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## Special Article

## Nursing Home Research: The First International Association of Gerontology and Geriatrics (IAGG) Research Conference

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## A B S T R A C T

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fear of falling  
exercise intervention  
homecare  
technological nursing home  
eye care in the nursing home

The International Association of Gerontology and Geriatrics held its first conference on nursing home research in St Louis, MO, in November 2013. This article provides a summary of the presentations.

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The development of nursing homes (NHs) began with St Helena of Constantinople when she developed homes for the old and dying.<sup>1</sup> The modern NH has undergone many changes since these first NHs. In some countries, such as the United States, NHs have been highly medicalized, whereas in other countries, a social or nursing model is more common.<sup>2</sup> In recent years, there has been an increased emphasis on research in the NH.<sup>3,4</sup> Much of this research has used the Minimum Data Set (MDS) 2.0 (the Resident Assessment Instrument)<sup>5</sup> and it is expected that in the future, the newer MDS 3.0 will be the key tool for epidemiological studies in the NH.<sup>6–13</sup> The International Association of Gerontology and Geriatrics (IAGG) consensus group stressed the need to increase high-quality research to improve the quality of care of persons in NHs.<sup>14</sup> As part of the IAGG commitment to enhancing NH care, the first IAGG Conference on Research in the Nursing Home was held in St Louis, MO, in November 2013.

This article represents an overview of the cutting-edge research areas that were presented at this conference.

### Research in Long-Term Care (Resnick)

There are numerous challenges and opportunities associated with research in long-term care (LTC) settings. Although types of settings and services provided vary considerably throughout the different states, regions, and parts of the world, they have several things in common that influence the conduct of research. These include such things as addressing a vulnerable population with a high prevalence of cognitive impairment, and subsequent challenges associated with consenting these individuals to participate in research. There are staff-related challenges that include being able to reach these individuals during busy workdays, high turnover rates, and differing levels of knowledge and education. There are specific methodological challenges when doing work within LTC settings with regard to measurement issues and high rates of missing data and selective attrition in longitudinal studies because of expected deaths or relocations of residents and the noted turnover of staff. Conversely, there are many opportunities for research in these settings and a great need to better understand such things as end-of-life care and when stopping medications and treatments may be most

appropriate, best ways to optimize quality of life (QOL), and best ways to disseminate evidence-based interventions into real-world settings.

Solutions for the challenges identified are available, thereby facilitating the research opportunities in these settings. To help with consent challenges, there are numerous tools that can be used to evaluate a resident's ability to self-consent to participate in a research study. For missing data, innovative statistics methods can be used to ensure that missing data are appropriately managed and controlled for. Measurement challenges can be viewed as opportunities to use a triangulation approach and include subjective data obtained from residents and/or caregivers and objective measures with devices such as the Actigraph. Overall, the advantages for doing research in these settings outweigh the challenges. Regardless of study findings, research provides residents with an opportunity to perform an important volunteer activity for society-at-large and sites are afforded partnerships with external experts, often affiliated with academic institutions, in the field of geriatrics.

### Physician Practice in the Nursing Home (Katz)

Physician practice in the NH varies considerably around the world. The spectrum ranges from intensive physician involvement in the Netherlands, with low physician-to-resident ratios, to several countries where the physician's role is ill defined and where nursing and social models of care predominate.<sup>2</sup> If a physician model of care is to be promulgated, the relationship between physician practice patterns and relevant clinical outcomes must be more clearly defined.

Recent evidence is emerging that begins to substantiate a conceptual model linking physician care and quality. This model posits that physician commitment, competency, and organizational structure are key determinants of quality care.<sup>15</sup> In this context, NH medical staff organization has been linked to several care outcomes with physician presence on site being a key factor. Further, the percentage of a physician's practice devoted to NH care relates to significantly fewer rehospitalizations.<sup>16–19</sup>

Measuring physician performance remains a major challenge. The commonly used Resident Assessment Instrument (RAI)-based measures are imperfect given their general lack of specificity to the

physician component of care. Financially based productivity measures do not necessarily capture the clinician's special skill set related to NH care and its application at the bedside. Measures based on a newly developed set of competencies for NH attending physicians, developed by the American Medical Directors Association, hold promise, as do previously described NH-specific Assessing Care of Vulnerable Elders (ACOVE)-based process measures.<sup>20–23</sup> Significant research is needed that will determine the ideal set of NH-based physician performance measures and their relationship to quality of care.

### Transitions Between Nursing Home and Hospital (Little)

Patients moving between care settings are vulnerable to medical errors and hospital readmissions, which increase morbidity and financial costs. Many readmissions are potentially preventable, particularly in the last year of life.<sup>24–32</sup> Pneumonia, congestive heart failure (CHF), urinary tract infection, dehydration, falls/trauma, and chronic obstructive pulmonary disease have been identified as the leading causes of potentially avoidable hospitalizations (PAHs)<sup>24–26,29,33</sup>; however, multiple other NH-specific factors play a role in readmissions. Studies suggest that facilities with lower rates of PAH have higher availability of skilled services, including onsite radiography, higher nursing staff to patient ratios, high numbers of skilled nursing staff, nurse practitioners/physician assistants available onsite, and utilization of primary providers who dedicate a higher percentage of their clinical effort to long-term care. Financial disincentives for treating sicker patients in the NH setting, such as bed-hold policies and for-profit status, were associated with higher rates of PAH.<sup>16,24,25,32,34</sup> The criteria to identify PAH in NH residents is based on previously defined ambulatory care-specific conditions, which may not apply in the NH setting.<sup>29,31,35</sup> Other barriers to effective transitions of care include poor communication between providers, lack of advance care planning, and polypharmacy and complex medication regimens.<sup>36–40</sup>

Many models designed to improve transitions and reduce readmission rates between hospitals and NHs have been developed<sup>41–51</sup>; however, model implementation has yielded mixed results with consistent,<sup>41,42</sup> variable,<sup>44,45</sup> or no<sup>52</sup> change in 30-day rehospitalizations. Common components thought to be integral to the success of the various models are early palliative care consultation for advance care planning and chronic disease symptom management,<sup>43–46,48,49</sup> assigning a nurse (usually an advance practice nurse) as clinical manager,<sup>41–45,47,49</sup> standardized communication forms and integration of electronic health records,<sup>43–48,50,53</sup> and formal discharge packets for patients entering the community from the skilled NH setting.<sup>47,48</sup> Limitations to the widespread application of currently available models of care include poor experimental design, heterogeneity in study population, limited generalizability, questionable

actual cost benefit, lack of financial support, and difficulty in implementation (staff buy-in).<sup>51</sup> In future studies, the following research gaps and remaining questions will need to be addressed: how to optimize communication between providers; the impact of incorporating advance care planning tools, such as what is the Physician Orders for Life Sustaining Treatment (POLST); what are the effects of new and/or integrated financial models; improved medication reconciliation techniques; identification of NH-sensitive conditions/true PAH diagnoses; creation and validation of readmission risk prediction models; and incorporation of patient perspectives into transitions of care planning.<sup>25,38</sup>

### The INTERACT Quality Improvement Program: Lessons Learned From Quality Improvement Research and Implications for Implementation and Dissemination (Ouslander and Bonner)

Interventions to Reduce Acute Care Transfers (INTERACT) is a comprehensive, quality-improvement program developed by Dr Joseph Ouslander and a team of LTC and geriatric experts. The intervention was piloted in 3 NHs in Georgia, then tested in a larger demonstration project in 30 NHs in New York, Florida, and Massachusetts. Results from the demonstration (Table 1)<sup>44</sup> reflected a 24% relative reduction in hospitalization rates in NHs where staff was highly engaged in the process. Program implementation costs were \$7700 and the net savings was estimated at \$117,000 per facility per year. These results suggest that there could be a significant reduction in total Medicare costs if INTERACT were implemented more widely in US NHs. Most importantly, NH residents would avoid transfer trauma and the risk of adverse events often associated with hospitalization of frail elders, such as falls, delirium, pneumonia, pressure ulcers, and others.

The principal strategies behind the INTERACT program are as follows: (1) **Prevent** conditions from becoming severe enough to require hospitalization through **early identification and evaluation** of changes in resident condition; (2) **Manage** some conditions without transfer when this is feasible and safe; (3) **Improve advance care planning** and the use of palliative care plans when appropriate as an alternative to hospitalization for some residents; and (4) **Improve documentation and communication** within LTC facilities and programs, and between LTC and acute care. Challenges that were experienced during our quality-improvement research included ensuring support and engagement of facility leadership, addressing the heterogeneity of the NH population, addressing a fear of “research” by NH staff and families, recruitment of representative NHs, ensuring that residents were managed in the NH only when it was safe and feasible, and minimizing NH attrition. The presenters discussed several strategies for mitigating these risks, and outlined details of a current National Institutes of Health (NIH) randomized

**Table 1**  
Absolute and Relative Changes in Hospitalization Rates\*

Facilities <sup>†</sup>	Hospitalization Rate per 1,000 Resident Days, Mean ± SD					
	Before Intervention	During Intervention	Change, Mean ± SD	95% Confidence Interval	P-Value	Reduction, %
Engaged facilities (n = 17)	4.01 ± 2.56	3.13 ± 2.27	−0.90 ± 1.28	−0.23 to −1.56	.01	24
Not engaged facilities (n = 8)	3.96 ± 1.79	3.71 ± 1.53	−0.26 ± 1.83	−1.79 to 1.27	.69	6
All participating facilities (n = 25)	3.99 ± 2.30	3.32 ± 2.04	−0.69 ± 1.47	−0.08 to −1.30	.02	17
Comparison facilities (n = 11)	2.69 ± 2.23	2.61 ± 1.82	−0.08 ± 0.74	−0.41 to 0.58	.72	3

SD, standard deviation.

\*Hospitalizations per 1,000 resident days are for the periods of July to December 2008 and July to December 2009 (during the Interventions to Reduce Acute Care Transfers (INTERACT) II intervention).

<sup>†</sup>The 25 nursing homes (NHs) that completed the 6-month intervention for which complete data on hospitalization are available were divided into two groups based on their level of engagement in the project (see text). Each of the 11 comparison facilities was matched to one of the 25 participating NHs based on selected characteristics (see text) but did not participate in the INTERACT II intervention. (See text for additional data related to the 11 comparison NHs.)

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controlled trial that is under way. Several other current INTERACT studies in various countries were presented as well.

### **A Methodology for Study of Care Transitions (Geary, Schumacher, and Thompson)**

Care transitions from hospital to skilled nursing facility are known to be a time of increased risk. Research of this transition, however, is limited both in quantity and scope. This descriptive study will use a complexity science lens to view the transition from hospital to skilled nursing care and for up to 120 days following for patients older than 65 with advanced chronic illness. The study will include perspectives of patients, informal caregivers, and health care providers obtained qualitatively. These qualitative perspectives will be considered in the context of quantitative measures of patient QOL, symptom distress, and unplanned health care utilization by using a mixed methods approach.

Multiple perspectives of each transition will support the development of rich longitudinal descriptions that reflect the complex and dynamic interactions between patients, their caregivers and the many health care providers in both the hospital and the NH. Such dynamic characterizations will more fully support the development of innovative practices to improve outcomes for patient, informal caregiver, and health systems.

### **Nursing Homes in Europe: Trends and Quality Initiatives (Martin)**

There is a spectrum of care and assistance given or bought to support older people in Europe. This goes from care homes providing intensive 24/7 nursing support through to sheltered housing with visiting or occasionally onsite personal assistance. Most European (EU) countries have developed policies designed to enable older people to remain “at home,” so the age-specific rates of care-home living has fallen in some countries despite family-based help falling owing to demographic change with falling birth rates. Nevertheless, some 4% to 8% of older Europeans (aged 65+) receive institutional-based LTC and the total number is likely to increase because the proportion of the population in the 28 EU countries aged 80+ years is predicted to rise from 4.7% to 11.3% between 2010 and 2050. In many states, achieving the necessary carer workforce depends increasingly on immigration. The public/private balance of provision varies widely, but the trend is toward more commercial or not-for-profit independent providers, and this has been accompanied by a trend toward central registration and/or accreditation of facilities, sometimes linked to eligibility to receive public funding for residents' care.

There have been several EU-sponsored projects to promote quality improvement. “Quality management by result-orientated benchmarking in residential care for older people” was developed through a Delphi process, building on the experience of 6 quality frameworks operating across 1 or more of 7 EU states, several of which had demonstrated positive impact on the experience of care.<sup>52,54,55</sup> Ninety-four standards were described in 5 domains: quality of care, QOL (eg, experience), leadership, economic performance, and context of care. A separate project, which aimed to reflect more directly the views of service users and their advocates, produced a “European charter of the rights and responsibilities of older people in need of LTC and assistance” and a derivative voluntary “European Quality Framework for long-term care services” intended for policy makers, service providers, professional care staff, and older peoples' organizations.<sup>56</sup> At present, there is no EU-wide policy or consensus on assessment or care-planning systems, but the Shelter project showed that it is feasible to use routinely collected InterRAI data for benchmarking and thus potentially quality assurance and promotion.

The Netherlands is unique in having national requirement to use common data collection (InterRAI) and in having a specialized medical workforce for NHs (the elderly care physicians), plus national quality standards relating to medical care. In general across Europe, there are no specified standards, and it is primary care doctors who provide the medical care, with no specific training requirements. Geriatricians are not a large workforce in most European countries, but in a few (Scandinavia, Germany, Spain, and Italy) are significant providers to NHs focused on rehabilitation and/or palliative care. In the United Kingdom, the geriatricians have sought to impact commissioning and medical care provided by primary care through a policy and practice initiative “Quest for Quality.”<sup>57</sup> Recently, the European Union Geriatric Medicine Society (EUGMS) care homes group developed a set of medical care standards for approval by the EUGMS board in Spring 2014.

### **Nursing Homes in Germany: An Overview (Wilbers)**

The first homes for the elderly in Germany were founded in the 15th century. These homes were built for people without family members or who were homeless. Not earlier than the 1960s, a more medical setting was established: homes were developed for people with chronic diseases and a need of care that could not be matched by the relatives. Meanwhile, modern German homes are predominantly designed as places to live, not to be treated. Although this approach helps to introduce or maintain “normalcy” in an NH setting, other problems occur, especially in the cooperation with the medical professionals: Residents keep their family doctor and can stick to their former pharmacist. Thus, the average NH has to deal with quite a number of physicians, which makes quality care and treatment difficult.

In 1995, mandatory LTC insurance was introduced, paying part of the costs for care at home as well as in NHs. The LTC insurance is separate from the health insurance and follows different rules, which leads to problems in achieving a high standard of care, including medical treatment.

The number of people needing LTC in Germany is estimated to rise about 50% in the next 25 years, which will strain German society financially. But probably more important will be the lack of skilled personnel for the care of the elderly, which NH operators have to deal with even today.

### **Work Environment, Careworker, and Resident Outcomes in Swiss Nursing Homes: A Cross-Sectional Study (Zúñiga, Ausserhofer, and Schwendimann)**

A growing minority of elderly people live in NHs. The quality and safety of residential care depends on organizational factors, such as the quality of the nurses' work environment. The Swiss Nursing Homes Human Resources Project (SHURP) aims to gain a comprehensive and in-depth understanding of key organizational factors and their relationships with careworker and resident outcomes in Swiss NHs. SHURP is a cross-sectional, multicenter study. The survey was conducted in a randomized sample of 163 Swiss NHs among careworkers of all educational levels from May 2012 to April 2013. The careworker questionnaire consisted of established scales (eg, Practice Environment Scale—Nurse Work Index, Safety Attitudes Questionnaire), as well as investigator-developed items. Additional facility and unit data (eg, staffing, grade-mix, turnover), and NH resident outcomes were collected with a questionnaire filled out by the NH directors.

Overall, the careworker survey response rate was 76% (n = 5323 careworkers). In the 163 NHs, the mean full-time equivalent was 49 careworkers per 100 beds. Turnover had a median of 9% and the

median percentage of registered nurses (RNs) in a unit care team was 30%. Only 63% of the RNs were trained in Switzerland, showing the heavy reliance of Swiss NHs on qualified personnel from other countries. In total, 94% of the careworkers considered the quality of care to be good (range between NHs: 57% to 100%) and 91% felt supported by their supervisors (range between NHs: 41% to 100%). They agreed less on the adequacy of the number of staff at hand to get the work done (61%). Many careworkers reported some health problems (eg, 71% back pain, 48% sleeping problems). As for NH residents, 4.5% showed weight loss in the past 3 months, 5.1% had a urinary tract infection treated with antibiotics in the past 30 days, 3.2% had physical restraints, and 1.7% had a pressure ulcer they acquired in the NH. The most prominent outcome was the use of bedrails among 18.5% of the NH residents, ranging from 0% to 62% between NHs. Overall, the NH resident outcomes measured showed a good quality of care, which is corroborated by the careworkers. Some problematic issues were staffing resources and dependence on qualified personnel from other countries, and relatively high health complaints of careworkers. Moreover, there was a high variability of quality between NHs. In the next phase of this study, we will analyze the associations between these key themes using multivariate and multilevel analyses.

#### Care Dependency and Nursing Care Problems in Austrian Nursing Home Residents With Dementia (Schüssler, Dassen, and Lohrmann)

The aim of this study was to explore the degree of care dependency and the prevalence of nursing care problems (eg, falls) in Austrian NH residents at different stages of dementia. A cross-sectional study was conducted in 9 Austrian NHs and standardized instruments were used to collect data (Care Dependency Scale, the Prevalence Measurement of Care Problems, Mini-Mental State Examination-2 [MMSE-2]).

The analysis of care dependency of the 277 residents with dementia at different stages shows that 89.6% of the residents with severe dementia, 49.5% with moderate dementia, and 18.3% with mild dementia are completely or to a great extent care dependent. Residents are mostly care dependent in the areas of hygiene, getting (un)dressed, avoiding of danger, and continence; 81.2% of the residents are affected by urinary incontinence (severe dementia: 88.7%, moderate dementia: 82.5%; mild dementia: 69.4%), followed by fecal incontinence (51.3%), malnutrition (14.3%), falls (11.9%), restraints (7.6%), and pressure ulcer (5.1%). The study demonstrates a high degree of care dependency and prevalence of nursing care problems, particularly incontinence, in residents with dementia, which confirms experiences of health care professionals in NHs. Supporting residents' self-care abilities and improvements in incontinence care are suggested.

#### Medical Foster Home: An Effective Substitute to Nursing Home Placement? (Levy and Whitfield)

The Veterans Affairs (VA) Medical Foster Home (MFH) Program represents an alternative to NH care for veterans who prefer to remain in a noninstitutional setting. Medical care is provided by VA staff in the home of a caregiver from the community. To understand how demographic characteristics and health care use differed between veterans enrolled in this program and those in traditional VA NHs, we examined a sample of veterans with enrollment in the MFH Program from October 1, 2009, through September 30, 2010, compared with veterans enrolled in a VA NHs during the same time frame. Data were extracted from the Residential History File, a longitudinal data set containing utilization data for veterans in geriatric and extended care programs within the VA.

Compared with veterans residing in VA NHs ( $n = 2180$ ), of the 181 veterans cared for in the MFH program, 41% were younger than 65 years compared with 27% ( $P < .001$ ) in VA NHs and a higher percentage were divorced/never married (59% vs 33%,  $P < .001$ ). A primary psychiatric/neurologic diagnosis was also more common in the MFH cohort (36% vs 14%,  $P < .001$ ). Length of stay was similar (235 vs 245 days,  $P = .318$ ), as was mortality in the first year (20% vs 18%,  $P = .597$ ). Total annual costs of care in the MFH were significantly lower than in a VA NH, even after accounting for the increase in home medical visits (\$55,002 vs \$179,139,  $P < .001$ ), largely due to significantly fewer hospitalizations and NH encounters. MFH care was provided at one-third the cost of VA NH care for a unique population of younger, divorced/never married veterans admitted more often with primary neurologic/psychiatric diagnoses and appears to be an effective substitute for NH care based on continued residence in the MFH for 90% of living residents 1 year following enrollment.

#### A Multicentric Individually Tailored Controlled Trial of Education and Professional Support to Nursing Home Staff (Rolland and de Souto Barreto)

The number of older people living in institutional settings is expected to rise in the next decades in Europe. This specific population has complex medical conditions and needs high-quality care. However, research on optimal organization of NHs to provide the best care to NH residents is still scarce, especially in France. Very few multicentric controlled trials have previously been conducted to examine the impact of a quality intervention on health care provided in NHs. As a result, there is a lack of evidence on how to effectively improve both the quality of care in NHs and residents' health.

In this context, we developed the IQUARE (Impact d'une démarche QUALITÉ sur l'évolution des pratiques et le déclin fonctionnel des Résidents en EHPAD) study, an 18-month multicentric individually tailored controlled trial of education and professional support to NH staff. The 2 main objectives of the IQUARE study were to improve the quality of the health care provided in NHs, and to reduce the risk of functional declines among NH residents during the follow-up period. During the International Nursing Home Research Conference held at Saint Louis University in November 2013, preliminary results of IQUARE were presented.

Data on internal organization and residents' health for the 175 participating NHs were recorded by NH staff. All NHs were volunteers and located in the Midi-Pyrénées region, southwestern France; 85 NHs were allocated to a strong intervention group (3017 randomly selected participants included at baseline) and 90 NHs to a light intervention group (3258 randomly selected participants included at baseline). In the strong-intervention arm, the NHs received descriptive statistics on indicators of quality (various indicators of quality proposed by health authorities in France) regarding their NH and the NHs from their region. Moreover, the quality indicators were discussed during a cooperative work (2 half-day meetings at least) between a volunteer hospital geriatrician and NH staff (coordinating nurse, and NH physician and the administrative director). The aim of these meetings was to find individualized strategies to overcome the weaknesses of the NH in terms of quality indicators. On the other arm, the light intervention was limited to delivering the descriptive statistics on indicators of quality to the NH staff. The efficacy of the strategy on quality indicators and resident health was evaluated at 18 months. Differences between the strong-intervention group and the light-intervention group were assessed through baseline data. Mixed-effect regression models were performed on the postintervention assessments, adjusting by the baseline values of the dependent variable, group allocation (intervention), time, and the interaction group-by-time using the principle of intent-to-treat analysis.

As expected, baseline data showed high levels of dependence, comorbidities, psychological disturbances, and medication consumption among NH residents. There were no statistical differences between the strong- and the light-intervention groups for the Katz Activities of Daily Living (ADL) score (mean score [SD] = 2.52 [2.06] and 2.51 [2.03], respectively), or the Charlson score (2.02 [1.7] and 2.05 [1.7], respectively), pressure ulcers (4.0% and 4.1%, respectively), history of fracture (39.3% and 37.2%, respectively), or fall in the past week (4.0% and 4.6%, respectively) and aggressive behavior (20.8% and 20.6%, respectively). Residents included in the strong-intervention group were statistically older (86.51 years [7.9] vs 85.48 [8.3]), were more frequently women (75.1% vs 72.2%), and reported more pain (24.0% vs 22.1%). In the strong-intervention group, psychiatric diseases were significantly less prevalent (16.0% vs 19.0%). At baseline, very large discrepancies among NHs quality indicators (eg, number of residents with an assessment of Behavioral and Psychological Symptoms of Dementia (BPSD)/number of residents; number of residents with a cognitive assessment/number of residents; number of residents with an assessment of depression/number of residents; number of residents with at least 1 fall during the past year/number of residents present in the NH for 1 year at least; number of residents with 3 weight measurements during the past 3 months/number of residents; number of residents with pressure ulcers developed in the NH/number of residents; number of residents with a measure of pain/number of residents; number of residents with at least 1 antipsychotic/number of residents with a diagnosis of dementia; number of residents with a treatment of osteoporosis/number of residents with a history of osteoporosis fracture; number of residents with a measured creatinine clearance in the past 12 months/number of residents) were observed among the 175 institutions. The NH characteristics (number of beds, public/private, or rate of health professionals working in the NH) were not statistically significantly different in both arms. In both arms, all the quality indicators improved. No statistical differences were observed between the light and the strong intervention at 18 months for the previously listed quality indicators. The rate of depression assessment tended to be higher in the intervention group (from 13.6% to 28.6% in the strong-intervention group compared with 10.6% to 17.2% in the light-intervention group; group  $\times$  time coefficient = 8.61 [−1.40; 18.632];  $P = .09$ ). The adjusted decline of the mean Katz ADL score was also similar in both groups (group  $\times$  time coefficient = −0.62 [−0.73; −0.51];  $P = .46$ ). On the other hand, we observed a statistically significant reduction of the rate of residents addressed for emergency department visit at least 1 time during the past 12 months (group  $\times$  time coefficient = −7.0 [−11.9; −2.1];  $P = .005$ ). In conclusion, we demonstrated in this research-to-action study, an improvement of the quality indicators in both intervention groups. The education and professional support to NH staff seem to result in additional benefits in some quality indicators (depression assessment) and a statistically significant lower rate of emergency department visits. The proven feasibility of IQUARE, as well as its results, may constitute the basis for the development of new work modalities within the French health system and should constitute a model of a research-to-action approach in NHs for other countries.

### Culture Change Toolkit (Etherton-Beer)

This presentation described a current study supported by the Australian Government Department of Social Services under the Encouraging Better Practice in Aged Care Initiative to develop and evaluate a toolkit for sustainable culture change within residential aged care facilities. The prior work of the team (Christopher Etherton-Beer, Barbara Horner, Lorraine Venturato, Rosemary Saunders, Nina Graham, Andrea Steel, and Leon Flicker) running studies of

educational interventions in LTC and developing an intervention comprising external facilitation of change cycles (TOrCCh: Toward Organisational Culture Change) was summarized. The TOrCCh intervention, implemented by staff work teams, was found to be feasible and effective. The present study aimed to develop and evaluate a Toolkit and process for implementation of the TOrCCh intervention, eventually without external facilitation.

Professor Etherton-Beer presented interim results of the study, which is being run in 8 residential care facilities across 2 states. Participants perceive benefits, including staff development, increased communication, teamwork, and leadership. The role of a project sponsor, and organizational support, are perceived as important for sustainability. Challenges were the complexity and application of the Toolkit resource and management of workplace constraints. The presentation generated interested discussion, in which other delegates endorsed the workforce development approach, and reinforced the importance of organizational and executive support for change.

### Nursing Interventions to Optimize Medication Use in Nursing Homes (Dilles)

In Belgium, 7% of the population aged 65 and older resides permanently in an NH.<sup>58</sup> Almost each community has its own NH services. When people get more dependent of assistance in their ADLs and require continual nursing care, they can receive care in an NH, close to their former house. Most residents prefer to keep their former general practitioner for medical care in the NH. Table 2 shows some characteristics of the Flemish NHs. In 2011, medical care to the residents was provided by 2 to 110 different general practitioners per NH. A coordinating and advising physician is responsible for the general medical coordination and quality. In some NHs, he takes over the medical care for up to 97% of the residents; in other NHs, none of the residents is treated by the coordinating and advising physician. Daily care is provided by a team of nurses and care assistants.<sup>59</sup>

Nurses have a crucial role in monitoring pharmacotherapeutic care in NHs, especially when medical care for the resident is provided by a general practitioner who does not regularly visit the NH.<sup>60</sup> Medication anamneses are performed by nurses in 58% of the residents.<sup>59</sup> Pharmacotherapeutic care and medication evaluation in NHs is a complex task because of a high incidence of polypathology and polypharmacy, the sensitivity of the older patients for adverse drug events, and a decreased medication self-care of residents owing to physical and mental problems. To support the nurses' role in pharmacotherapy in NHs, Professor Tinne Dilles developed an interdisciplinary intervention to identify and resolve drug-related problems, Dr Majda Azermai studied the effects of the abrupt antipsychotic discontinuation in NHs, and Jolyce Bourgeois described the impact of discontinuing the chronic use of sleep medication on the sleep quality of NH residents.

**Table 2**  
Characteristics of Flemish Nursing Homes in 2011 (n=235)

Management authority (%)	
Private	59
Public	41
Number of residents (median, range)	96 (34–350)
Number of nursing beds (median, range)	64 (25–249)
Number of low-care beds (median, range)	31 (0–176)
Number of units (median, range)	3 (1–11)
Number of head nurses (median, range)	3 (1–10)
% of residents treated by the CRA (median, range)	14 (0–97.6)
Number of visiting general practitioners (median, range)	26 (2–110)

CRA, Coordinerend de Raadgevent Arts (Dutch for Coordinating and Advising Physician).

## Pharmanurse: A Nurse-Driven Adverse Drug Reaction Screening for the Improvement of Pharmacotherapy (Dilles)

Pharmacotherapy requires the adaptation of medication use to the individual patient, aiming for a maximum of therapeutic effects and a minimum of side effects. In NHs, nurses' observations and reports of these effects and side effects in patients are an elementary part of trying to reach this goal.<sup>59</sup> Nurses do, however, experience a lack of knowledge, information from physicians, interdisciplinary communication, and attention to report observations, impeding the quality of drug monitoring.<sup>61</sup> The Pharmanurse intervention supports the interdisciplinary drug monitoring process through resident-specific screening lists for adverse drug reactions (ADRs) generated by the Pharmanurse software program, the creation of standardized reports of nurses' observations, and the facilitation of interdisciplinary medication review.<sup>62</sup>

The intervention was tested in 418 residents of 8 NHs. Per resident, a median of 3 ADRs (0–22) were observed by nurses and a median of 2 ADRs (0–17) per resident were confirmed in interdisciplinary medication review. During medication review, 214 medication changes were planned (Figure 1), which was significantly more than in other NH residents ( $P < .01$ ).<sup>62</sup> Physicians and nurses were very satisfied about the improvement of nurses' drug monitoring and the opportunities to improve pharmacotherapeutic care.<sup>62</sup> Nurses can make a valuable and respected contribution to drug monitoring in NHs if the drug monitoring process is supported.<sup>62</sup>

## Use and Misuse of Psychotropic Drugs: A Focus on Antipsychotics and on Discontinuation (Azermai)

Psychotropic drugs, such as benzodiazepines, antipsychotics, and antidepressants, are dominating medication charts of NH residents in Belgium. A nationwide study in 2006<sup>63</sup> revealed a psychotropic drug use of 79% in NHs, of which antipsychotics were used by 33% of residents. Main indications for use were agitation associated with dementia and psychosis, confirming difficulties with the management of BPSDs.

Antipsychotic use for BPSDs remains controversial, given the limited effectiveness within the broad spectrum of behavioral symptoms. Antipsychotics have a modest efficacy in reducing aggression and psychosis but do not improve functioning or QOL. Stroke, falls and consecutive fractures, cognitive decline, and deep vein thrombosis have been reported as adverse effects of antipsychotics in older persons, and even in short-term trials. Although trials had a time span of less than 12 weeks, antipsychotics are used far longer in clinical practice. Therefore, serious concerns with regard to the long-term effects exist. For all these reasons, guidelines advise to minimize antipsychotic use in older persons with dementia, to initiate antipsychotics only in severe distress after a risk-benefit analysis, and to limit treatment duration with attempts of discontinuation.

In our pilot study,<sup>64</sup> we aimed to explore the feasibility of abrupt antipsychotic discontinuation in hospitalized, cognitively impaired

geriatric patients, and the effects with regard to withdrawal phenomena, recurrence of neuropsychiatric symptoms, and relapse to antipsychotics over time. Mild withdrawal symptoms were common after abrupt discontinuation, but these symptoms weaned quickly over time, and led to relapse of antipsychotics in only a small minority of patients. At 1-month follow-up, 85% of participants were still off the antipsychotics. Patients who relapsed to antipsychotics had more severe baseline symptoms, and needed resumption of therapy. Our study confirmed that high baseline antipsychotic doses and severe baseline behavioral scores are predictive of relapse and deteriorating behavioral effects after discontinuation. However, patients relapsing to antipsychotics showed no residual effects or deteriorating behavior as a result of a period of discontinuation and subsequent resumption of therapy, still leading to a trend of some modest improved neuropsychiatric symptoms.

A recent Cochrane review in 2013 confirmed our findings.<sup>65</sup>

## Stopping Benzodiazepines in the Nursing Home Setting: Barriers and Feasibility (Bourgeois)

Prescription guidelines caution against chronic benzodiazepine and z-drug (BZD/Z) use. Nevertheless, chronic use among older adults, especially in NHs is widespread. We wanted to explore why it is difficult to implement discontinuation in this setting.

### Barriers Towards Discontinuation

In one study, we investigated the perceptions of general practitioner (GP) and nurse (key caregivers in Belgian NH setting). By focusing on perceptions pertaining to an individual resident, we obtain a more realistic view on the feasibility to discontinue chronic BZD/Z use.<sup>66</sup> There are no clinical trials on chronic effectiveness of BZD/Z, but in our study, the GPs and nurses indicated that the BZD/Z still had the desired effect in respectively 87% and 83% of the 109 residents. When we inquired the side effects, GPs and nurses observed none in 75% and 70%, respectively. Dependence was seen in respectively 41% and 28%.

Barriers toward discontinuation were higher among GPs than nurses. On the other hand, GPs were willing to try discontinuation in 1 of 3 residents, whereas nurses wanted to try in only 1 of 5. Both caregivers were willing to stop chronic BZD/Z in 13% of the residents. Overall, there was a low level of agreement between GP and nurse, indicating the need for interdisciplinary contacts. The perceived effectiveness, the absence of side effects, and the presence of dependence in most residents on chronic BZD/Z use resulted in a low willingness to stop.

### Feasibility of Stopping BZD as Sleeping Aid

In a second naturalistic cohort study, we investigated the feasibility of stopping chronic BZD/Z in NH residents with no impaired cognitive function.

In a convenience sample of 5 NHs, 138 residents were chronic BZD/Z users and were cognitively fit. We sent a recruitment letter to their GPs and got positive response for 44% (59 residents) to initiate a discontinuation process. The main indication why GPs were not initiating a discontinuation was the expected resistance of the resident. After consulting the resident, 38 of the 59 residents agreed to start discontinuation. After 2 months, 66% were BZD/Z free and 24% reduced their dose.

By increasing the awareness of chronic BZD use, we were able to successfully discontinue chronic BZD use in 18%. The large cascade shows the influence of the (lack of) residents' motivation in this group of cognitively fit older adults.

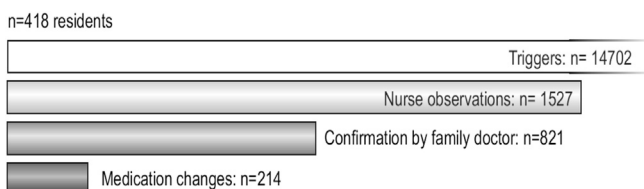


Fig. 1. Medication changes planned.

### Cognitive Stimulation Therapy (Orrell)

In the past, the poor evidence for psychological interventions for dementia was due to a number of difficulties. Studies were often small, with limitations in design, a wide range of outcome measures, and interventions that were not well specified and not supported by standardized manuals and training. Moreover, approaches often lacked a well-articulated theory and there was confusion about what could be considered a therapy compared with just an enjoyable activity. Techniques to stimulate cognition in older people with dementia are now widely used. The best evidenced and most well known is cognitive stimulation therapy (CST). The original randomized controlled trial compared a twice-weekly cognitive stimulation therapy group with treatment as usual for older people with dementia; 201 people were in the study and an intention to treat analysis showed the intervention group improved relative to the group on cognition, and QOL. The number needed to treat was 6 for the intervention group, similar to the level of improvement found with antedementia drugs. The updated 2012 Cochrane review looked at randomized controlled trials of cognitive stimulation as an intervention for dementia and found that cognition, depressive symptoms, and quality of life (QOL) all improved.

Qualitative methods have been used both to refine the CST package and investigate the experiences of the people attending CST groups, their carers, and the group facilitators. Themes identified in the analyses were positive experiences of being in the group and changes experienced in everyday life providing evidence for the mechanisms of change. These findings helped contribute to the updating of the CST manual. Recent results from the largest-ever study of maintenance CST indicate that it continues to benefit QOL even after 6 months and also helps cognition for people on cholinesterase inhibitor medication. CST is now widely used across the world, including in China, Africa, Japan, and the United States. Cognitive stimulation approaches improve cognition in people with dementia but further research is needed to look at length and intensity of treatment of home-based CST programs. Training and manualization of approaches should improve the delivery of treatment ([www.cstdementia.com](http://www.cstdementia.com)).

A recent proof of concept study on CST in NHs was published in the *Journal*.<sup>67</sup>

### Depression in the Nursing Home (Grossberg)

Mood disorders (depression) are the second most common psychiatric disorders after dementias in NHs.<sup>68</sup> The spectrum of mood disorders includes major and minor depression, apathy, suicidality, and mania (bipolar disorder). A study by Levin et al.<sup>69</sup> of more than 76,000 residents in 921 US NHs found that 48% had an active depression diagnosis. Of these, 23% received no treatment. Untreated depression can affect a variety of factors, including adherence to medications/medical treatments, response to analgesics, level of independence in ADLs and tendency toward frailty, failure/poor rehabilitation, such as after hip fracture or stroke, and even morbidity and mortality (including suicide).<sup>69</sup> Prompt diagnosis and effective treatment can be curative, improve QOL, positively affect comorbid medical problems, and decrease caregiver burden.<sup>70</sup>

A variety of research opportunities/needs exist relative to mood disorders in LTC. Research needs to focus on better understanding risk factors, signs and symptoms, early detection, and most effective treatments for mood disorders in LTC. For example, how can we address the stigma of psychiatric illness and myths that all old people in NHs are expected to be depressed? How can we use electroconvulsive therapy (ECT) more often given its efficacy? Research is urgently needed to identify the most cost-effective ways of educating

LTC staff at all levels relative to recognizing and understanding the importance of mood disorders: the impact of staff education. How and when to use current depression screening tools and which are best for the LTC setting needs to be investigated. We need to better understand who and when to refer to a geriatric mental health specialist (eg, geriatric psychiatrist).

More research should focus on the utility of activities therapy, exercise, and social/psychological and environmental interventions in potentially preventing mood disorders in LTC. Of research interest is how and when can we use nonpharmacologic approaches for treating mood disorders in LTC, given staffing and educational needs? How do we pay for more resources, such as activity therapy?

### Vision in Older Institutionalized Individuals (Kergoat)

The literature indicates that older residents living in long-term care facilities (LTCFs) do not receive regular eye care. Standards of care dictate that individuals 65 years or older should receive an eye examination every 1 to 2 years. Our studies indicate that a full eye examination, including visual acuity, ocular refraction, and ocular health assessments, is feasible for a large proportion of these residents, irrespective of their older age, level of cognition, or communication abilities. An optimization of their visual acuity by ocular refraction improved the acuity level by an average of 5 lines on the Snellen chart. We have further shown that letters contained in the regular Snellen chart can be used advantageously to measure visual acuity in residents with dementia.

A more recent study looking at the eye care provided by LTCFs indicated that these institutions are rather satisfied with the eye care services they are able to offer their residents, although the services are mostly offered by request and outside the institution, and even if the services are not offered regularly and to all residents. This study concluded that eye care professionals should work more closely with LTCFs to optimize the level of eye care offered to their older residents. This is even more important considering that a great proportion of these residents have dementia and are not necessarily able to advocate for themselves. Finally, our research team is currently working on the validation of a screening test that could be used to screen visual acuity in LTCF residents with dementia. If the tool is demonstrated to be valid for that population, then it could be used widely by non-eye care specialists to determine which LTCF residents most need an eye examination.

### Research Evaluating Prevention and Treatment of Pressure Ulcers (Thomas)

Although most pressure ulcers occur in acute care settings, the prevalence in long-term care facilities is high because of the long trajectory of healing. The prevention and treatment of pressure ulcers is often empiric, relying on opinion rather than evidence-based clinical trials.

The consensus for prevention of pressure ulcers includes passive positioning, reduction of bed/interface pressure, topical skin care, and addressing nutrition. Few data are available to verify these recommendations. Systematic reviews of prevention strategies suggest that a clear benefit of passive positioning or the optimum frequency of turning is not known. Pressure-reducing surfaces have been shown to be superior to standard mattresses for prevention, but one device is not superior to another. Three trials of skin care products have not shown clear benefit over simple moisturizers. One of 5 trials of nutritional supplements for prevention has shown a slight benefit.

Treatment of pressure ulcers includes pressure relief, topical wound care, debridement, and addressing nutritional issues. Systematic reviews suggest that pressure-reducing surfaces improve



healing compared with standard mattresses, but time to complete healing is not different. The optimum time for passive positioning may be 4 hours on a pressure-reducing surface, rather than the traditional 2 hours. Only 21 randomized, controlled trials evaluate topical dressings. Advanced dressings compared with “traditional dressings,” such as saline gauze, improve wound-healing rates, but comparisons of advanced dressing with each other show little or no difference among products. Adjunct therapies, such as topical negative pressure, ultrasound, and others, have not shown improved healing rates in pressure ulcers, and may cause harm. Although widely recommended, there are no outcome trials for accelerated healing after surgical debridement. Nutritional supplements, including vitamin C, zinc, or specific amino acids, either delivered per mouth or per enteral tube, have not been shown to produce higher healing rates.

Clearly, there is a dearth of good-quality studies to guide prevention and treatment recommendations for management of pressure ulcers. This remains a fertile field for research in LTC settings.

### **Fear of Falling After Hip Fractures in Older Persons (Visschedijk)**

Fear of falling (FoF) is associated with poor outcomes in patients after a hip fracture. To develop an intervention to reduce FoF, FoF was studied through a systematic literature review and a cross-sectional study in 10 skilled nursing facilities in NHs, where most vulnerable older people rehabilitate after a hip fracture. In this study, 100 participants with hip fractures were included and the Falls Efficacy Scale-International was the outcome measure for FoF.

The literature review revealed that FoF is common among older patients after a hip fracture and indeed is associated with unwanted outcomes, such as increased falls, reduced mobility, and increased mortality. Knowledge about risk factors and interventions was limited. The cross-sectional study showed that factors associated with frailty, such as number of complications and anxiety, were significantly related to a high level of FoF. A multivariate model demonstrated that walking ability before fracture, ADLs after fracture, and anxiety were independently related to FoF. This information is important to develop interventions for patients with a high level of FoF after a hip fracture.

### **Older People's Exercise Intervention in Residential and Nursing Accommodation (OPERA): A Cluster Randomized Trial and Parallel Process Evaluation (Taylor, on behalf of the OPERA Study Team)**

Many care home residents have depression, much of which is unrecognized. The OPERA (Older Peoples' Exercise in Residential and Nursing Accommodation) study was a large cluster randomized trial to evaluate the impact of a “whole-home” intervention, consisting of training for care home staff backed up with a twice-weekly, physiotherapist-led exercise class, on depressive symptoms in older care-home (residential and NH) residents.<sup>71</sup> The primary outcome was the Geriatric Depression Scale 15 (GDS-15). We compared the overall prevalence of depression at 12 months after randomization, and the number of depressive symptoms at 6-month follow-up in those residents who were depressed at baseline, in intervention and control homes. Alongside the main trial we conducted a parallel, mixed-methods process evaluation,<sup>72</sup> which included quantitative data from all the study homes and additional quantitative and qualitative data from a purposive sample of 8 case study homes (2 control and 6 intervention). Qualitative methods included participant observation, interviews, and focus groups.

We recruited 78 care homes and a total of 1045 study participants. Of the 765 residents recruited before randomization with a GDS-15

score, 374 (49%) were depressed. OPERA delivered 3191 exercise classes with 31,705 person attendances. In the cross-sectional analysis at 12-month follow-up, the odds for being depressed were 0.76 (95% confidence interval [CI] 0.53–1.09) lower in the intervention group. Point estimates for benefit for the depressed cohort (0.22, 95% CI –0.52 to 0.95) favored the control intervention.<sup>73,74</sup> Just over one-third of participants attended 51 or more exercise classes, the pre-defined estimate of an effective dose; 9% attended no classes. The commonest reason for nonattendance (60%) was “unwillingness.”<sup>75</sup> There was little evidence of fall off in the numbers attending the classes across time, but residents who were depressed at baseline attended fewer exercise classes on average than those who were not depressed. Quantitative activity sweeps in case-study homes revealed patterns of activity that were stable across time within homes, but varied greatly between homes. There was no evidence of differences in fracture rates or mortality between the intervention and control homes, nor evidence of differences in any other outcomes. The intervention was not cost-effective.

The OPERA intervention was successfully implemented and delivering an ongoing, exercise class-based intervention in care home settings was viable. But depressed residents were less likely to attend exercise classes and, overall, residents were often unwilling to attend. There appeared to be large, unexplained variations between patterns of physical activity in care homes. The results do not support the use of a whole-home physical activity and moderate-intensity exercise program to reduce depression in care-home residents.

### **Experimental Study in Homecare: Health Education and Exercise for Dementia and Quality of Life (Handajani, Widjaja, and Turana)**

The increased life expectancy is reflected in the increasing number of elderly each year. It resulted in an increased number of the elderly population to 18 million or 7.7% in Indonesia in 2011.<sup>76</sup> The rapidly growing numbers of older people will be implicated in a greater risk of physical and cognitive decline, disability, and decreasing QOL of the elderly. The challenge in the 21st century is to delay the onset of disability and to ensure optimal QOL for older people.<sup>77</sup> Dementia has significant social and economic implications in terms of direct medical costs, social costs, and the costs of informal care. As a consequence, promoting health and achieving a good QOL for older people are very important, including primary prevention, by promoting a healthy lifestyle. QOL is more important than longevity and viability; the QOL of elderly is considered as the first and the most basic need. Because of the importance of QOL and health status in health care, the improvement of QOL and health status are the priority.

The objective of the study was to analyze the effects of intervention: the effect of exercise (Brain Vitality Exercise [BVE]) itself and the effect of BVE combined with health education for cognitive function and QOL in home care. This research is an experimental study with a 1-year intervention. A convenience sample included 112 respondents, 60 years or older, in 2 homecare components (Homecare I and II). There were 70 respondents in Homecare I, which was divided into 2 groups: 36 respondents as the intervention group and 34 respondents as the control group. For Homecare II, there were 42 respondents who participated in pretest and posttest. A 12-month BVE training program consisted of exercise 3 times per week for 60 minutes and health education (HE) 2 times per month for 1 year for the intervention group in Homecare II. The intervention group in Homecare I was not given HE. BVE has as a notice of motion a series of concepts and principles of anatomy and physiology of the brain.

BVE is an exercise tailored to the culture of Indonesia and a book and video guide have been created. Movements on BVE derived from martial arts and traditional dances of Indonesia is slow, repetitive,

involving the eye, regulated breathing, and imagination while doing the motion.<sup>78</sup>

Data were collected before and after completing the 12-month study. The evaluation of interventions was carried out by questionnaire, recording, document analysis, and ongoing monitoring and evaluation during the intervention. Before and after the intervention, several tests were carried out, such as MMSE, Clock Drawing Test (CDT), Verbal Fluency, Consortium to Establish a Registry for Alzheimer's Disease (CERAD), Boston Naming Test, and Visuoconstruction. For measuring QOL, the WHOQOL-BREF instrument was used.

Table 3 shows significant increase of CDT, MMSE, and Boston Naming score in the intervention group compared with the control group in Homecare I ( $P < .005$ ).

Similarly, there were significant increases on the facet "thinking, learning, memory, and concentration" and the facet "negative feelings" on the psychological domain of the intervention group. The same thing happened in the facet of the environment domain. There were significant differences between the intervention group and control group on the facet "opportunities for acquiring new information and skill" and the facet "health and social care: accessibility and quality" (Table 4).

Significant differences were found on CDT, Boston Naming score, and psychological and environment domain of QOL between baseline and end point after the intervention of BVE and HE (Table 5).

Physical exercise when done regularly is an important element of overall health promotion.<sup>79</sup> Effective prevention strategies would result in substantial benefits through improved QOL, prolonged independent life expectancy, and reduced economic cost and social burdens.<sup>80</sup> In other findings, regular exercise is associated with delayed onset of dementia and Alzheimer disease, further supporting its value of elderly. More recent studies showed that walking was associated with reduced risk of dementia and Alzheimer disease in a cohort of Japanese-American men.<sup>81</sup> Higher physical function and greater cognitive ability have been associated with better QOL.<sup>82</sup> Functional decline is one of the main factors affecting QOL for people with dementia.<sup>83</sup> A study in South Korea showed that dance exercise 2 times per week for 6 months increases the verbal fluency, word list delayed recall, recognition, and the word list, as well as CERAD total score with  $P < .05$ .<sup>84</sup> The study by Hamidizadeh et al<sup>85</sup> conducted on elderly living in NHs found that exercise training intervention has improved QOL scores. Based on our findings, there were differences between of QOL of elderly in Homecare I and Homecare II. In Homecare I, there were mean score differences between the intervention group and control group significantly in the facet of psychological domain and environment domain.

Homecare II showed an increase in the mean score of the posttest group that was significantly higher than the pretest group. This could have happened because Homecare II gives 2 types of interventions, BVE and HE, whereas the intervention group in Homecare I gives only BVE. Evidence suggests that HE and exercise intervention approaches can be used to elicit cognitive and functional improvements and QOL of older people. Much of this research has been focused on each of these intervention types independently.<sup>86</sup> The 2 intervention models have been found to improve cognitive function and functional QOL of older people. However, brain vitality exercise and health education

**Table 3**

Score Differences of Clock Drawing Test (CDT), Mini-Mental State Examination (MMSE) and Boston Naming Score Between Intervention and Control Groups in Homecare I

Variable	Intervention Group	Control Group	P Value
CDT	3.73 ± 1.14	2.62 ± 1.21	.003
MMSE	26.58 ± 2.62	25.19 ± 3.15	.011
The Boston Naming Test	13.48 ± 2.72	11.83 ± 1.50	.000

**Table 4**

Score Differences Between Intervention and Control Groups on Facet of Psychological and Environment Domain in Homecare I

Variable	Intervention Group	Control Group	P Value
Psychological domain of quality of life			
Facet of "thinking, learning, memory, and concentration"	3.00 ± 0.88	2.61 ± 0.68	.004
Facet of "negative feeling"	3.38 ± 0.49	3.01 ± 0.64	.003
Environment domain of quality of life			
Facet of "opportunities for acquiring new information and skill"	3.58 ± 0.88	3.03 ± 0.57	.001
Facet of "health and social care: accessibility and quality"	3.37 ± 0.84	3.00 ± 0.83	.015

**Table 5**

Score Differences Between Pretest and Posttest of Clock Drawing Test (CDT), Boston Naming, and Psychological and Environment Domain of Quality of Life (QOL) in Homecare II

	Baseline	End Point	P Value
CDT	1.94 ± 1.22	3.53 ± 1.11	.03
The Boston Naming Test	11.32 ± 2.71	13.20 ± 1.50	.02
QOL			
Psychological domain	53.79 ± 10.47	64.09 ± 9.94	.00
Environment domain	51.65 ± 7.85	57.16 ± 9.62	.01

interventions are not mutually exclusive; there may be additional benefits for combining the 2 types of interventions, with each intervention augmenting the effects of the other. It showed the most important aspects of these types of intervention and how they have been shown to elicit functional improvements of older people with a range of cognitive impairments and will highlight the possibilities of linking the 2 types of interventions together.<sup>80</sup>

BVE intervention combined with HE can impede dementia and also improve the QOL of elderly. HE and exercise intervention approaches can be used to elicit cognitive and functional improvements and QOL of older people. The BVE and HE interventions are not mutually exclusive; there may be additional benefits for combining the 2 types of interventions, with each intervention augmenting the effects of the other. This study showed the most important aspects of these types of interventions and how they have elicited functional improvements of older people with a range of cognitive impairments and highlighted the possibilities of linking the 2 types of intervention together.<sup>86</sup>

### The Technological Nursing Home: Health Alerts for Early Detection of Changes in Health Conditions (Rantz and Skubic)

The Sinclair School of Nursing initiated the Aging in Place (AIP) Project in 1996, with a vision to (1) dramatically change the way LTC is provided in this country through a new approach of proactive health care for older adults; (2) provide RN care coordination so that older adults can get the right services at the right time to maximize maintaining or regaining health and independence; and (3) to provide research and education opportunities.<sup>87</sup>

AIP was first tested in the community, in both private and public housing, and is now being tested at TigerPlace, an independent senior housing development in Columbia, MO. The School of Nursing obtained a 4-year Centers for Medicare and Medicaid grant in 1999 to develop a wellness center–focused, licensed home health agency to serve Medicare, Medicaid, private insurance, and private-pay older adult clients.

Legislation in 1999 and 2001 enabled TigerPlace to be built so that the AIP concept could be tested in an ideal housing environment.

TigerPlace was built by Americare in affiliation with the Sinclair School of Nursing; it opened in 2004, and expanded in 2009 and 2011. Each day, 65 older adults in 54 apartments are served in TigerPlace independent housing and now 85 in rehabilitation and traditional skilled care at the Neighborhoods at TigerPlace.

Key clinical and financial outcomes of the AIP evaluation in the community demonstrated that RN care coordination reduces adverse health events, improves care outcomes and NH utilization, and costs less.<sup>88</sup> Clinical outcomes are better (ADL performance, less depressed and better cognition, continence, pain, and shortness of breath). Cost savings for AIP were \$1591 per month (NH comparison) and \$483 (community comparison).

In TigerPlace, similar clinical outcomes have been achieved. Costs for any TigerPlace participant (even through end of life) has *not* approached NH care (average *annual* care cost for 2008 was \$7331 for those NH eligible and \$2591 for those not eligible, plus housing cost). TigerPlace has been the site for hundreds of student experiences of all disciplines. It was designed to promote independence and aging in place with RN care coordination as the key for cost savings and outcomes. The building is built to NH standards but operated as independent living with services. Residents are able to live in their apartments through end of life.

TigerPlace was envisioned to be a new model of care, providing a new option of independent housing through the end of life with a focus on maximizing independence, and providing care and services that people want and need. *It was also envisioned to be a research environment for developing technology solutions for older people.* Engineers were recruited to join with nurse researchers and other clinicians to engage in research and development of new technology. They helped with designing the technology infrastructure and are leaders in the collaborative research environment at TigerPlace. Researchers have come together to “create new solutions to old problems” that have “nagged” helping older adults age well, promote independence, and engage in life through the end of life.

#### *Technology Solutions Developed, Tested, and Now in Daily Operations*

Specific sensors for early illness and fall detection and fall risk assessment have been developed and tested by the Eldertech research team at TigerPlace.<sup>89</sup> These include motion sensors, bed sensors, and automated gait and fall-detection sensors. These have been installed in individual apartments at TigerPlace or rooms in other LTC settings since 2005. A series of studies have been conducted to evaluate how the sensors might be helpful in interpreting changes in resident condition and “alert staff to take a closer look.” Through decision-support of clinicians, residents have changes detected earlier and interventions put in place to help them recover more quickly, before conditions deteriorate and function dramatically declines.

Residents who live at TigerPlace complete assessments that are made up of a group of standardized assessment tools (the NH MDS, parts of the OASIS, Geriatric Depression Scale, SF12, MMSE, and fall risk) at admission, 6 months, and at times of changes in condition. There are also periodic measurement of gait using the GAITrite mat and grip strength; these measures are used to monitor changes as well as provide measures for outcomes of care and the use of the sensors (more than a third of the residents live with sensors, so there are natural comparison groups to use with adequate numbers to match on other characteristics for pilot work).

Ground truth is periodically collected to validate installed accuracy of their sensors; ground truth in the Eldertech laboratory at Missouri University (MU) is provided by a Vicon Motion Capture system, the GAITrite mat, and other sensors. Residents in TigerPlace have motion sensors, a new hydraulic bed sensor that fits under the

mattress (it measures quantitative pulse, respiration, and restlessness), and the Kinect sensors to measure activity and gait parameters, as well as to detect falls.

When changes are detected in the normal sensor pattern for each person, alerts are sent via e-mail to clinicians and researchers. There is a link in the e-mail so the clinician can go to the sensor Web interface and see graphical displays of the data on the Web-based interface. After looking at the alert information, when warranted, the RN care coordinator assesses the resident and coordinates the appropriate care. It is easy to see both the sensor data Web interface and the electronic health record of the resident to determine if intervention is warranted, or record actions taken on behalf of the resident.

Multiple illnesses have been detected early. These include urinary tract infections, pneumonia and other upper respiratory infections, increasing congestive heart failure, pain after hospitalization, delirium, low blood sugar, and others. Automated algorithms, developed by the engineers working with the clinicians on the research team, detect the changes in function and impending illness development through change detection.

A completed NIH study confirmed positive results when residents have the advantage of living with the sensor technology. With the automated alerts being sent to clinicians, in a 1-year study, statistically significant differences in health outcomes between the control group ( $n = 20$ ) and the intervention group with early illness alerts ( $n = 21$ ) were detected. Specifically, the gait speed score: Q3,  $P = .03$ ; GaitRite functional ambulation profile: Q2,  $P = .05$ ; left hand grip average: Q2,  $P = .02$ ; right hand grip average: Q4,  $P = .05$ . A large-scale randomized trial, funded by NIH, National Institute of Nursing Research, is under way at this time in 11 assisted living facilities in Missouri.

The MU hydraulic bed sensor has added increasing sensitivity and specificity to the sensors deployed. This important sensor that fits unobtrusively under the mattress captures the ballistocardiogram, respiration, and restlessness. There are 4 hydraulic transducers that transmit the signals and automated algorithms for detection and display of the sensor signals. The Web interface shows daily averages, with zoom-in to see hourly averages, zoom-in again to see 15-second values, respiration daily averages, and zoom-in for hourly averages.

Kinect gait system measures a variety of gait parameters (walking speed, step time, step length) that are estimated using points from the legs. It is ideal for use in the NH or home settings. At TigerPlace, Kinect is mounted above the front door, near the ceiling. A computer is placed in a cabinet over the refrigerator. These also have been deployed in an LTC retirement community in Cedar Falls, IA.

At this time, we are capturing gait in the apartments daily, and estimating fall risk. Real-time fall detection and alerts are operational at TigerPlace for about 8 months. Additionally, we have been conducting 2 studies focused on automated fall risk assessment and fall detection. These studies include more than 2 years of data collection with 10 Kinects, 10 radar, 10 Web cams, and ground truth monthly fall-risk assessments of participating residents (funded by Agency for Healthcare Research and Quality and National Science Foundation).

We also have been working on real-time fall alerts with anonymized images of falls sent to staff in the hospital setting. This will be used for fall detection and to “rewind” the event for quality-improvement processing. This was pilot tested on one unit at University Hospital, and is now being installed on a complete unit for further evaluation.

So, what do the residents think about living with sensors and using technology to help them? Elders take ownership of the sensor data; elders want control over who has access to their data; acceptance is related to need and perceived benefits; privacy can be sacrificed for needs/benefits; elders tend to underestimate their own

needs; elders care about the look of the technology; elders are willing to accept technology if it meets a need and has an appropriate interface (address sensory limitations); elders do not consider silhouette imagery to be a privacy invasion.

Additional information and articles are available at [www.agingmo.com](http://www.agingmo.com) and at the Center for Eldercare and Rehabilitation Technology's Web site at [www.eldertech.missouri.edu](http://www.eldertech.missouri.edu).

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