

# The AdHOC Study of Older Adults' Adherence to Medication in 11 Countries

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**Objective:** Authors investigated, cross-nationally, the factors, including demographic, psychiatric (including cognitive), physical, and behavioral, determining whether older people take their prescribed medication. Older adults are prescribed more medication than any other group, and poor adherence is a common reason for non-response to medication. **Methods:** Researchers interviewed 3,881 people over age 65 who receive home care services in 11 countries, administering a structured interview in participants' homes. The main outcome measure was the percentage of participants not adherent to medication. **Results:** In all, 12.5% of people (N=456) reported that they were not fully adherent to medication. Non-adherence was predicted by problem drinking (OR=3.6), not having a doctor review their medication (OR=3.3), greater cognitive impairment (OR=1.4 for every one-point increase in impairment), good physical health (OR=1.2), resisting care (OR=2.1), being unmarried (OR=2.3), and living in the Czech Republic (OR=4.7) or Germany (OR=1.4). **Conclusion:** People who screen positive for problem drinking and who have dementia (often undiagnosed) are less likely to adhere to medication. Therefore, doctors should consider dementia and problem drinking when prescribing for older adults. Interventions to improve adherence in older adults might be more effective if targeted at these groups. It is possible that medication-review enhances adherence by improving the doctor-patient relationship or by emphasizing the need for medications. (Am J Geriatr Psychiatry 2005; 13:1067-1076)

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Older adults receive more prescriptions per-capita than any other group,<sup>1</sup> but may adhere to only 60% of medication.<sup>2</sup> Compared with the knowledge we have gained in developing, evaluating, and making clinical decisions about prescribing medication

for older adults, we know little about what determines whether patients actually take it. Adherence, defined as the extent to which a person's behavior conforms to medical or health advice,<sup>3</sup> determines response to treatment in all medical conditions. In

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## Medication Adherence

North America, more than 10% of older peoples' medical emergency admissions and 25% of nursing home admissions<sup>4,5</sup> relate to medication non-adherence.<sup>6</sup>

Factors previously associated with non-adherence include being male,<sup>7</sup> less fear of illness, not living with a relative,<sup>8</sup> having had adverse effects, poor instructions, patients' denial of the need for treatment,<sup>9</sup> and cost.<sup>10</sup> Reasons older adults might be less adherent than younger adults include their greater likelihood of cognitive deficits, poor physical health, polypharmacy, and adverse effects. Conversely, older adults may be more likely to adhere to medication because of, for example, lower rates of substance misuse. Some studies have excluded people with cognitive impairment and so may overestimate adherence in older people. Findings concerning the relationship of age with adherence have been inconsistent, finding, for example, improved adherence in people over 50,<sup>11</sup> decreased adherence in older age,<sup>12,13</sup> greater adherence in patients age 55–64 than in older and younger groups,<sup>14</sup> and, in people over 65, no difference in adherence between the younger and the oldest-old.<sup>10</sup> Trials of interventions to improve adherence so far have been disappointing.<sup>9,15</sup> Knowing more about the associates of non-adherence in older adults may help develop and target measures to increase the proportion of medication actually taken, and therefore potentially to improve their medication effectiveness.

Nearly 4,000 older adults, living in 11 countries, took part in the AdHOC (Aged in Home Care) Study. We used these data to carry out the first cross-national study of medication adherence and to investigate the relationship of putative risk factors to adherence.

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## METHODS

Ethics permission was granted in all countries according to local regulations.

### Setting

A total of 3,881 adults ( $\geq$ age 65 years, who were receiving health or social community services in any setting, participated in The AdHOC Study. Table 1 gives eligibility criteria for health and social services in the countries studied.<sup>16</sup> The mean level of depen-

dency of participants was lowest in the Nordic countries, the Netherlands, and the Czech Republic, followed by England and Germany, and highest in Italy and France.<sup>16</sup> Italy and the Czech Republic had the lowest levels of formal care provision, and the UK had the most.

Table 2 describes the population, numbers interviewed, and refusal rates for each country. Each national study organizer selected an area judged to be representative of the country. Trained interviewers approached all potential participants in these areas for interview. Methodology has been described by The AdHOC Group.<sup>16</sup> We included AdHOC study participants who were taking prescribed medication. Medication data were available for 3,803 people interviewed for the AdHOC study (98.0%), of whom 3,643 (95.8%) were taking prescribed medication.

### Data Collection

We recorded patient information with the interRAI ([www.interrai.org](http://www.interrai.org)) Version 2.0 Minimum Data Set for Home Care (MDS–HC), which is a structured, standardized assessment instrument with adequate psychometric properties.<sup>17</sup> The MDS–HC has been used for epidemiological research in several participating countries.<sup>16</sup> Before data collection, the instrument was translated, back-translated, and examined for face validity in the language of each participating country.

We used adherence as our main outcome measure, and divided it into three bands: 100%,  $\geq$ 80%, and  $<$ 80% adherence. We used this high cut-point for adherence because we expected high rates of non-adherence in this frail, elderly study population and because these thresholds have been used previously.<sup>18</sup> Interviewers asked the participant (or their caregiver, if the person was cognitively impaired or the caregiver administered the medication) open questions about their adherence such as "What medications have you taken today/yesterday?" to ascertain reported adherence over the last 7 days. They checked responses with medication available and with prescriptions. We also analyzed sociodemographic data, along with cognition, psychiatric, and physical health and medication details, which were collected at the interview.

TABLE 1. Characteristics of Services of Homecare Agencies by Country<sup>16</sup>

	CZ	Denmark	Finland	France Health Care	France Social Care	Germany	Iceland	Italy	NL	Norway	Sweden	UK
Administrative characteristics												
Eligibility criteria			X		X	X	X	X	X	X	X	X
Physical functioning level	X	X	X		X	X	X	X	X	X	X	X
Cognitive level	X		X			X	X	X	X	X	X	X
Presence of psychiatric diseases	X		X			X	X	X	X	X	X	X
Family support level	X		X		X	X	X	X	X	X	X	X
Means tested	X		X		X	X	X	X	X	X	X	X
Medical prescriptions	X		X		X	X	X	X	X	X	X	X
Comprehensive geriatric assessment			X	X		X		X	X		X	X
Team meetings				X								
Never				X								
Sometimes				X						X	X	X
Always	X	X	X			X	X	X	X			
GP participating in team meetings						X	X	X	X			
Participation of informal caregiver		X	X			X	X	X	X	X	X	X
Multidisciplinary team approach					X	X	X	X	X	X	X	X
Case manager			X			X	X	X	X	X	X	X
Administrative status				X								
Profit/Non-profit	X			X		X	X	X	X	X	X	X
Public	X	X	X			X	X	X	X	X	X	X
Financial characteristics												
Public payment/compulsory insurance	X	X	X	X	X	X	X	X	X	X	X	X
Personal contribution (co-payment)	X		X	X	X	X	X	X	X	X	X	X
Contribution by others (municipalities, charities, others)			X	X	X	X	X	X	X	X	X	X

Note: CZ: Czech Republic; NL: Netherlands; UK: United Kingdom; GP: geriatric psychiatrist.

## Medication Adherence

**Cognitive measure.** The MDS Cognitive Performance Scale (CPS) score is a 7-point scale measuring cognitive impairment (0: intact; 6: very severely impaired). A CPS score of 2 indicates dementia.<sup>19</sup> The mean Mini-Mental State Exam (MMSE) score for those who score 2 is 19; for those who score 3, it is 15; for those who score 4, it is 7; for those who score 5, it is 5; and for those who score 6, it is 0.<sup>19</sup>

**Behavioral symptoms.** Caregivers were asked about the presence of wandering (moving with no rational purpose, seemingly oblivious to needs or safety), verbally abusive behavior (threatening, screaming at, or cursing others), physically abusive behavior (hitting, shoving, scratching, sexually abusing others), socially inappropriate behavior (making disruptive sounds, noisiness, screaming, self-abusive acts, sexual behavior or disrobing in public, smearing or throwing food or feces, hoarding, rummaging through others' belongings), and resisting of care (resisting treatment, activities of daily living [ADL] assistance, eating, or changes in position) in the last 3 days, and each item was scored as 0 (behavior absent), 1 (behavior present but easily altered with current interventions), and 2 (present and not easily altered). This behavioral scale has been validated against the Alzheimer's Disease Patient Registry Physician Behavior checklist scores, with a correlation coefficient of 0.520. Over 2 years, the MDS behavior domain (Effect Size [ES]=0.058) was comparable to the Research Behavior Checklist (ES=0.065). These data demonstrate reasonable criterion validity of the MDS behavior rating scales.<sup>20</sup>

**Psychiatric morbidity.** Participants were asked whether they had a psychiatric or dementia diagnosis or had delirium in the last 7 days.

We used the MDS–Depression Rating Scale Score (DRS), with a cut-off point of 2/3 for caseness. It has been validated against the Hamilton Rating Scale for Depression (Ham-D) and the Cornell Scale, a measure of depression in dementia (CSDD), and it has high sensitivity (94% and 78%, respectively) and specificity (72% and 77%, respectively)<sup>21</sup> It compared favorably with the Geriatric Depression Scale (GDS) when tested against DSM-IV diagnosis.<sup>21</sup>

**Alcohol misuse.** Interviewees screened positive for alcohol misuse if, in the last 90 days, they had felt the need or were told to cut down on drinking, if others were concerned about their drinking, if they had a drink on waking to steady their nerves, or they had been in trouble because of drinking.

**Physical functioning.** Physical functioning was measured by using the MDS Activities of Daily Living Hierarchy (MDS–ADL)<sup>22</sup> and Instrumental ADL index (MDS–IADL) scores.<sup>23</sup> Also, we recorded scale scores for hearing (0–3) and vision (0–4), with 0 representing no impairment.

**Medication.** Participants were asked about number of medications taken. Four classes of psychotropic drugs (antidepressants, anxiolytics, hypnotics, and antipsychotics) were coded as prescribed or not prescribed in the last 7 days. Participants were asked whether their medication had been reviewed by a doctor in the last 6 months.

### Statistical Analysis

Because of the high number of statistical tests, we used a significance level of  $p < 0.01$  for univariate analyses. We calculated the proportion of people in

TABLE 2. Characteristics of Each Site, Including National Population, Percent Over Age 65, Sampling, and Refusal Rate<sup>16</sup>

Country of Residence	National Population, millions	% Age 65+ in Country	People in Study Area, 000s	% Age 65+ in Study Area	N, Study Sample (All 65+)	Refusal Rate, %
Germany	82.26	16.6	655	21.2	607	4
Czech Republic	10.27	13.8	93.9	19.9	430	18
Denmark	5.37	14.8	71.8	16.5	401	10
England	49.14	15.9	241.6	15.8	290	39
Finland	5.19	15.2	73	14.6	187	57
Netherlands	16.20	13.9	735	12.0	197	49
France	59.20	15.9	260	15.5	311	0
Sweden	8.59	17	60.0	22.4	250	38
Norway	4.52	15	128	16	388	7
Italy	57.61	18.6	215	16.7	412	1
Iceland	286	13.7	35.9	14.2	405	3

the three categories of adherence and made cross-national comparisons using ANOVA and Tukey honestly significant difference (HSD) post-hoc tests to indicate which differences were significant. We determined which countries were significantly different from at least seven and at least eight others and reported this. We used  $\chi^2$  tests and univariate analyses of variance, as appropriate, to compare proportions and means of each variable studied. We used a logistic regression to determine which factors were independent predictors of non-adherence and calculated odds ratios (OR) and confidence intervals (CI). The independent variables we included were age; gender; country of residence; living alone; living with a caregiver; living in a residential/nursing home; marital status; amount of formal and informal care received; scale scores for hearing, vision, wandering, resisting care, verbally or physically abusive or socially inappropriate behavior; score and caseness on CPS and DRS; screening positive for alcohol abuse; dementia diagnosis; any psychiatric diagnosis; ADL and IADL scale scores; number of medications; receipt of antidepressants, anxiolytics, antipsychotics, or hypnotics; occurrence of medication review in the last 6 months.

## RESULTS

The overall response rate for people contacted was 79.7% (N = 3,881).

### Cross-National Variation

As shown in Table 3, 12.5% of respondents overall (N = 456) reported that they were not fully adherent to medication. The median number of medications prescribed was 6, and 82.4% of those interviewed (N = 3,019) had received a medication review in the previous 6 months. Rates of non-adherence were highest in the Czech Republic and Germany.

### Univariate Analysis

Table 4 reports factors associated with reduced adherence on univariate analysis. Those who were not currently married, lived alone, were cases, or scored higher on the CPS or DRS scales, had been diagnosed with dementia or delirium, were cases on the alcohol screen, exhibited behavioral problems of resisting care or wandering, and who had not had their medication reviewed by a doctor in the last 6 months were all less likely to be adherent. Although people at all stages of dementia were less adherent than those without dementia, non-adherence rates demonstrated an inverted-U-shaped relationship with CPS score, with lowest adherence found in moderate dementia (Figure 1). One-way ANOVA demonstrated that adherence rates varied significantly with CPS score ( $F_{[6]} = 7.32$ ;  $p < 0.001$ ), Tukey HSD post-hoc tests indicated that the significant differences were between intact cognition and moderate (mean difference: 0.051;  $p < 0.001$ ) and moderately-severe (mean difference: 0.076;  $p < 0.001$ ) impairment.

**TABLE 3. Adherence, Number of Medications Prescribed, and Proportion of People Receiving 6-Month Medication Reviews in the Participating Countries**

Country of Residence	Fully Adherent to Medication, N (%)	≥80% Adherent to Medication, N (%)	<80% Adherent to Medication, N (%)	Prescribed Drugs, Median N	Had Medication Review in Last 6 Months, N (%)
Germany	417 (83.1%) <sup>a</sup>	43 (8.6%) <sup>a</sup>	42 (8.4%) <sup>a</sup>	5 <sup>b</sup>	456 (82.5%)
Czech Republic	280 (66.5%) <sup>a</sup>	116 (27.6%) <sup>a</sup>	25 (5.9%) <sup>a</sup>	7 <sup>b</sup>	378 (88.3%)
Denmark	324 (87.1%)	36 (9.7%)	12 (3.2%)	6 <sup>b</sup>	283 (70.8%) <sup>b</sup>
U.K.	230 (82.7%)	41 (14.7%)	7 (2.5%)	5	126 (43.6%) <sup>a</sup>
Finland	161 (90.4%)	14 (7.9%)	3 (1.7%)	8 <sup>b</sup>	146 (78.1%)
Netherlands	168 (88.0%)	20 (10.5%)	3 (1.6%)	5	157 (79.3%)
France	290 (96.0%)	8 (2.6%)	4 (1.3%)	6	163 (94.8%)
Sweden	215 (90.0%)	21 (8.8%)	3 (1.3%)	6	188 (78.0%)
Norway	338 (92.6%)	23 (6.3%)	4 (1.1%)	4 <sup>b</sup>	366 (94.8%)
Italy	388 (97.2%)	8 (2.0%)	3 (0.8%)	4 <sup>b</sup>	392 (96.1%)
Iceland	376 (94.9%)	17 (4.3%)	3 (0.8%)	7	364 (90.3%)
Total	3,187 (87.5%)	347 (9.5%)	109 (3.0%)	6	3,016 (82.4%)

<sup>a</sup> Denotes statistically significant differences between country indicated and at least 8/10 other countries.

<sup>b</sup> Denotes statistically significant differences with at least 7/10 other countries (by Tukey's HSD test).



TABLE 4. Association of Variables Studied With Adherence

	N (%) / Mean (SD) of People Adherent			<sup>a</sup> F / $\chi^2$	p
	100% (N = 3,187)	>80% of the Time (N = 347)	<80% of the Time (N = 109)		
Age, years, mean (SD)	82.15 (7.3)	81.93 (7.5)	82.26 (7.6)	F = 0.159	0.853
Men	855 (26.8%)	75 (21.6%)	24 (22.0%)	$\chi^2 = 5.411$	0.067
Married	795 (24.9%)	56 (16.1%)	14 (12.8%)	$\chi^2 = 20.78$	<0.001**
Living in care-home	85 (2.7%)	15 (4.4%)	5 (4.6%)	$\chi^2 = 3.958$	0.138
Living alone	1,871 (58.7%)	259 (74.6%)	72 (66.1%)	$\chi^2 = 34.70$	<0.001**
Formal care, hours/week	5.54 (12.0%)	5.21 (8.9%)	7.15 (10.8%)	F = 1.166	0.312
Case score 2+ on CPS	857 (26.9%)	128 (36.9%)	56 (51.4%)	$\chi^2 = 43.94$	<0.001**
CPS score, mean (SD)	1.1 (1.6)	1.2 (1.3)	1.9 (1.7)	F = 14.94	<0.001**
Psychiatric diagnosis	276 (8.7%)	41 (11.8%)	14 (12.8%)	$\chi^2 = 5.651$	0.059
DRS score, mean (SD)	1.01 (2.0)	1.7 (2.2)	1.6 (2.6)	F = 19.236	<0.001**
Caseness on DRS	500 (15.7%)	103 (29.7%)	24 (22.0%)	$\chi^2 = 44.83$	<0.001**
Dementia diagnosis	401 (12.6%)	44 (12.7%)	26 (23.9%)	$\chi^2 = 11.91$	0.003*
Alcohol screen	54 (1.7%)	9 (2.6%)	8 (7.3%)	$\chi^2 = 18.41$	<0.001**
Delirium in last week	189 (5.9%)	25 (7.2%)	16 (14.7%)	$\chi^2 = 14.14$	0.001*
Impaired ADLs, mean (SD)	2.7 (3.0)	2.3 (2.6)	2.7 (2.7)	F = 2.610	0.074
Impaired IADLs, mean (SD)	4.4 (2.2)	4.1 (2.0)	4.5 (2.1)	F = 1.241	0.289
Vision, mean (SD)	0.6 (1.0)	0.6 (1.0)	0.6 (0.8)	F = 0.211	0.810
Hearing, mean (SD)	0.5 (0.7)	0.5 (0.8)	0.5 (0.8)	F = 0.208	0.812
Verbally abusive, mean (SD)	0.0 (0.2)	0.0 (0.2)	0.1 (0.3)	F = 1.920	0.147
Physically abusive, mean (SD)	0.0 (0.1)	0.0 (0.0)	0.0 (0.2)	F = 1.634	0.195
Socially disruptive, mean (SD)	0.0 (0.2)	0.0 (0.2)	0.1 (0.3)	F = 3.427	0.033
Resisting care, mean (SD)	0.0 (0.2)	0.1 (0.3)	0.2 (0.5)	F = 28.80	<0.001**
Wandering, mean (SD)	0.0 (0.2)	0.0 (0.2)	0.1 (0.4)	F = 10.48	<0.001**
Medications, mean (SD)	5.7 (2.7)	6.0 (2.5)	5.3 (2.6)	F = 3.714	0.024
Doctor review in last 6 months	2,573 (84.2%)	262 (76.2%)	66 (61.7%)	$\chi^2 = 48.13$	<0.001**
Antipsychotics	215 (6.8%)	27 (7.8%)	11 (10.1%)	$\chi^2 = 2.226$	0.329
Anxiolytics	399 (12.5%)	59 (17.0%)	9 (8.3%)	$\chi^2 = 7.712$	0.021
Hypnotics	675 (21.2%)	77 (22.2%)	14 (12.8%)	$\chi^2 = 4.726$	0.094
Antidepressants	503 (15.8%)	38 (11.0%)	18 (16.5%)	$\chi^2 = 5.752$	0.056

Note: Values are N (%), unless otherwise indicated. SD: standard deviation. The F statistic indicates test values for univariate analysis of variance; degrees of freedom (df): 2 for all tests shown.

CPS: Cognitive Performance Scale; ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living; DRS: Depression Rating Scale.

\*\*p < 0.001; \*p < 0.01.

### Logistic Regression

As shown in Table 5, non-adherence was predicted by screening positive for problem drinking, greater cognitive impairment, resisting care, being unmarried, lesser ADL impairment, having no medication review in the last 6 months, and living in the Czech Republic or Germany. The overall model had a  $-2_{\log}$  likelihood of 766.250, cox and snell  $R^2$  of 0.051, and Nagelkerke  $R^2$  of 0.208.

### DISCUSSION

Reported adherence rates are higher than in previous studies and did not decline with age. This might be because earlier studies have examined discontinuation rates, whereas we measured adherence to established medication regimes. Most older adults

interviewed adhered to medication, even when experiencing psychiatric illness, physical morbidity, or cognitive decline, and despite taking, on average, six different types of medication daily. Problem drinking, dementia, having no medication review in the last 6 months, resisting care, and poorer ADL functioning predicted non-adherence.

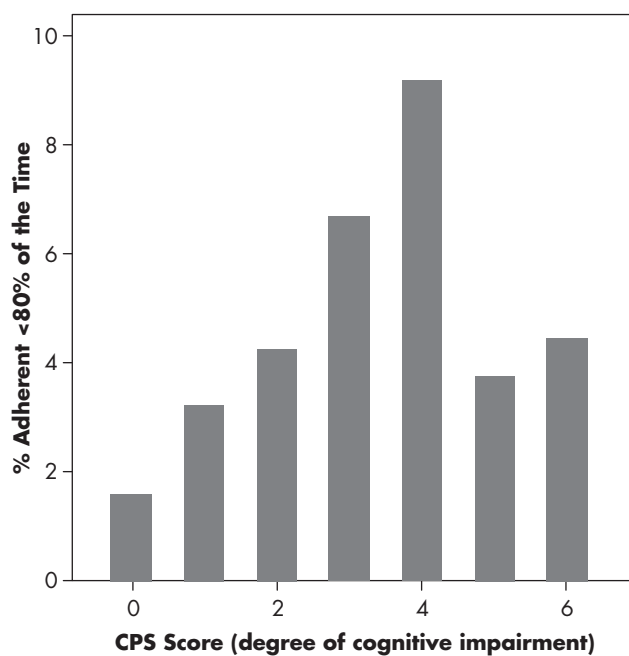
Decreased adherence was associated with dementia and with resisting care, which often occurs in people who have limited insight into their dementia. The non-linear relationship between adherence to medication and cognitive functioning, with adherence lowest in those with moderate impairment, appears to explain previous conflicting research findings. Perhaps participants with mild cognitive impairments are more aware of their impairment and use systems such as pillboxes to help remind them to take their medication. This would suggest that practitioners could improve treatment adherence by tailoring in-

terventions to the degree of cognitive impairment. More people with severe dementia live with others who act as caregivers, prompting or administering their medication, because of their greater care needs. This could explain their increased adherence compared with people with moderate dementia, who are more likely to live alone. Results suggest that those who live alone with significant cognitive impairment are most likely to be non-adherent. Non-adherence could be a significant factor determining when institutionalization is required.

### Country of Residence

Living in Germany or the Czech Republic predicted non-adherence. In the Czech Republic, this might relate to the lower levels of formal service provision, either because medication was monitored less often or because good relationships between the care-recipient and provider could foster good adherence. This cannot be the only factor influencing results, however, because Germany had similar levels of service provision to other countries, but lower adherence.

**FIGURE 1. Relationship Between Rates of Non-Adherence to Medication and CPS Score**



*Note:* CPS: (Minimum Data Set) Cognitive Performance Scale (measure of cognitive impairment, where 0: no impairment, and 6: very severe impairment).

Measurement biases between raters from different countries could have accounted for part of the association of adherence with country of residence, but there may also be true national differences, over and above confounding factors, in the likelihood of people adhering to medication. In the Czech Republic, the older people might have felt less able to approach doctors to discuss medication problems because of their experiences during the communist era of doctors as strong hierarchical figures. Medical staff in the Czech Republic have particularly high caseloads and are perhaps less accustomed to asking patients about adherence. Many older Czech people are economically disadvantaged, but they are subject to the same prescription charges as younger adults. For economic reasons, older drugs, which are less effective and have more side effects, are more likely to be used there than in Western Europe.<sup>24</sup>

We did not study the association of non-adherence with the cost of medication, but people pay more for their medication in Germany, on average, than in the other countries studied,<sup>25</sup> and it is possible that this could account for the higher rates of non-adherence in that country. This is consistent with research in the United States, finding that many elderly persons, most of whom pay for their own medication, are unable to afford to fill their prescriptions.<sup>26</sup>

### Possible Interventions

Review of medication by a doctor in the last 6 months was associated with improved adherence. Attending for regular medication review might reflect an obedient, medicalized individual who is also more compliant with medication. It is also possible that a medication review enhances adherence by improving the doctor-patient relationship or by emphasizing the relevance of medications. Polypharmacy is common in older people,<sup>27</sup> and it has been suggested that reviewing and possibly reducing the number of medications might help adherence.<sup>28</sup> However, number of medications was not a significant predictor of non-adherence in our study. This may be explained by the "intent-to-treat" effect of doctors prescribing more medications to patients they judge more likely to take them. Our results suggest that treatment of problem drinking and dementia might also improve adherence. This presents a difficulty, because effective treatment programs often include medication.

## Medication Adherence

Currently, the evidence for interventions specifically developed to improve adherence is not convincing.<sup>9,15</sup> We suggest that the failure of studies in this area to differentiate between people with and without cognitive impairment may have limited the effectiveness of the interventions. Perhaps simpler interventions are useful where cognitive deficits are present, but in un-

impaired older people, as has been suggested<sup>15</sup> and our group has pilot-studied,<sup>29</sup> ambivalence and attitudes to medication need addressing.

### Study Strengths and Limitations

This is the largest-ever study of medication adherence. We compared rates of adherence cross-nation-

**TABLE 5. Results of Logistic Regression (p < 0.05 in bold)**

	$\beta$	Standard Error	Wald $\chi^2_{(df)}$	p	Exp( $\beta$ )	95% CI for Exp( $\beta$ )	
						Lower	Upper
Sociodemographic factors							
Gender	-0.052	0.274	0.036 <sub>(1)</sub>	0.849	0.949	0.555	1.624
Age	0.007	0.016	0.171 <sub>(1)</sub>	0.679	1.007	0.976	1.038
Living alone	0.444	0.318	1.955 <sub>(1)</sub>	0.162	1.559	0.837	2.906
In nursing/residential home	0.090	0.534	0.028 <sub>(1)</sub>	0.867	1.094	0.384	3.112
Having resident caregiver	0.121	0.369	0.107 <sub>(1)</sub>	0.743	1.129	0.547	2.328
<b>Being unmarried</b>	<b>0.843</b>	<b>0.387</b>	<b>4.750<sub>(1)</sub></b>	<b>0.029</b>	<b>2.323</b>	<b>1.089</b>	<b>4.956</b>
With formal care (hours)	-0.004	0.008	0.292 <sub>(1)</sub>	0.589	0.996	0.981	1.011
With informal care (hours)	0.006	0.004	2.494 <sub>(1)</sub>	0.114	1.006	0.999	1.013
Physical morbidity							
<b>Lesser ADL impairment</b>	<b>0.166</b>	<b>0.065</b>	<b>6.567<sub>(1)</sub></b>	<b>0.010</b>	<b>1.181</b>	<b>1.040</b>	<b>1.341</b>
IADL score	-0.045	0.081	0.308 <sub>(1)</sub>	0.579	0.956	0.815	1.121
Vision	0.088	0.126	0.492 <sub>(1)</sub>	0.483	1.092	0.854	1.398
Hearing	0.294	0.160	3.386 <sub>(1)</sub>	0.066	1.342	0.981	1.837
Psychiatric morbidity							
<b>Cognitive impairment (for each point-increase in CPS score)</b>	<b>-0.325</b>	<b>0.136</b>	<b>5.755<sub>(1)</sub></b>	<b>0.016</b>	<b>1.4</b>	<b>1.1</b>	<b>1.8</b>
CPS caseness	-0.319	0.410	0.605 <sub>(1)</sub>	0.437	0.727	0.325	1.624
<b>Screening positive for problem drinking</b>	<b>-1.279</b>	<b>0.482</b>	<b>7.046<sub>(1)</sub></b>	<b>0.008</b>	<b>0.278</b>	<b>0.108</b>	<b>0.716</b>
Psychiatric diagnosis	-0.095	0.352	0.073 <sub>(1)</sub>	0.787	0.909	0.456	1.814
DRS caseness	0.496	0.487	1.035 <sub>(1)</sub>	0.309	1.642	0.632	4.268
DRS score	-0.084	0.085	0.982 <sub>(1)</sub>	0.322	0.920	0.779	1.085
Dementia diagnosis	0.222	0.305	0.527 <sub>(1)</sub>	0.468	1.248	0.686	2.270
Behavioral problems							
Wandering	-0.316	0.306	1.064 <sub>(1)</sub>	0.302	0.729	0.400	1.329
Verbal abuse	0.156	0.395	0.156 <sub>(1)</sub>	0.693	1.169	0.539	2.538
Physical abuse	-0.007	0.811	0.000 <sub>(1)</sub>	0.993	0.993	0.203	4.865
Being socially inappropriate	-0.121	0.497	0.059 <sub>(1)</sub>	0.808	0.886	0.334	2.350
<b>Resisting care</b>	<b>-0.731</b>	<b>0.280</b>	<b>6.802<sub>(1)</sub></b>	<b>0.009</b>	<b>0.481</b>	<b>0.278</b>	<b>0.834</b>
Medications							
Medications, N	0.051	0.044	1.328 <sub>(1)</sub>	0.249	1.052	0.965	1.147
Antipsychotics	-0.251	0.369	0.462 <sub>(1)</sub>	0.497	0.778	0.378	1.604
Anxiolytics	0.477	0.402	1.409 <sub>(1)</sub>	0.235	1.612	0.733	3.544
Antidepressants	-0.243	0.312	0.605 <sub>(1)</sub>	0.437	0.785	0.426	1.446
Hypnotics	0.208	0.322	0.416 <sub>(1)</sub>	0.519	1.231	0.655	2.315
<b>No medication review in last 6 months</b>	<b>-1.193</b>	<b>0.239</b>	<b>24.881<sub>(1)</sub></b>	<b>0.000</b>	<b>3.3</b>	<b>2.1</b>	<b>5.3</b>
Living in							
<b>Czech Republic</b>	<b>-1.540</b>	<b>0.664</b>	<b>5.373<sub>(1)</sub></b>	<b>0.020</b>	<b>4.7</b>	<b>1.3</b>	<b>17.2</b>
Denmark	-0.147	0.342	0.184 <sub>(1)</sub>	0.668	0.863	0.441	1.689
Finland	0.062	0.287	0.047 <sub>(1)</sub>	0.828	1.064	0.606	1.867
France	0.021	0.251	0.007 <sub>(1)</sub>	0.933	1.021	0.624	1.671
<b>Germany</b>	<b>-0.333</b>	<b>0.129</b>	<b>6.635<sub>(1)</sub></b>	<b>0.010</b>	<b>1.4</b>	<b>1.1</b>	<b>1.8</b>
Iceland	0.112	0.142	0.622 <sub>(1)</sub>	0.430	1.119	0.847	1.478
Italy	0.053	0.127	0.177 <sub>(1)</sub>	0.674	1.055	0.823	1.351
Norway	0.038	0.089	0.186 <sub>(1)</sub>	0.666	1.039	0.873	1.237
Sweden	0.038	0.086	0.197 <sub>(1)</sub>	0.657	1.039	0.878	1.229
U.K.	0.008	0.067	0.014 <sub>(1)</sub>	0.905	1.008	0.884	1.149

Note: df: degrees of freedom; CI: confidence interval; ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living; CPS: Cognitive Performance Scale; DRS: Depression Rating Scale.



ally, investigated most postulated associations for non-adherence, and considered whether they are independent predictors. To collect adherence data, we combined subjective and objective measurements of adherence. This method had good face validity and does not change behavior, unlike, for example, electronic pillboxes, although self-report measures have been found to significantly overestimate adherence rates.<sup>30</sup> We did not have data about use of reminder systems such as pillboxes.

The sample consisted of those who had home-care services and was, therefore, not random. It is likely that people who refuse services are the least adherent group, and they were not sampled. There were higher refusal rates in Finland, Sweden, the Netherlands, and UK. Those who refused to be interviewed may have been less adherent, so overall adherence may have been over-estimated. Caregivers were asked about non-adherence where they were responsible for administering the medication, but they may have been reluctant to report non-adherence if they perceived tablet intake as their responsibility. Therefore, although the adherence in the de-

mentia group was poor, it might still have been an overestimate.

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## CONCLUSION

Doctors may increase adherence in older people by reviewing medication every 6 months and by considering dementia when prescribing. Improved detection of dementia and alcohol use disorders might have a positive impact on adherence. Interventions developed to improve adherence might be more effective if adapted for and targeted at specific populations, for example people with moderate cognitive impairment.

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