	21	severely dependent for ADLs. Patients who missed medications were on average 70 years old, 64% were male
46 47	22	and the majority (48%) were moderately dependent for ADLs.
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50 51	24	Table 1 here
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Support with daily medication taking

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Overall, 55.5% (95% CI: 51.7-59.7) of the participants received help in at least one aspect of taking medication, in that they ticked one of the options from 'all the time' to 'rarely' on one or more of the five questions related to medicine taking. 11% (95% CI: 8.8-13.9) of patients reported experiencing unmet needs and needing more help with at least one of the aspects of taking medication, in that they ticked 'yes' to the question "do you feel you need more help", on one or more of the five questions related to medicine taking. The proportion of questionnaires reporting unmet needs filled in by caregivers, 19.6% (n=9), and by patients, 10.7% (n=57), had no significant difference (p=0.068).

10 Among participants help was needed to some degree with prescriptions and collection of medicines (49.8 %), getting medicines out of the box or packet (27.9 %), reminding to take medicines (36.4 %), 11 12 swallowing medicines (20.2 %) and checking that medicines have been taken (34.1 %).(see Table 2). Being 13 reminded to take medicines, dealing with prescriptions and collection of medicines and getting medicines out 14 of a pack or bottle were the most commonly reported areas of unmet needs. Almost two thirds of participants (65.3%) reported never missing medicines in the last 30 days. Out of the 34.7% of patients who said they 15 missed taking medicine at any point in the previous 30 days, 23.9% said rarely, 9.3% sometimes, 0.8% often 16 17 and 0.7% all the time. The proportion of questionnaires reporting missing medication at some point, filled in by caregivers, 27.7% (n=13), and by patients 35.3% (n=193), had no significant difference (p=0.292). 18

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Table 2 here

20 Factors associated with unmet needs

Being on a higher total number of daily medications (OR: 1.2, (1.1-1.3), p<0.001), severe dependence for ADLs (OR: 11.6 (4.2-32.4) p<0.001) and receiving any kind of help (OR: 5.9, (2.7-11.6), p<0.001) in relation to taking medication was associated with experiencing unmet needs. Getting help with swallowing medicines (OR: 6.8, (3.8-12.0), p<0.001), getting medicines out of a box, blister packs or bottles (OR: 6.6, (3.6-11.8), p<0.001) showed the strongest associations with experiencing unmet needs (see table 3).

When the analyses were conducted with data from questionnaires filled by patients only, the variables

2	significantly associated with unmet needs were the same, apart from years since stroke (Supplementary
3	Appendix 1).
4	Table 3 here
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7 8	Factors associated with missing medications
9	Being older (age \geq 70) was associated with a lower probability of missing medication (OR: 0.6
10	(0.4-0.9) p=0.006). Being on a higher number of daily medicines (polypharmacy) (OR: 1.1 (1.0-1.1), p=0.008)
11	and getting any kind of help with medicine taking (OR:2.1 (1.4-3.0) p<0.001) was associated with higher
12	probability of missing medicines. The more unmet needs stroke survivors had with taking medication, the
13	more likely they were to miss their medicines (OR: 5.3 (3.0-9.4), p<0.001). (see Table 4). When the analyses
14	were conducted with data from questionnaires filled by patients only, the variables significantly associated
15	with missing medication were the same (Supplementary Appendix 1).
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18	Table 4 here
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20	Discussion
21	Summary of findings
22	From workshops we identified 5 key issues that patients regarded as important with medication taking
23	after stroke. We converted these into a five item questionnaire that we distributed to people on stroke registers
24	in 18 general practices. We obtained a response rate of 35%. Among respondents, 56% of survivors in the
25	community were receiving help in some aspect of daily medication taking, 11% reported needing more help in

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at least one domain of medicine taking and 34% missed taking their medicines at some point in the previous
 30 days.

A higher total number of daily medicines, being severely dependent for ADLs and receiving help with medication were predictors of experiencing at least one unmet need in respect of medication taking. Stroke survivors who were younger, taking a higher number of daily medicines and experiencing a greater number of unmet needs were more likely to miss medications.

7 This work identified issues from a population that includes patients severely affected by stroke, who are often
8 excluded from research.¹⁷ Results presented here shed light on the effect of stroke related impairments on
9 practical domains and predictors of medicine taking, which are shown to have significant effects on overall
10 adherence.

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13 Strengths and limitations

14 A strength of this study is that the questionnaire was developed from patients' and caregivers' own 15 views gathered through workshops. Although not recruited through purposive sampling, workshop participants 16 suffered from a range of stroke related impairments, as highlighted by the reported use of Dossette boxes, 17 dependence on others for aspects of medicine taking like prompting medication times, and dependence for ADLs such as collecting prescriptions and taking tablets out of boxes. In the postal survey, the inclusion of 18 19 stroke survivors regardless of level of dependence for ADLs permitted investigating a population who are understudied,¹⁷ yet may have significant unmet needs that can affect their adherence to medications. This 20 21 investigation highlights caregivers' role in managing medicines in survivors dependent for ADLs.

However, study limitations should also be considered. The response rate across recruited GP practices
was low and harder to reach stroke survivors may have been missed. Poor response rate is a source of bias that
might affect our estimates.

Interestingly, considering the average age at stroke in England (i.e. 74 for men and 80 years for women¹⁹), our
participants' population was slightly younger (73 years), perhaps reflecting the fact that patients receiving
institutional long term care were excluded from the study or that older people found harder taking part in a
postal survey. Through the Barthel score, we did not assess cognition directly, although low cognitive function

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is associated with poor adherence.³³ As the Barthel focuses on physical disability it is not known to what
extent study participants were cognitively impaired or suffered from communication difficulties like aphasia.
In addition, dependency for ADLs could have been caused by existing co-morbidities other than stroke. We
did not collect information on the use of blister packaged medication or devices to aid compliance, which
could have influenced medication taking practices. Finally this study examined all medicine taking and did not
differentiate between stroke secondary prevention medications and other drug categories.

7 8

Comparisons with existing research

9 To our knowledge this is the first study that shows that more than half of all stroke survivors get help 10 with some aspect of medicine taking and that those receiving help are more likely to have unmet needs. This 11 provides some insight in to why adherence to medication in stroke survivors may be poor.³⁴

12 Moreover, the greater the number of medicines, the more likely stroke survivors were to miss 13 medications. Addressing pill burden by simplifying drug regimens may be an important focus for future 14 interventions. Indeed the polypill approach to medication taking has been shown to reduce cardiovascular as well as total pill burden in a primary care setting.³⁵ Simpler dosing regimens, are known to be associated with 15 better medication adherence ³⁶ while fewer medicines has been shown to be an independent predictor of long 16 term medication persistence among stroke survivors.^{37 38} A recent trial incorporating a fixed-dose combination 17 18 polypill approach to taking cardiovascular medicine demonstrated better adherence among patients receiving a single pill.³⁹ 19

20 Receiving help with prescriptions and collecting medicines was identified as the area where most help 21 was received (49.7% of respondents). Stroke survivors who are dependent for activities of daily living may 22 face considerable practical challenges accessing health care resources at the pharmacy and the GP practice. A 23 recent study in the USA found that around 2/3 of caregivers were involved in at least 1 medication 24 management activity of elderly patients and that high involvement in Instrumental Activities of Daily Living (IADLs) was associated with the caregiver providing the patient with assistance in ordering medicines.⁴⁰ 25 Filling prescriptions is also known to be an important factor influencing medication adherence.^{41 42} Indeed 26 27 caregivers can play a significant role in ensuring appropriate medication taking. A recent interview study exploring potential barriers and facilitators of medication adherence in stroke identified the central role of the 28

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caregiver in medication adherence.⁴³ Our evaluation of an online stroke forum also confirmed the important
role of the caregiver in facilitating medication adherence.¹⁴ Monitoring prescription collections, liaising with
the GP and pharmacy, increasing the time between prescriptions or arranging medication deliveries, may help
to address prescription needs.

5 Around 11% of stroke survivors reported unmet medication needs. We found that stroke survivors 6 severely dependent for ADLs and receiving help with medicines were more likely to report unmet needs, 7 which is in line with a recent study investigating stroke/TIA survivors in Australia, where greater functional ability was associated with fewer unmet needs, including those related to secondary prevention.⁴⁴ In previous 8 9 research on unmet needs among stroke survivors, a 44 item survey study by McKevitt and colleagues (2011) reported that 49% of stroke survivors had at least one unmet need ²⁵, while in a study of Australian survivors 10 who completed a 58 item survey, the percentage was 84%.²⁴ Both these studies however examined unmet 11 12 needs over a variety of domains including health, work, leisure and everyday living, social support and 13 finances, whereas our study focused on medication needs only.

Getting help to take medicines out of a box, packet or bottle was the area where the greatest proportion 14 15 of stroke survivors needed help all of the time. We previously found that the use of pill boxes and blister packed medication to be both a facilitator ³⁵ and a barrier ¹⁴ to adherence among stroke survivors¹⁵, while 16 17 interventions using blister packaging and pill boxes have been found to be associated with improved adherence.⁴⁵ Although electronic medication devices were considered potentially effective in improving 18 19 medication taking behaviour among patients with cognitive impairments, success in using such devices was 20 dependent on the patient having a good level of dexterity, while removing the medication from these devices was also found to be challenging. 46 47 48 21

The need for further support in this domain, as reported in the current study, suggests that handlingmedications remains problematic for stroke survivors.

An interesting finding from this survey study is that stroke survivors who missed medicines were younger. This is consistent with other research on adherence in stroke that found that younger age was predictive of poor adherence⁴⁹, and has also been described in patients taking medication for cardiovascular disease.⁵⁰ The finding in the present study contrasts with the view that older patients are more likely to face difficulties taking medication^{51 52} which is frequently attributed to higher number of pre-existing comorbidities

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resulting in polypharmacy and increased complexity of medication taking regimens. The fact that older patients may be less likely miss medicine might be down to the support they receive from caregivers. Our findings suggests that support needed with medications may be overlooked in younger stroke survivors.⁵³ In this study a significant proportion of patients admitted missing medications occasionally. There is evidence that improving adherence by one anti-hypertensive pill/week for a once-a-day regimen reduces the hazard of stroke by 8–9 % and death by 7 %.⁵⁴ Each incremental 25% increase in proportion of days covered with statin medications is associated with a 0.10 mmol/L reduction in LDL-C cholesterol.^{55 56} Non-adherence to cardiovascular medications is associated with increased risk of morbidity and mortality.⁵⁷

10 Implications for clinical practice

12 A significant proportion of patients, particularly those who take large numbers of tablets, are disabled 13 or receive help to take medication, have unmet needs and miss their tablets, which can increase risk of 14 recurrent cardiovascular events. These particularly vulnerable groups of patients might benefit from focused 15 clinical attention. Through understanding the needs of survivors and caregivers in different aspects of daily 16 medication taking, we can help direct future resources to the areas of greatest need. For example, further 17 exploration of medication packaging is warranted to understand the difficulties stroke survivors face handling 18 medicines. Polypharmacy remains a difficulty for older patients. Therefore, exploring the use of combination 19 pills and further efforts to reduce the burden of multiple medications among stroke survivors is warranted. 20 The questionnaire we have developed could be used to understand the challenges around medication 21 faced by other patient groups. Unmet medication needs among UK stroke survivors have not been previously explored in the context of activities both survivors and caregivers consider important for taking medicines. 22 Through understanding the extent of unmet needs as well as the areas in which these are greatest, strategies 23 24 can be developed which address poor medication taking practices and therefore improve medication 25 adherence. 26 27 28

Future research

Acknowledgements

Competing interests

Data sharing statement

Author/s contribution

No additional data are available

authors agreed on the final draft of the submitted manuscript.

None declared

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Novel interventions focussing on the practicalities of taking medicines and aimed at improving stroke

interventions. Advances in technology have the potential to facilitate delivery of such interventions, e.g.

electronic devices prompting medication taking times.^{58 59} Efforts to improve medication taking among

survivors of stroke using technology are already underway and have shown promise.⁶⁰.

The authors wish to thank all the stroke survivors and caregivers who participated in this study.

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ADS is the Chief Investigator, contributed to the study design, data analysis and commented on the

submission. JM is a co-investigator on the study, wrote and commented on the manuscript. SS is a co-

manuscript. JJ contributed to the study design, data collection, data analysis and prepared the manuscript for

investigator on the study, wrote and commented on the manuscript. LA contributed to the data analysis and

commented on the manuscript. GDiT contributed to the data analysis and commented on the manuscript. All

survivors' adherence to treatment are needed. The findings reported here may inform the development of such

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SD

12.2

8.5

4.5

Table 1. Characteristics of participants who took part in the survey study (mean scores reported unless otherwise stated). N represents the number of participants

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Ν

64

18

45

61

59

5

17

29

Patients with unmet needs

Mean

68.8

9.3

9.7

SD

9.2

7.1

%

28.6

71.4

9.8

33.3

56.9

Patients who receive any kind of help

Mean

73.6

7.97

7.3

%

36.2

63.2

18.9

46.4

34.6

SD

13.0

8.5

4.1

Patients who miss medication

Mean

70.5

7.7

6.9

24

%

35.6

64.4

25.7

48.0

26.3

Ν

203

68

123

186

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All patients

Mean

72.7

7.7

6.4

SD

11.6

7.6

4

who completed the survey in respect to the different variables. BI: Barthel Index.

Ν

331

112

197

295

312

53

130

97

%

37.8

67.2

28.3

47.1

24.6

Ν

588

210

346

535

557

139

231

121

Age

Female

Male

Time since

stroke

N of daily

medicines

Independent

for ADLs

(BI=20)

Moderately dependent for

ADLs (BI=15-19)

Severely dependent for

ADLs (BI=0-14)

46	
17	

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	N	All the Time N (%)	Often N (%)	Sometimes N (%)	Rarely N (%)	Never N (%)	Yes N (%)	No N (%)
Question 1 Is somebody helping with prescriptions and collection	583	186 <i>(31.9)</i>	19 (3.3)	40 (6.9)	45 (7.7)	293 (50.2)		
of your medicines? Question 1a Do you feel you need more help with prescriptions and	551						33	518
collection of your medicines? Question 2							(6.0)	(94.0)
Is somebody helping you getting the medicines out of the box, bottle or blister pack?	578	85 (14.7)	15 (2.6)	31 (5.4)	30 (5.2)	417 (72.1)		
Question 2a Do you feel you need more help with getting the medicines out of the box, bottle or blister pack?	553	5					33 (6.0)	520 (94.0)
Question 3 Is somebody helping with reminding you when is the time to take your medicine?	577	78 (13.6)	22 (3.8)	59 (10.2)	51 (8.8)	367 (63.6)		
Question 3a Do you feel you need more help with reminding when is the time to take your medicine?	564			ē.			35 (6.2)	529 (93.8)
Question4 Is somebody helping you with swallowing your medicine?	579	56 (9.7)	11 (1.9)	29 (5.0)	21 (3.6)	462 (79.8)		
Question 4a Do you feel you need more help with swallowing your medicine?	560				C	5,	9 (1.6)	551 (98.4)
Question 5 I somebody helping you with checking that you have taken your medicines	576	76 (13.2)	23 (4.0)	58 (10.0)	40 (6.9)	379 (65.9)		
Question 5 a Do you feel you need more help with checking that you have taken your medicine	558						20 (3.6)	538 (96.4)
Thinking of the last 30 days, how often did you miss taking your regular medicines?	594	4 (0.7)	5 (0.8)	55 (9.3)	142 (23.9)	388 (65.3)		

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		Univariable analysis	Multivariable analysis		
Variable		Odds ratio (95% CI) p value	N	Odds ratio (95% CI) p value	
Age ≥70	581	0.6 (0.4-1.1) p=0.084	544	0.7 (0.4-1.2) p=0.180	
Gender (female)	544	0.7 (0.4-1.2) p=0.137	544	0.7 (0.4-1.2) p=0.147	
Number of different medicines	542	1.2 (1.1-1.3) p<0.001	509	1.2 (1.1-1.3) p<0.001	
Moderate Dependence for ADLs (BI: 15-19)	479	2.2 (0.8-6.1) p=0.135	447	2.7 (1.0-7.5) p=0.068	
Severe Dependence for ADLs (BI: 0- 14)	479	8.5 (3.2-22.8) p<0.001	447	11.6 (4.2-32.4) p<0.001	
Years since stroke	522	1.0 (1.0-1.1) p=0.078	490	1.0 (1.0-1.1) p=0.160	
Getting help with prescriptions and collection of medication	568	4.7 (2.5-8.8) p<0.001	533	4.6 (2.4-8.7) p<0.001	
Getting help with taking medicines out of the box, bottle or blister pack	563	6.7 (3.8-11.8) p<0.001	527	6.6 (3.6-11.8) p<0.001	
Getting help with reminding you when is the time to take your medicine?	562	4.7 (2.7-8.2) p<0.001	526	4.3 (2.4-7.6) p<0.001	
Getting help to swallow the medication	565	6.7 (3.9-11.6) p<0.001	528	6.8 (3.8-12.0) p<0.001	
Getting help by checking that you have taken your medicines	562	4.9 (2.8-8.6) p<0.001	526	5.9 (3.1-10.1) p<0.001	
Getting any kind of help	574	5.9 (2.8-12.1) p<0.001	537	5.9 (2.7-11.6) p<0.001	

Table 3. Results of the multivariable analysis showing the variables associated with unmet needs. N: number of observations; ADLs: Activities of daily living; BI: Barthel Index.

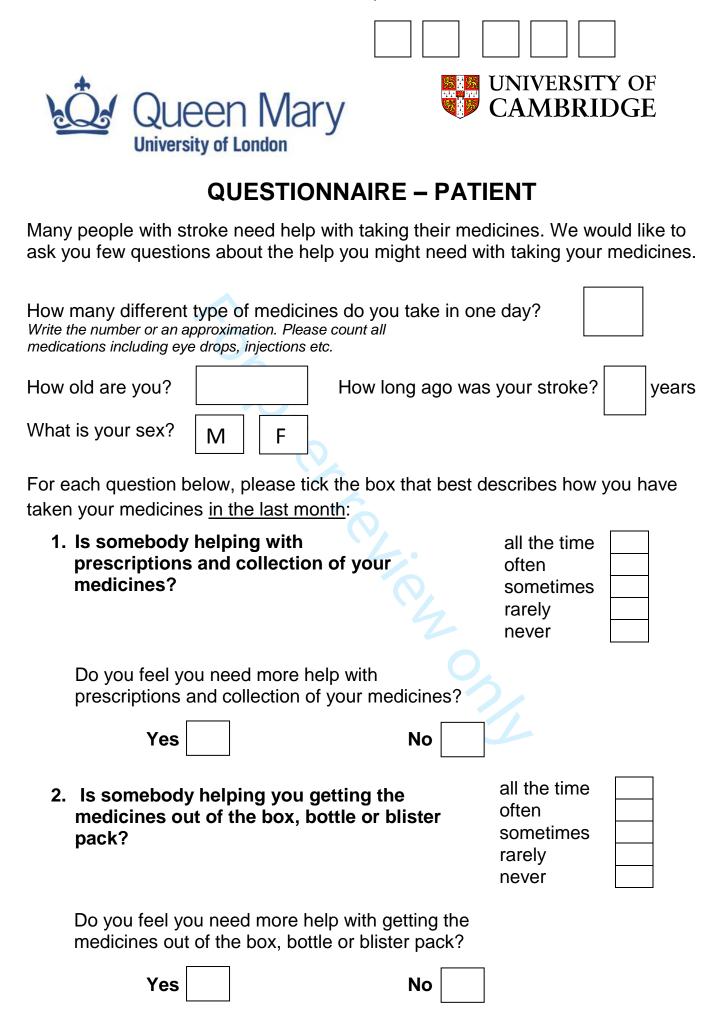
	ι	Inivariable analysis	Multivariable analysis		
Variable	Ν	Odds Ratio (95% CI) p value	N	Odds Ratio (95% CI) p value	
Age ≥70	594	0.6 (0.4-0.8) p=0.003	555	0.6 (0.4-0.9) p=0.006	
Gender (female)	555	0.9 (0.6-1.2) p=0.401	555	0.9 (0.6-1.3) p=0.498	
Number of different medicines	555	1.0 (1.0-1.1) p=0.040	520	1.1 (1.0-1.1) p=0.008	
Moderate Dependence for ADLs (BI: 15-19)	490	1.2 (0.8-1.8) p=0.468	456	1.3 (0.8-2.0) p=0.343	
Severe dependence for ADLs (BI 0- 14)	490	1.3 (0.8-2.1) p=0.342	456	1.4 (0.8-2.4) p=0.239	
Years since stroke	533	1.0 (0.9-1.0 p=0.950	499	1.0 (0.9-1.0) p=0.971	
Getting help with prescriptions and collection of medication	581	2.0 (1.5-2.9) p<0.001	544	2.3 (1.6-3.3) p<0.001	
Getting help to have the medicines out of the box, bottle or blister pack	576	1.4 (1.0-2.0) p=0.089	538	1.5 (1.0-2.2) p=0.051	
Getting help with reminding you when is the time to take your medicine?	575	2.5 (1.7-3.6) p<0.001	537	2.7 (1.8-3.9) p<0.001	
Getting help to swallow the medication	578	1.5 (1.0-2.3) p=0.045	539	1.7 (1.1-2.6) p=0.022	
Getting help by checking that you have taken your medicines	576	2.4 (1.7-3.4) p<0.001	537	2.5 (1.7-3.7) p<0.001	
Getting any kind of help	587	2.1 (1.4-3.0) p<0.001	548	2.1 (1.4-3.0) p<0.001	
Unmet needs (participant reported more help needed)	580	5.3 (3.0-9.2) p<0.000	544	5.3 (3.0-9.4) p<0.001	

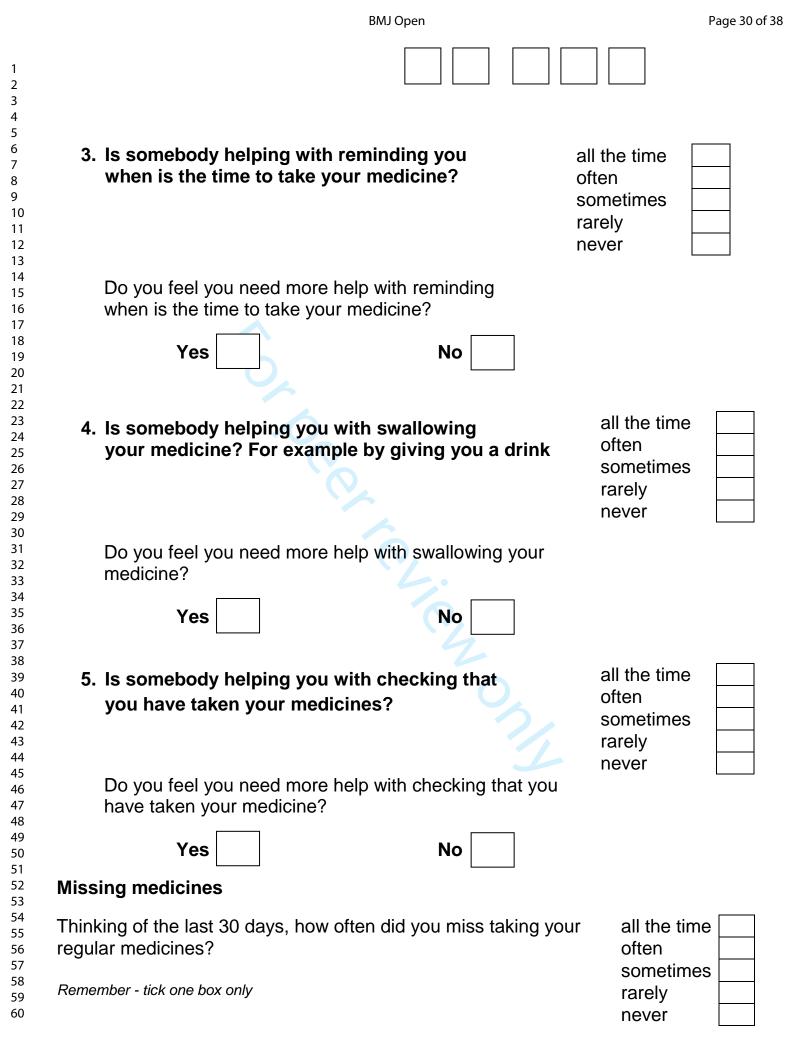
Table 4. Results of univariable and multivariable analysis showing associations with missing medicines.

N: number of observations; ADLs: Activities of daily living; BI: Barthel Index.

		Unmet needs	Missing medication		
Variable	N	Odds ratio (95% CI) p value	N	Odds ratio (95%CI) p value	
Age ≥70	498	0.7 (0.4-1.2) p=0.248	508	0.6 (0.4-0.9) p=0.009	
Gender (female)	498	0.7 (0.4-1.3) p=0.262	508	0.9 (0.6-1.3) p=0.576	
Number of different medicines	465	1.2 (1.1-1.3) p<0.001	475	1.1 (1.0-1.1) p=0.015	
Moderate Dependence for ADLs (BI: 15-19)	408	2.6 (0.9-7.5) p<0.075	417	0.3 (-0.2-0.7) p=0.289	
Severe Dependence for ADLs (BI: 0-14)	408	10.9 (3.8-31.0) p<0.001	417	0.5 (-0.1-1.0) p=0.119	
Years since stroke	446	1.0 (1.0-1.1) p=0.036	454	1.0 (0.9-1.03) p=0.725	
Getting help with prescriptions and collection of medication	487	4.6 (2.4-8.9) p<0.001	497	2.6 (1.8-3.8) p<0.001	
Getting help with taking medicines out of the box, bottle or blister pack	481	6.6 (3.6-12.2) p<0.001	491	1.7 (1.1-2.6) p=0.20	
Getting help with reminding you when is the time to take your medicine?	480	4.7 (2.6-8.5) p<0.001	490	3.0 (2.0-4.5) p<0.001	
Getting help to swallow the medication	482	7.8 (4.2-14.8) p<0.001	492	2.1 (1.3-3.4) p=0.005	
Getting help by checking that you have taken your medicines	480	5.9 (3.2-10.9) p<0.001	490	2.8 (1.8-4.2) p<0.001	
Getting any kind of help	491	5.6 (2.7-11.9) p<0.001	501	2.3 (1.6-3.4) p<0.001	

, anaryses, all models adjusted for age an Supplementary Appendix 1. Predictors of unmet needs and missing medication, responses given by patients only (i.e. caregivers' filled questionnaire excluded). Multivariable analyses, all models adjusted for age and gender. N: number of observations.





Bart	hel Questionnaire		
These are some questions about your ability to look after yourself.			
They may not seem to apply to y	/ou.		
Please answer them all.			
Tick one box in each section.			
Bathing			
In the bath or shower do you:	manage on your own?		
	need help getting in and out?		
Remember - tick one box only	need other help?		
	never have a bath or shower?		
	need to be washed in bed?		
Stairs			
Do you climb stairs at home:	without any help?		
	with someone carrying your frame?		
Remember - tick one box only	with someone encouraging you?		
	with physical help?		
	not at all?		
	don't have stairs?		
Dressing			
Do you get dressed:	without any help?		
Pomember tick and hav any	just with help with buttons?		
Remember - tick one box only	with someone helping you most of the time?		
Mobility			
Do you walk indoors:	without any help apart from a frame?		
,	with one person watching over you?		
Remember - tick one box only	with one person helping you?		
	with more than one person helping?		
	not at all?		
	Or do you use a wheelchair independently?		
	(e.g. round corners)		
Transfer			
Do you move from bed to chair:	on your own?		
,	with a little help from one person?		
Remember - tick one box only	with a lot of help from one or more people?		

Feeding		
Do you eat food:	without any help?	
Remember - tick one box only	with help cutting food or spreading butter? with more help?	
Toilet use		
Do you use a toilet or commo		
Remember - tick one box only	with some help but can do something? with quite a lot of help?	
Grooming		
_	5]
Do you brush your hair and to Wash your face and shave: Remember - tick one box only	eeth without help? with help?	
Bladder		
Are you incontinent of urine?		
Remember - tick one box only	less than once a week less than once a day	
,	more often	
	Or do you have a catheter managed for you	
Bowels		
	1	[]
Do you soil yourself?	never Occasional accident	
Remember - tick one box only	all the time	
	or do you need someone to give you an enema?	







Help with taking tablets after stroke

FAMILY MEMBER/FRIEND OR PRIVATE CARER COPY

Many people with stroke need help with taking their medicines. We would like to ask you few questions about the help you might be offering to your family member/friend/ patient with stroke with taking medicines.

Relation with your family member/friend with stroke

Remember - tick one box only

partner
son or daughter
friend
carer from an agency
other
if other relation entry

if other, please specify

How many different types of medicines does your family
member/friend/patient with stroke take in one day?
Write the number or an approximation. Please count all medications
including eye drops, injections etc.
How old is your family mombar/friand/patient with stroke? (years)

How old is your family member/friend/patient with stroke? (years)

How many years ago was your family member/friend/patient's stroke?

What is your family member/friend/patient with stroke sex?

Μ	F
bes the	help ne

For each question below, please tick the box that best describes the help needed by your family member/friend/patient with stroke with taking medicines in the last month.

 Is somebody helping your family member/friend/patient with stroke with prescriptions and collection of his/her medicines? all the time often sometimes rarely never



Do you feel your family member/friend/patient with stroke needs more help with prescriptions and collection of his/her medicines?

Yes

No

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2.	Is somebody helping your family member/friend/patient with stroke getting the medicines out of the box, bottle or blister pack?all the till often someting rarely never	
	Do you feel your family member/friend/patient with stroke needs more help with getting the medicines out of the box, bottle, or blister pack?	
	Yes No	
3.	with stroke with reminding when is time to take his/her medicine?	all the time
	Do you feel your family member/friend/patient with stroke needs more help with reminding when is time to take his/her medicine?	
4.	Is somebody helping your family member/friend/patient with stroke with swallowing his/her medicine? For example by giving a drink.	all the time often sometimes rarely never
	Do you feel you your family member/friend/patient with stroke need more help with swallowing his/her medicine?	
	Yes No	
5.	Is somebody helping your family member/friend/patient with stroke with checking that he/she has taken his/her medicines?	all the time often sometimes rarely never
	Do you feel your family member/friend/patient with stroke needs more help with checking that he/she has taken his/her medicine?	

Yes

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No

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Missing medicines

Thinking of the last 30 days, how often did your family member/friend/patient with stroke miss taking his/her regular medicines?

Remember - tick one box only

all the time often sometimes rarely never



Barthel Questionnaire

These are some questions about the ability of your family member/friend/patient with stroke to look after him/herself.

Please answer them all.

Please fill this questionnaire even if you are not regularly caring for your family member/friend/patient with stroke, trying to answer questions in the way you think most accurately describes the disability of your family member/friend/patient with stroke.

Tick one box in each section.

Bathing

In the bath or shower do you:

Remember - tick one box only

Stairs

Do you climb stairs at home:

Remember - tick one box only

Dressing

Do you get dressed:

Remember - tick one box only

need to be washed in bed? without any help? with someone carrying your frame? with someone encouraging you?

manage on your own?

need other help?

with physical help?

don't have stairs?

without any help?

just with help with buttons?

with someone helping you most of the time?

not at all?

need help getting in and out?

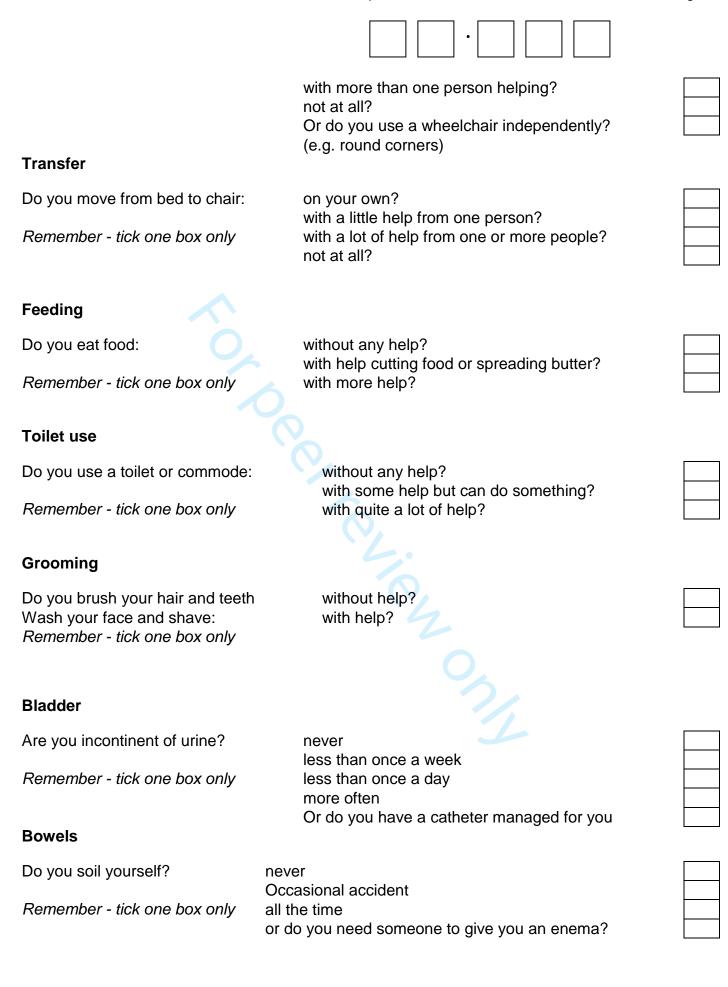
never have a bath or shower?

Mobility

Do you walk indoors:	without any help apart from a frame?
	with one person watching over you?
Remember - tick one box only	with one person helping you?







1 2 3 4 5 6 7 8 9 10 11 22 33 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 37 37 37 37 37 37 37 37 37	
32 33 34 35 36 37 38 39	
40 41 42 43 44 45 46 47	

Section/Topic	ltem #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale 2 Explain the scientific background and rationale for the investigation being reported		4-5	
Objectives	3	State specific objectives, including any pre-specified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-9
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8-9
		(b) Describe any methods used to examine subgroups and interactions	8-9
		(c) Explain how missing data were addressed	-
		(d) If applicable, describe analytical methods taking account of sampling strategy	-
		(e) Describe any sensitivity analyses	-

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility,	10
		confirmed eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential	10
		confounders	
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence	11-12
		interval). Make clear which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	12-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and	13-14
		magnitude of any potential bias	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from	14-16
		similar studies, and other relevant evidence	
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on	3
		which the present article is based	

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.