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## Review

## The Treatment of Hypertension in Care Home Residents: A Systematic Review of Observational Studies

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### A B S T R A C T

#### Keywords:

Hypertension  
long term care  
systematic review  
antihypertensive

**Aim:** To describe the prevalence of hypertension in care home residents, its treatment, change in treatment over time, and the achievement of blood pressure (BP) control.

**Method:** The PubMed, Cochrane, Embase, and PsychINFO databases were searched for observational studies involving care home residents with a diagnosis of hypertension. The search was limited to English language articles involving adults and humans published from 1990 onward. Abstracts and titles were reviewed with eligible articles read in full. Bibliographies were examined for further relevant studies. The final selection of studies was then analyzed and appraised.

**Results:** Sixteen articles were identified for analysis, of which half were studies carried out in the United States. The prevalence of hypertension in care home residents was 35% (range 16%–71%); 72% of these were on at least 1 antihypertensive (mean 1.5 antihypertensives per individual), with diuretics being the most common. The prevalence of hypertension in study populations was greater in more recent studies ( $P = .004$ ). ACEi/ARBs ( $P = .001$ ) and  $\beta$ -blockers ( $P = .04$ ) were prescribed more frequently in recent studies, whereas use of calcium-channel blockers and diuretics remained unchanged over time. The number of antihypertensives prescribed per patient was higher (correlation 0.332,  $P = .009$ ), whereas fewer patients achieved target BP (correlation  $-0.671$ ,  $P = .099$ ) in more recent studies.

**Conclusion:** Hypertension is common in care home residents and is commonly treated with antihypertensive drugs, which were prescribed more frequently in more recent studies but with no better BP control. These studies indicate a tendency toward increasing polypharmacy over time, with associated risk of adverse events, without demonstrable benefit in terms of BP control.

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Hypertension is common in older people, approximately 80% of those older than 80 are hypertensive,<sup>1</sup> and even at these ages, hypertension remains a risk factor for cardiovascular and cerebrovascular disease. A number of trials of antihypertensive medication, including the Hypertension in the Very Elderly Trial (HYVET),<sup>2</sup> the Systolic Hypertension in Europe Study (Syst-Eur),<sup>3</sup> the Systolic Hypertension in the Elderly Program (SHEP),<sup>4</sup> and the Study on Cognition and Prognosis in the Elderly (SCOPE),<sup>5</sup> demonstrated that antihypertensives can bring benefits in the oldest old. However, the average trial patient bears little resemblance to the many very old people who live in care homes, who are often cognitively and physically impaired because of multiple comorbidities, who are exposed to multiple medications,<sup>6</sup> and where chronic disease

management is often suboptimal.<sup>7</sup> Although terminology describing long term care facilities varies from country to country,<sup>8</sup> in the United Kingdom, the term “care home” describes institutions that provide “accommodation, together with nursing or personal care, for persons who are or have been ill, who have or have had a mental disorder, who are disabled or infirm, or are or have been dependent on alcohol or drugs.”<sup>9</sup> They include homes with and without 24-hour on-site nursing staff, known as residential and nursing homes, respectively.

Given the marked vulnerability of care home residents, there is concern that they may not benefit from aggressive management of blood pressure in the same way that study populations do. Conversely, there are also concerns that care home residents may be undertreated for long-term conditions compared with their community-dwelling peers. To inform rational service and research responses to hypertension for patients resident in this sector, we set out to describe the prevalence of hypertension in care home residents, whether and how it is treated and how treatment patterns have changed over time.

The authors declare no conflicts of interest.

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## Method

A prespecified protocol was used to search for and identify suitable articles.

### Eligibility

#### Study characteristics

Observational studies conducted in care homes describing the prevalence of hypertension and treatments used.

#### Report characteristics

Non-English-language articles and studies carried out before 1990 were excluded.

#### Information Sources

A systematic search of the literature was conducted by searching electronic databases, and scanning reference lists of articles. The following databases were used: PubMed (1946 – present), Cochrane, Embase (1974 – present), and PsychINFO (1806 – present). The last full search was run on November 14, 2012, with updates to this until April 2013.

#### Search

The following search terms were used and were adapted for each database as appropriate: care home, nursing home, residential home, care homes, nursing homes, residential homes, care-home, nursing-home, residential-home, residential facilities, homes for the aged, long term care facility, long-term care facility, long-term care, hypertension, blood pressure, antihypertensive, management, treatment.

An example search strategy is provided in [Appendix 1](#).

The search was then limited to English-language articles, to studies involving humans, and to studies involving adults.

#### Study Selection

The title and abstract of the retrieved records were assessed against the eligibility criteria by one reviewer (T.W.) in a standardized manner. Where there was uncertainty about eligibility, the full article was reviewed. The bibliographies of eligible articles were searched for further relevant articles, which were again appraised against eligibility criteria.

#### Data Collection and Items

Relevant data were extracted from the articles and entered into a structured database that recorded (1) characteristics of the trial patients, (2) type of trial and country, (3) prevalence of hypertension, (4) antihypertensive agents used, and (5) achievement of target blood pressure.

#### Assessment of Risk of Bias

The risk of bias was assessed using the tool developed by Agency for Healthcare Research and Quality (AHRQ)<sup>10</sup> ([Appendix 2](#)). This allowed systematic review of different potential sources of bias for each study type. The risk of bias for each study is summarized in [Table 1](#).

#### Method of Synthesis

Having extracted the data from the selected articles, the combined data were analyzed to test whether there had been any change in treatment patterns over time using regression analysis. Where

necessary, data from the articles were transformed to facilitate comparison.

## Results

A total of 6170 citations were identified initially, and after applying limits and removing duplicates this was reduced to 2792 citations. Of these, 2765 articles were rejected after review of the abstract demonstrated that they did not meet the eligibility criteria. The full text of the remaining 27 articles was then reviewed in detail. Fifteen of these articles were then discarded because of failure to meet the eligibility criteria at more detailed review. An additional 8 articles were identified by review of the included article's bibliographies. Four of these were found to meet the eligibility criteria. In total, therefore, 16 articles were included in the review ([Figure 1](#)).

### Characteristics of Studies

The characteristics of individual studies are summarized in [Table 2](#). Of the 16 articles, 8 reported studies were conducted in the United States,<sup>11–18</sup> 2 each in Canada<sup>19,20</sup> and the United Kingdom,<sup>7,21</sup> and 1 each in Germany,<sup>22</sup> France,<sup>23</sup> Italy,<sup>24</sup> and Malaysia.<sup>25</sup>

### Methods

All 16 studies were observational cross-sectional studies; in addition, 2 studies<sup>7,22</sup> used a matched control group. Eight of the studies<sup>13,14,17–19,23–25</sup> collected prospective data, the remaining 8 retrospectively analyzed data, 2 used the results of the US National Nursing Homes Survey,<sup>15,16</sup> 2 used databases compiled with information from the minimum dataset used in the United States and Canada for all nursing home admissions,<sup>12,20</sup> the 2 UK studies used databases built using data held by general practitioners,<sup>7,21</sup> and the remaining 2 retrospectively analyzed digital and hard copy data from nursing homes.<sup>11,22</sup>

The selection method was not reported in 3 of the studies,<sup>11,19,24</sup> and in 4 studies the nursing homes involved were affiliated with the local university or medical center.<sup>13,14,18,25</sup> Two studies used data from the National Nursing Home Survey, a nationally representative sample of US nursing homes.<sup>15,16</sup>

### Participants

The included studies involved 102,429 people with hypertension of a total population of 328,667. The inclusion criteria were residence in a care home or equivalent and a diagnosis of hypertension. Fish and colleagues<sup>11</sup> were more specific and included only those in which hypertension was the sole identifiable indication for antihypertensive prescription.

### Objectives

The objectives of the studies varied. One study aimed to identify the cost of antihypertensive treatment.<sup>11</sup> Two studies aimed to compare the quality of care received by care home residents with community-dwelling older people.<sup>7,21</sup> One set out to compare the adequacy of hypertension management in care homes and in the community.<sup>22</sup> Ten studies aimed to describe the prevalence of hypertension and treatment patterns in care homes, and 2 of this group<sup>12,16</sup> also aimed to compare this with concurrent guidelines.

### Individual Study Findings

The findings of each individual study are summarized in [Table 3](#).

**Table 1**  
Risk of Bias

Source	Selection Bias		Performance Bias		Attrition Bias		Detection Bias		Publication Bias		Included in Synthesis?
	Inclusion/Exclusion Criteria Applied Uniformly?	Confounders Accounted For?	Concurrent Intervention Accounted For?	Missing Data Handling?	Outcome Assessors Blinded?	Diagnosis Defined With Valid and Reliable Measures?	Outcomes Defined With Valid and Reliable Measures?	Confounders Assessed?	Outcomes Prespecified?	Suspicion of Publication Bias?	
Manopulo and Sturani 1991 <sup>24</sup>	No criteria	No	No	N/A	N/A	Yes	No	No	No	No	Yes
Fish et al 1995 <sup>11</sup>	Yes	Yes	Yes	Yes	N/A	No	No	No	No	No	Yes
Gambassi et al 1998 <sup>12</sup>	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	No	Yes
Trilling et al 1998 <sup>13</sup>	Yes	Yes	Yes	N/A	N/A	Yes	Yes	Yes	Yes	No	Yes
Maxwell et al 2000 <sup>20</sup>	Yes	Yes	Yes	N/A	N/A	Yes	No	Yes	No	No	Yes
Fahey et al 2003 <sup>7</sup>	Yes	Yes	N/A	N/A	No	Yes	Yes	Yes	Yes	No	Yes
Ziesmer et al 2003 <sup>14</sup>	Yes	Yes	Yes	N/A	N/A	Yes	Yes	Yes	Yes	No	Yes
Koka et al 2007 <sup>18</sup>	Yes	Yes	Yes	N/A	N/A	Yes	Yes	Yes	Yes	No	Yes
Coover et al 2008 <sup>17</sup>	Yes	Yes	Yes	N/A	N/A	Yes	Yes	Yes	Yes	No	Yes
Tsuyuki et al 2008 <sup>19</sup>	Yes	Yes	Yes	N/A	N/A	Yes	Yes	Yes	Yes	No	Yes
Drawz et al 2009 <sup>16</sup>	Yes	Yes	N/A	N/A	N/A	Yes	Yes	Yes	Yes	No	Yes
Rolland et al 2009 <sup>23</sup>	Yes	Yes	Yes	N/A	N/A	Yes	Yes	Yes	Yes	No	Yes
Ong et al 2010 <sup>25</sup>	No	No	No	N/A	N/A	Yes	Yes	No	Yes	No	No
Shah et al 2011 <sup>21</sup>	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	No	Yes
Simonson et al 2011 <sup>15</sup>	Yes	Yes	N/A	N/A	N/A	Yes	Yes	Yes	Yes	No	Yes
Lochner et al 2012 <sup>22</sup>	Yes	Yes	Yes	N/A	N/A	Yes	Yes	Yes	Yes	No	Yes

## Synthesis of Results

Data were combined from each study where available. As Simonson and colleagues<sup>15</sup> and Drawz and colleagues<sup>16</sup> used the same data set, only the data presented by Drawz and colleagues<sup>16</sup> were used in the synthesis, giving a total of 15 studies included.

## Characteristics of Study Participants

The average age of the patients across the studies was 82, with most (71%) being female. The population had a high burden of comorbidity, with 32% experiencing falls, 39% dementia, 25% coronary heart disease, 28% cerebrovascular disease, and 23% diabetes mellitus.

## Prevalence

The prevalence of hypertension in care home residents as reported by these studies varied between a minimum of 16%<sup>24</sup> and a maximum of 71%.<sup>17,18,22</sup> The mean prevalence of hypertension across the studies was 35% (SD 18.4%). The prevalence increased over time, when later studies and earlier studies were compared, the lowest estimate being 16% in 1991<sup>24</sup> and the highest being 71% in 2010<sup>22</sup> (correlation coefficient: 0.682,  $P = .004$ ).

## Prescribing Patterns

Of the 9 studies<sup>11–14,16–19,22</sup> that reported details of treatment, between 70% and 100% of their participants were on at least one antihypertensive agent. Combined across all the studies, a mean of 72% were on at least one antihypertensive agent.

Overall, diuretics (27%, range 24%–66%), calcium channel blockers (26%, range 18%–30%), and angiotensin-converting enzyme inhibitors/angiotensin receptor blockers (ACEi/ARBs) (24.6%, range 22%–65%) were most commonly used, whereas  $\beta$ -blockers were less commonly used (10.8%, range 8%–75%).

A higher proportion of the hypertensive care home population took ACEi/ARBs (correlation coefficient: 0.875,  $R^2 = 0.736$ ,  $P = .001$ ) and  $\beta$ -blockers (correlation coefficient: 0.654,  $R^2 = 0.427$ ,  $P = .04$ ) in later studies than in earlier studies, whereas the use of calcium channel blockers and diuretics remained static over time.

## Number of Antihypertensive Agents and Target Blood Pressure

There was a significant increase in the number of antihypertensive classes prescribed, when older studies were compared with more recent studies, from an average of 1.1 in 1994 to 2.0 in 2007 (correlation coefficient: 0.770,  $P = .025$ ), with the median increasing from 1 in 1994 to 2 in 2010.

When results from these studies were combined, 70% of those with hypertension had blood pressure readings within the target range. This compared to figures of 49% on treatment in the US population (1994) with 22% reaching target blood pressures<sup>26</sup> and 63% on treatment with 27% reaching target levels as recorded in the National Health and Nutrition Examination Survey (NHANES) database 1999–2000.<sup>27</sup> Blood pressure control was no better in recent studies compared with older studies, and there is a trend toward poorer control over time (correlation coefficient:  $-0.671$ ,  $R^2 = 0.450$ ,  $P = .099$ ).

## Discussion

The review demonstrated that hypertension is common in care home residents and is often treated. The prevalence of hypertension is higher in later studies than in earlier studies. The number of

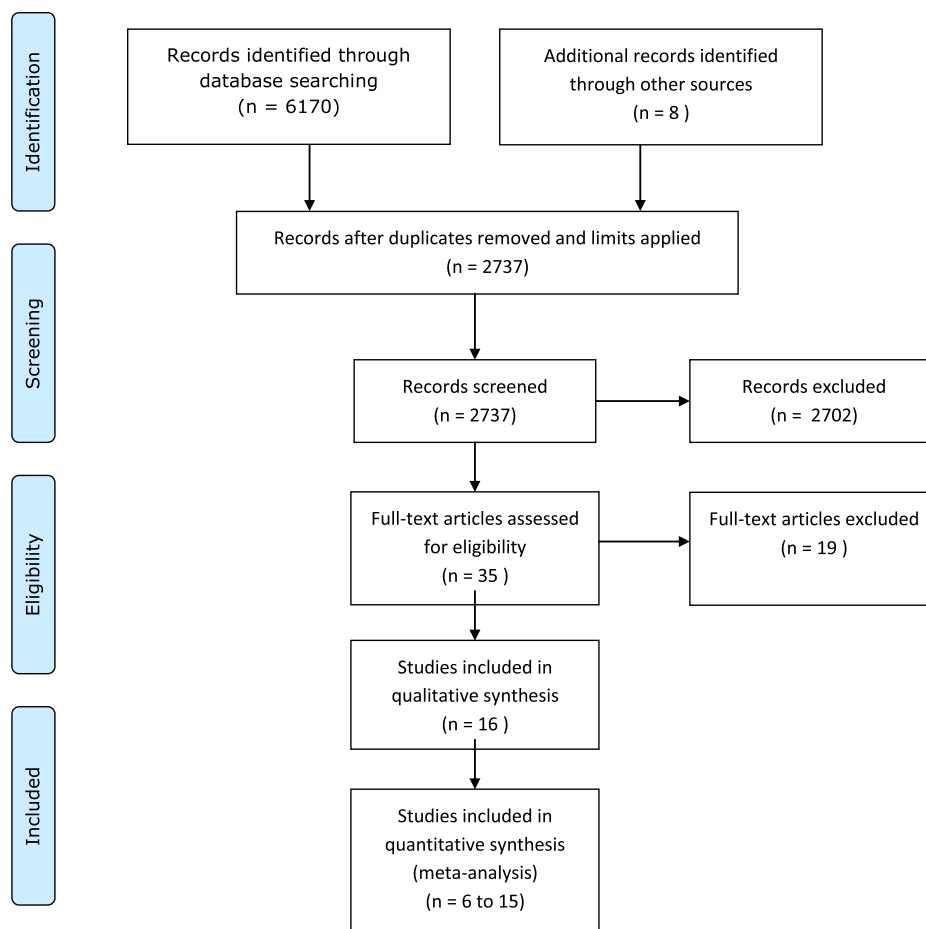


Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

antihypertensive classes used per patient increased over time and the classes of antihypertensives used differed in more recent studies compared with older studies. ACE inhibitors, ARBs, and  $\beta$ -blockers were prescribed more frequently in more recent studies, whereas calcium channel blockers and diuretics have not shown any significant change in prescribing over time. Although the number of antihypertensive classes used has increased, the proportion of participants with adequate blood pressure control has not.

Studies carried out in the United States dominated the literature. This reflects, to an extent, the large amount of care home literature produced in the United States.<sup>28</sup> There are well-recognized differences in the composition of the population resident in long term care between countries<sup>7</sup> and also differences in how doctors prescribed for long-term conditions,<sup>29</sup> which means that there are some caveats about generalizing these findings.

Four of the articles selected for the review were located through the bibliographies of other studies. It is possible that other studies may have been missed by the electronic search and may not have been found in reference lists. Articles not in English were omitted.

We are unaware of any previous systematic review looking at the treatment of hypertension in care home residents. Similarly, we are unaware of any specific guidance for the treatment of hypertension in care home residents with which to compare these findings. The increasing prevalence of hypertension seen over time may relate either to increasing awareness of hypertension and hence an increased rate of diagnosis and recording of the diagnosis, or an increasing true prevalence of hypertension in the general population.<sup>27</sup> The rise over time in the use of  $\beta$ -blockers was

unexpected, as most guidance no longer recommends them for the treatment of hypertension and favors the use of calcium channel blockers. This could be an example of a treatment lag in this population, or that other factors, such as heart failure, are acting as confounders. However, treatment rates for hypertension in care home populations were higher than in noncare home hypertensive populations (70% vs 63%),<sup>27</sup> which does not support the hypothesis that the treatment of this long-term condition is overlooked in care home residents.

## Conclusion

Despite the use of increasing numbers of antihypertensive agents in care home residents, there has been no improvement in the control of their blood pressure. These vulnerable people are therefore being exposed to an increased risk of side effects without the intended benefit. This increase in the number of agents may well reflect the growing problem of polypharmacy, which has been extensively documented and discussed over the past few years.<sup>30</sup> These findings justify further study of the treatment of hypertension in care homes in countries outside the United States. They also justify reexamination of whether the benefit of treatment exceeds the harm in some diagnostic groups resident in care homes, such as those with dementia in whom the risk of side effects may be particularly high. The findings also remind clinicians to take particular care to weigh potential benefits and harms in prescribing for hypertension in care home residents, given that increasing treatment does not necessarily lead to better blood pressure control.

**Table 2**  
Summary of Studies' Characteristics

Source [Reference No.]	Type of Study	No. of Patients	No. With Hypertension (%)	Mean Age (Range)	Location	Country	Identification of Hypertensive Patients	Blood Pressure Measured	Selection Method
Manopulo and Sturani 1991 <sup>24</sup>	Cross-sectional	108	17 (16)	78.6 (65–90)	2 nursing homes	Italy	Recorded diagnosis	Yes	Not stated
Fish et al 1995 <sup>11</sup>	Cross-sectional Retrospective review of charts	550 (only 50 included in the study)	150 (27)	87 (50–106)	Long term care residents	United States	Recorded diagnosis. (Only those with hypertension as the sole indication for an antihypertensive were included)	Yes	Not stated
Gambassi et al 1998 <sup>12</sup>	Cross-sectional Retrospective review of database	270,148	80,206 (30)	82.7 (65–115)	Nursing home population of 5 states (Kansas, Maine, Mississippi, New York, South Dakota)	United States	Recorded diagnosis	No	Not stated (availability of the data set)
Trilling et al 1998 <sup>13</sup>	Cross-sectional	804	355 (44)	Not available	3 care homes (two veterans' homes)	United States	Recorded diagnosis	Yes	NHs affiliated with the university
Maxwell et al 2000 <sup>20</sup>	Cross-sectional Retrospective review of minimum data set	23,655	5241 (22)	80.7 (SD 7.7)	Chronic hospital patients	Canada	Recorded diagnosis	No	Not stated. (availability of the data set)
Fahey et al 2003 <sup>7</sup>	Controlled observational study	172	34 (20)	85 (SD 7)	Four nursing homes	United Kingdom	Recorded diagnosis	No	Via 3 general practitioner practices. Random selection of controls
Ziesmer et al 2003 <sup>14</sup>	Retrospective Chart audit	255	129 (51)	77 (68–86)	Single academic nursing home	United States	According to the criteria of JNC VI	Yes	Nursing home affiliated with the medical center
Koka et al 2007 <sup>18</sup>	Cross-sectional	202	143 (71)	73 (50–98)	Single academic nursing home	United States	According to the criteria of JNC VII	Yes	Nursing home affiliated with the medical center
Coover et al 2008 <sup>17</sup>	Cross-sectional	966	683 (71)	78.1 (SD 17.2)	Single skilled nursing facility	United States	Recorded diagnosis	Yes	12 skilled nursing facilities were chosen
Tsuyuki et al 2008 <sup>19</sup>	Cross-sectional Chart audit	2063	733 (36)	84 (SD 8)	15 long term care facilities	Canada	Recorded diagnosis	Yes	Not stated
Drawz et al 2009 <sup>16</sup>	Cross-sectional	13,507	7129 (53)	81.6	Data from the NNHS 2004	United States	Recorded diagnosis	No	NNHS
Rolland et al 2009 <sup>23</sup>	Cross-sectional	4920	2676 (54)	85.7 (SD 8.8)	Single care home	France	Recorded diagnosis	No	Survey of Nursing homes within a region. All invited, participation was voluntary
Ong et al 2010 <sup>25</sup>	Cross-sectional	205	74 (36)	(62–98)	Single care home	Malaysia	Recorded diagnosis and measured blood pressure	Yes	Author is visiting medical officer for the facility
Shah et al 2011 <sup>21</sup>	Cross-sectional Retrospective review of database	10387	4446 (43)	85.5	Care home	United Kingdom	Recorded diagnosis	No	Volunteer sample of UK general practices' data
Simonson et al 2011 <sup>15</sup>	Cross-sectional	13,507	7272 (54)	81.8	Data from NNHS 2004	United States	Recorded diagnosis	No	NNHS
Lochner et al 2012 <sup>22</sup>	Cross-sectional With matched controls Retrospective	725	513 (71)	85.9 (SD 7.1)	4 nursing homes	Germany	Recorded diagnosis	Yes	Four of 23 invited homes

JNC, Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; NNHS, National Nursing Home Survey.

**Table 3**  
Summary of the Studies' Findings

Source	Prevalence of Hypertension	Sex	Comorbidities	Antihypertensive Types	No. of Antihypertensives	Mean No. of Antihypertensives	Effectiveness (Meets Target <140/90)
Manopulo and Sturani 1991 <sup>24</sup>	16%	83% F 17% M*	Falls 80% Fractures — Incontinence — CHD — CCF — CVD — Dementia — DM —	—	—	—	Not measured
Fish et al 1995 <sup>11</sup>	27%	Not stated	Falls — Fractures — Incontinence — CHD — CCF — CVD — Dementia — DM —	ACEi/ARB: 22% Diuretic: 66% CC Blockers: 18% β-Blockers: 18% α-Blockers: 6% Other: 12%	None: N/A One: 66% Two: 26% Three: 8%	—	Not measured
Gambassi et al 1998 <sup>12</sup>	32%	77% F 23% M	Falls 32% Fractures 9% Incontinence 46% CHD 26% CCF 22% CVD 29% Dementia 39% DM 23%	ACEi/ARB: 22% Diuretic: 25% CC Blockers: 26% β-Blockers: 8% α-Blockers: 3% Other: 16%	None: 30% One: 38% Two: 21% Three: 11%	1.13 (SD 0.97)	Not Measured
Trilling et al 1998 <sup>13</sup>	44%	26% F 74% M	Falls — Hip fracture 3.7% Incontinence — CHD 54% CCF — CVD 38% Dementia 40% DM 25%	ACEi/ARB: 28% Diuretic: 28% CC Blockers: 30% β-Blockers: 8% α-Blockers: 5% Other: —	None: 24% One: 44% Two: 24% Three: 5% Four or More: 1%	1.16 (SD 0.88)	88.8%
Maxwell et al 2000 <sup>20</sup>	22%	65% F 35% M	Falls — Fractures — Incontinence — CHD 19% CCF 16% CVD 47% Dementia 23% DM 26%	—	—	—	Not measured
Fahey et al 2003 <sup>7</sup>	51%	77% F 23% M	Falls — Fractures — Incontinence — CHD 13% CCF — CVD — Dementia — DM 8%	—	—	—	Not measured
Ziesmer et al 2003 <sup>14</sup>	20%	62% F 38% M	Falls — Fractures — Incontinence — CHD 45% CCF 24% CVD 31% Dementia — DM 42%	ACEi/ARB: 54% Diuretic: 33% CC Blockers: 28% β-Blockers: 47% α-Blockers: 4% Other: 4%	None: 0 One: 50% Two: 30% Three: 18% Four or More: 2%	1.7 (SD 0.78)	84%

Table 3 (continued)

Source	Prevalence of Hypertension	Sex	Comorbidities	Antihypertensive Types	No. of Antihypertensives	Mean No. of Antihypertensives	Effectiveness (Meets Target <140/90)								
Koka et al 2007 <sup>18</sup>	71%	51% F 49% M	Falls	—	ACEi/ARB:	62%	None:	0%	2.03 (SD 0.76)	85%					
			Fractures	—	Diuretic:	34%	One:	27%							
			Incontinence	—	CC Blockers:	29%	Two:	43%							
			CHD	—	β-Blockers:	75%	Three:	22%							
			CCF	—	α-Blockers:	4%	Four or More:	9%							
			CVD	—	Other:	10%									
			Dementia	—											
			DM	—											
			Coover et al 2008 <sup>17</sup>	71%	76% F 24% M*	Falls	—	ACEi/ARB:			64%	None:	14%	1.65 (SD 0.99)	71%
						Fractures	—	Diuretic:			56%	One:	30%		
Incontinence	—	CC Blockers:				29%	Two:	33%							
CHD	38%*	β-Blockers:				13%	Three:	17%							
CCF	—	α-Blockers:				—	Four or More:	6%							
CVD	14%*	Other:				10%									
Dementia	—														
DM	48%*														
Tsuyuki et al 2008 <sup>19</sup>	38%	67% F 33% M				Falls	—	ACEi/ARB:	65%	None:	23%	1.29 (SD 0.96)	64%		
						Fractures	—	Diuretic:	24%	One:	37%				
			Incontinence	—	CC Blockers:	30%	Two:	28%							
			CHD	33%	β-Blockers:	20%	Three or More:	12%							
			CCF	—	α-Blockers:	—									
			CVD	45%	Other:	—									
			Dementia	65%											
			DM	27%											
			Drawz et al 2009 <sup>16</sup>	53%	73% F 27% M	Falls	—	ACEi/ARB:	42%	None:	16%			—	Not measured
						Fractures	—	Diuretic:	45%	One:	33%				
Incontinence	—	CC Blockers:				26%	Two or More:	52%							
CHD	23%	β-Blockers:				37%									
CCF	21%	α-Blockers:				—									
CVD	3%	Other:				12%									
Dementia	—														
DM	29%														
Rolland et al 2009 <sup>23</sup>	54%	74% F 26% M*				Falls	—	—	—	—	—	—	Not measured		
						Fractures	—								
			Incontinence	—											
			CHD (MI)	8.8%*											
			CCF	—											
			CVD	7.1%*											
			Dementia	44%*											
			DM	8.7%*											
			Ong et al 2010 <sup>25</sup>	36%	51% F 49% M	Falls	—	—	—	—	—			—	53%
						Fractures	—								
Incontinence	—														
CHD	—														
CCF	—														
CVD	—														
Dementia	—														
DM	—														



Author	Year	Sample Size	Gender	Comorbidities	Medication	Outcomes	Notes	
Shah et al	2011 <sup>21</sup>	43%	77% F 23% M*	Falls Fractures Incontinence CHD CCF CVD Dementia DM	—	Not measured	—	
Simonson et al	2011 <sup>15</sup>	54%	Not stated	Falls Fractures Incontinence CHD CCF CVD Dementia DM	ACEi/ARB: Diuretic: CC Blockers: β-Blockers: α-Blockers: Other:	16% 33% 31% 16% 5%	None: One: Two: Three: Four or More:	1.55 (SD 0.99) Not measured
Lochner et al	2012 <sup>22</sup>	71%	70% F 30% M	Falls Fractures Incontinence CHD CCF CVD Dementia DM	ACEi/ARB: Diuretic: CC Blockers: β-Blockers: α-Blockers: Other:	64% 54% 22% 46% — 2%	None:	Median 2 drugs 61%

ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; CC blockers, calcium channel blockers; CCF, congestive cardiac failure; CHD, coronary heart disease; CVD, cerebrovascular disease; DM, diabetes mellitus; F, female; M, male; —, data not reported.

\*Total population.

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## Appendix 1. Search Strategy Medline (PubMed)

- (1) care home
- (2) nursing home
- (3) residential home
- (4) care homes
- (5) nursing homes
- (6) residential homes
- (7) care-home
- (8) nursing-home
- (9) residential-home
- (10) residential facilities
- (11) homes for the aged
- (12) long term care facility
- (13) long-term care facility
- (14) long-term care
- (15) long term care
- (16) 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12  
OR 13 OR 14 OR 15
- (17) hypertension
- (18) blood pressure
- (19) antihypertensive
- (20) 17 OR 18 OR 19
- (21) management
- (22) treatment
- (23) 21 OR 22
- (24) 16 AND 20 AND 23

## Appendix 2. Bias Assessment Tool

Adapted from “Assessing the Risk of Bias of Individual Studies in Systematic Reviews of Health Care Interventions,” a guide published by the Agency for Healthcare Research and Quality, Department of Health and Human Services.<sup>10</sup>

Risk of Bias	Criterion
Selection bias	Did the study apply inclusion/exclusion criteria uniformly to all comparison groups? Does the design or analysis control account for important confounding and modifying variables through matching, stratification, multivariable analysis, or other approaches? Did researchers rule out any impact from a concurrent intervention or an unintended exposure that might bias results? If attrition (overall or differential nonresponse, dropout, loss to follow-up, or exclusion of participants) was a concern, were missing data handled appropriately (eg, intention-to-treat analysis and imputation)?
Performance bias	Were the outcome assessors blinded to the intervention or exposure status of participants?
Attrition bias	Were interventions/exposures assessed/defined using valid and reliable measures, implemented consistently across all study participants?
Detection bias	Were outcomes assessed/defined using valid and reliable measures, implemented consistently across all study participants? Were confounding variables assessed using valid and reliable measures, implemented consistently across all study participants? Were the potential outcomes prespecified by the researchers? Are all prespecified outcomes reported?
Publication bias	Suspicion of publication bias?