

# ASSESSING CARE OF VULNERABLE ELDERLY (ACOVE) – A REVIEW

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## ABSTRACT

**Background:** nowadays far more people survive to old age than at any other time in history. However, little attention has been paid to the quality of healthcare of older people and they are often excluded from clinical trials. The Assessing Care Of the Vulnerable Elderly (ACOVE) initiative has resulted in a set of quality criteria that have been recently suggested as an instrument for auditing the healthcare process pertaining to the vulnerable elderly.

**Objective:** to review the literature on ACOVE (the initiative and studies using the ACOVE criteria), and an outlook. Aspects of applying information technology (IT) and decision support are explicitly sought.

**Methods:** a literature search has been conducted in PubMed, Scopus and Google; the latter to find more information on the use of ACOVE in IT and decision support. Aside from these databases a specialized web source – of RAND Health– has been searched. Categories have been synthesized to uniformly describe the articles found.

**Results:** 85 articles have been found and categorized. 62 (73%) articles elaborate on the development process of the quality indicators, 12(14%) articles describe the selection of quality indicators, 21 (25%) articles describe the usage of quality indicators to assess the quality of care in certain themes and 50 (59%) other articles describe the validation of quality indicators or their adjustment to new settings. ACOVE is now in its third phase and only few articles discuss the use of IT (5 articles, 6%) and/or decision support (8 articles, 9%).

**Conclusion:** ACOVE, now in its third phase, is the only comprehensive set of quality indicators for the vulnerable elder population and is likely to become the basis of an international standard for assessing the quality of their care. Most articles on ACOVE describe the process of the development and selection of the QI but an increasing number of articles describe the application of ACOVE to assess quality of care. The fourth phase of ACOVE should focus more on interventions most notably those applying information technology and decision support systems. Furthermore, weighting the quality indicators according to importance or relevance to clinical outcomes merits more research.

## 1 INTRODUCTION

In the modern western world people are getting older, the Netherlands is no exception to that [1]. There are various reasons why people live longer including the development of new medical interventions, the improvement of healthcare and breakthroughs in healthcare. Most of the care delivered, concerns patients who are over 65 years or older. Over 13.3 billion euro was spent on elderly care of the total 72.0 billion euro (18%). The 13.3 billion euro is only the direct care delivered and marks probably a lower limit; most costs of care delivered to the elderly are intertwined in other costs of care [2].

Elderly suffer from a multitude of conditions and are susceptible to the effects of poor care delivered. However there is relatively little known about the quality of care delivered to the elderly. Besides, measures of quality of care are often inappropriate to the elderly and elderly patients have often

different preferences when it comes to healthcare and quality of care.

ACOVE has been recently suggested as an instrument for auditing the healthcare process pertaining to the vulnerable elderly. ACOVE endeavors to consider the heterogeneity and special needs of the vulnerable elderly in designing a comprehensive set of quality assessment tools.

In this paper the state of affairs of ACOVE will be described and some recommendations for the future will be made. In this paper several abbreviations are used, these abbreviations and their meaning can be found in **Appendix E – Abbreviations**. The term quality indicator and the difference with guidelines and protocols are explained in **Appendix A – Quality Indicators** and the terms process measures and outcome measures are explained in **Appendix B – Process vs. Outcome Measures**.



## 2 METHODS

A literature search has been conducted in Scopus [3], MEDLINE – accessed via PubMed [4]– RAND Health [5] and Google [6]. Some additional information about the quality indicators has been found via the Journal of the American Geriatrics Society [7] and additional information about the healthcare prospects of the Netherlands have been found on the website of the CBS [8].

When it was possible the queries were restricted to the title, abstract and keywords. This is because when a query was not reported in these three; the articles that were not found will probably not discuss relevant topics of ACOVE.

In the literature search I have used several queries, these queries were:

1. “Assessing care” AND Vulnerable AND (“Elder” OR “Elderly” OR “Elders”)
2. ACOVE
3. Information via website of ACOVE
4. “Assessing care” AND Vulnerable AND (“Elder” OR “Elderly” OR “Elders”) OR ACOVE
5. “Assessing care” AND Vulnerable AND (“Elder” OR “Elderly” OR “Elders”) AND “(Decision Support OR DS)”
6. “Assessing care” AND Vulnerable AND (“Elder” OR “Elderly” OR “Elders”) AND “(Information Technology OR IT)”

The first query has been used in Scopus and MEDLINE. The second query has been used in Scopus and MEDLINE, because of the few results of the first query. Via RAND Health the website of ACOVE was accessed – the third ‘query’. There may be some extra information when the abbreviation ACOVE is used in a query, this fourth query has been used in the same sources as the first query; it can be that the authors of an article used the abbreviation ACOVE in the title, abstract and keywords, these articles will be found with this query. The last two queries have been used in Google to find some information about the usage of IT and decision support, the reason why

these queries have not been used in the other sources is that the other – less specific – queries did find a few articles. Google may find some new developments in the area of ACOVE and assessment of quality of care (like announcements of research, research proposals, etc.). The time frame in which the literature search has been performed was from June 2 till June 10.

## 3 RESULTS

In this section the results will be discussed. First the search results will be reviewed, second the link between the literature and the ACOVE history and state of affairs will be elaborated upon and finally the use of decision support and IT will be discussed.

### 3.1 SEARCH RESULTS

The literature search resulted in 85 articles [10-93,102], see **Appendix C – Table 1** and **Appendix D – Figure 1**. All the articles that were found were published between 2000 and 2008. Scopus found 16 articles when the first or fourth query was used and 25 when the second query was used. Logically the results of the second query resulted in more articles which were not or only partially associated with the ACOVE project. Ten of the articles that were found were not ACOVE related and the topics of these articles were about macromolecules. Unfortunately it was not possible to access one of the 25 articles. Another article mentioned ACOVE, but did not discuss any ACOVE topic. Two articles were not selected because they were not written in Dutch or English. Articles were only included when they were written in Dutch or English.

The number of articles that were found by using MEDLINE were 15, 13 and 20 respectively. The articles that were not selected for review were exactly the same articles that were not selected for review when Scopus was used.

RAND Health has created a website about ACOVE [5]. This website has been accessed after searching in Scopus and MEDLINE. Under the header publications all the articles related to ACOVE can be



found. In total there were 74 articles selected for literature review. Some of the articles that were selected were elaborating on quality indicators for assessing care in nursing homes. These articles might have some important insights regarding to a specific primary care provider. One of the topics of those articles is the development of quality indicators in which – several – experts of the ACOVE panels were involved. The article that was not accessible was the same article as in Scopus and MEDLINE.

Of the articles found in the other sources than Google only a small part discussed the implications of IT (5 articles – 6%) and/or decision support (8 articles – 9%). Most articles which discussed at least one of these topics did this only briefly. Therefore an additional search in Google was performed; there may be articles, proposals or announcements on the internet about ACOVE and the usage of IT and decision support that are not in the scientific sources. Unfortunately the literature search in Google came up with only one new – relevant – article.

The articles have been summarized in two – main – tables. In the first table (**Appendix C – Table 2**) the general information of the articles is categorized according to publication year, number of patients, intervention/method, population characteristics, results, conclusion and limitations. The second table (**Appendix C – Table 3**) is describing the ACOVE related attributes; articles are categorized according to the measures that were taken, the quality indicator domains that were covered, the quality indicator themes that were covered, the quality indicator phase, the number of quality indicators that were used versus the total amount of quality indicators that could be used in the specific study, the sources of information that were used and finally the use of information technology and/or decision support.

In recent years two journals have published a supplement with the quality indicators of ACOVE-1 (**Appendix C – Table 6**) and ACOVE-3 (**Appendix C – Table 4**). On the RAND Health website there was

some information about the ACOVE-2 quality indicators, not all conditions are discussed, the conditions that are discussed can be found in **Appendix C – Table 5**.

### 3.2 ACOVE OVERVIEW

ACOVE has recently been suggested as an instrument for auditing the healthcare process pertaining to the vulnerable elderly. In 2000 the RAND Health researchers released the first set of quality indicators of ACOVE [94]. These first quality indicators were specially developed for assessing the care of the vulnerable elderly. Vulnerable elderly were defined as those patients who have a high risk to die or become severely disabled in the next two years [67].

Although there has been an explosion in attention to quality and quality measurement in the last decade, only few measures focused on the vulnerable elderly. While at the same time these vulnerable elderly are the most frequent consumer of healthcare and much of the healthcare budget is spent on the elderly patients.

Measuring the quality of care is hard in vulnerable elderly, because these patients have a wide variety of preferences in care and most of these patients have multiple – complex – conditions. ACOVE explicitly aims to comprehensively evaluate the medical care provided to the vulnerable elderly. The ACOVE measures reflect both expert opinion and clinical evidence. Some articles have used the ACOVE quality indicator set to measure certain processes of care in the United States [11-16,18-20,25,28,55-62,67,68].

In ACOVE-2 the results of the first phase of ACOVE were used to evaluate several practical interventions in primary care practices aimed at improving the performance on some of the healthcare processes. The healthcare processes which were selected were considered as the least performing healthcare processes [18,28,56,58,60,64,66,93,94].



Because healthcare is continually changing, the ACOVE researchers have developed an even more comprehensive set of quality indicators. These developments have moved ACOVE from the second phase to the third phase. The ACOVE investigators also added five new conditions in order to better reflect the range of healthcare problems in the vulnerable elderly [5,10-14,20,27,29-55,68,98].

### 3.3 ACOVE EVOLVEMENT

This section will elaborate on the different stages of ACOVE. For all the stages the procedure to create quality indicators is the same. Therefore the procedure of creation is discussed in depth under the header ACOVE-1; the sections ACOVE-2 and ACOVE-3 will elaborate briefly on this procedure. For information about a specific article used to create this literature review see **Table 2 – 7 of Appendix C**, given that not all information about every article is explicitly mentioned in this section.

#### 3.3.1 ACOVE-1

The objective of ACOVE was to develop a comprehensive set of quality assessment tools for the ill older persons. In particular, the goals of the project were to:

- Develop a definition of vulnerable elders that delineates a group of community-living persons 65 years of age and older, who are at high risk for death or functional decline within two years and develop a system to identify them [17,21,22,24,63].
- Identify important medical conditions that affect vulnerable elders and for which effective methods of prevention or management exist [21-26].
- Develop a set of evidence-based, quality of care indicators that are relevant to vulnerable elders using systematic literature reviews, expert opinion and the guidance of expert groups and stakeholders [10,21-24,26,27,29-54,64-79,83-92].
- Design a chart abstraction tool, interview instrument and administrative data analytic

methods to implement the quality of care indicator system [21,22,24].

#### Definition of vulnerable elders – creating VES-13

An expert panel considered alternative approaches to identify these elderly [63]:

- A survey has to be developed that is easily transportable across organizations
- It should not be dependent on prior utilization as a predictor, in case of dependency it is possible that elderly are missed who are under diagnosed or undertreated [22]
- Use IADL's as a predictor. IADL's are activities related to independent living and include preparing meals, managing money, shopping, performing light or heavy housework and using a telephone [108]. The lower the score, the more incapable the patient is to perform instrumental activities
- The survey should use an abbreviated list of items with simple scoring rules to minimize respondent burden and enhance provider willingness to adopt the identification strategy

The advice of the expert panel was adhered to and the researchers translated the definition of the vulnerable elderly into specific candidate predictors and outcomes. Furthermore prediction models for functional decline, death and a combination of those two were developed and tested. The prediction models which maximized prediction performance were translated into scoring systems and the predictive ability of the scoring systems were compared.

The result of these methods and measurements was a multivariate model using function, self-rated health and age to predict death or functional decline was only slightly improved when self-reported diagnosis and conditions were included as predictors. This multivariate model was significantly better than a model that used age and self-reported diagnosis. These results provide the basis for the 13-item function-based scoring system. The VES-13 considers



age, self-rated health, limitation in physical function and functional disabilities [17,63].

When using this scoring system to determine whether or not an older person is also vulnerable it appears that when a person scored  $\geq 3$  he/she had 4.2 times the risk of death or functional decline than a person who scored lower than 3 [17,63]. Of the total participants – 6,205 enrolled in Medicare [99] – 32% scored  $\geq 3$ . The system effectively and efficiently identifies older people at risk of functional decline and death; it relies on self-report and is easily transported across care settings [63]. For more – detailed – information about the development and usage, the interested reader can read the following article [63].

#### Important medical conditions

Besides the development of a system for identifying the vulnerable elderly it is also needed to identify important medical conditions and themes which are relevant to this population. A national panel or geriatric experts identified the medical conditions prevalent among the elderly that contribute most to morbidity, mortality and functional decline and death. Besides the aforementioned these medical conditions should be measureable and there should be effective methods of treatment or preventions available [66]. In total the geriatric experts came up with 21 conditions, the PAC added a 22nd condition; continuity and coordination of care [22,23,26,66,67]. These conditions are reported in **Table 7 in Appendix C**.

What can be seen in this table is that ACOVE has three axes; the theme (these are conditions, disorders, syndromes, impairments and clinical situations), the domain (domains of care which are divided in screening, prevention, diagnosis, treatment, follow-up and continuity of care) and finally the medical intervention. The selection of the themes has been extensively discussed in this article [95]. In the next paragraphs the creation of quality indicators will be discussed, as guide the **Figure 2 in Appendix D** can be used.

#### Develop a set of evidence-based, quality of care indicators

Now the conditions are defined a content expert was identified for each condition. This content expert worked together with a project member who has extensive knowledge in systematic reviews and quality indicator development [21]. Each team developed potential quality indicators from existing guidelines, review criteria and expert opinion. To find these existing guidelines and quality indicators they were requested from several agencies and organizations, each of them had something to do with the vulnerable elderly. Furthermore not only scientific databases were searched but also some specialized sources which can be found in this article [21].

When all the information was collected each content expert created 20 to 30 preliminary quality indicators for further review. These proposed quality indicators have an IF-THEN-BECAUSE structure; IF refers to the clinical characteristics that describe persons eligible for the quality indicator; THEN indicates the actual process that should or should not be performed and BECAUSE refers to the expected health impact if the quality indicator is adhered [21-23,66-68]. More information about quality indicators can be found in **Appendix A**. The potential set of quality indicators was sent to other clinical experts for their review, based on the comments of the experts the initial set was narrowed down to 10 – 25.

For these quality indicators in each condition a scientific review was conducted, the published evidence was assessed to for the link between processes and patient outcomes. Several databases were searched and citations found were reviewed by the expert. Studies that were found were prioritized according to the study design used; the strongest design received the highest priority. Sometimes direct evidence from RCT's was not available and indirect evidence was used when it was sufficient. When both direct and indirect evidence was missing the statements of authoritative bodies were used [21].



Next the author created an article with information about quality indicators along with the supportive evidence were sent for peer review [69-79]. The author revised quality indicators based on the comments of the peer reviewer or indicates why revision was not needed. The process of peer review was analogous as the peer review of an article in a journal [21].

The next step is to assess the validity of the quality indicators. A quality indicator is valid when it is supported by evidence which indicates that there is a link between the specified process and a health benefit to the patient, high adherence means higher quality of care and the physician or health plan influenced a majority of factors that determine adherence to the indicator [21]. Two multidisciplinary groups assessed the quality indicators for several conditions by – first – individually validate quality indicators and – second – panelists discussed the validity together and after the discussion each quality indicator was ranked for validity. All quality indicators with panel disagreement were rejected [21].

Because the two multidisciplinary groups assessed only a part of the quality indicators it was needed to review the entire set by the Clinical Committee. The Clinical Committee also assessed the rejected quality indicators briefly which resulted in a final set of 236 quality indicators out of an initial set of 420 [21,26,66,67].

### Implementing quality indicators

Several instruments were developed to implement the quality indicators; three sources of information were used, the medical record, patient/proxy interview (VES-13) and administrative data [22]. With these sources it was necessary to assess the quality of care by scoring the quality indicators. When a quality indicator was adhered the minimum quality of care was delivered to the patient, on the other hand, when a quality indicator was not adhered it means that a patient received below minimal accepted levels quality of care, more information about process measures (what these

quality indicators do) can be found in **Appendix B**. Therefore scoring accounts for clinical circumstances, patient preferences and patient prognosis. The scoring of each quality indicator accounts for these factors at the following five levels [10,22]:

- Any chart documentation indicating that a care process does not apply to the patient excludes application of this quality indicator to the patient [11-16,18-20,23,25,28,55-62,67,68]
- Any care process that is contraindicated because of comorbidity, allergy or intolerance excludes application of the quality indicator to the patient [11-16,18-20,23,25,28,55-62,67,68]
- When a patient is eligible for a quality indicator; this quality indicator is satisfied if the care process occurred as defined in the quality indicator, if the source of information indicates that the patient rejected the care process or if the source of information indicates/documents that the care process was offered to the patient [11-16,18-20,23,25,28,55-62,67,68]
- If the source of information states that the patient would not want to be hospitalized or undergo surgery, the quality indicators requiring hospitalization or surgery will not apply [12,14,19,20,29]
- If a patient has advanced dementia or poor prognosis, then specific quality indicators will not be applied to the measurement of quality of care for that patient [11,20]

The scoring principle remains unchanged when ACOVE is moving to the next stages.

Still one step remains to be taken; there are two special groups of vulnerable elderly, those with advanced dementia and those with a poor prognosis. Not all developed quality indicators are applicable to those two groups, because those groups have different preferences of care than other vulnerable elderly. Furthermore some of the quality indicators are simply not applicable to patients with advanced dementia or poor prognosis (e.g. participating in cardiac rehabilitation). Therefore all quality





indicators were checked whether or not they can be used in these two populations.

All the quality indicators were classified according to their goal (prevention, intervention or continuity of care) and their burdensomeness. In total there were 81.5 quality indicators excluded for advanced dementia and 70 quality indicators for poor prognosis. One of the dementia quality indicators – focusing on evaluation – was split in two, with half excluded; therefore it was possible to reach a total of 81.5 accepted quality indicators. The quality indicators that were included were associated with a low burden [20]. Several years later a quite similar study is performed – see section about ACOVE-3 – which came to the same conclusions [11].

#### **Assessing the quality of care with the quality indicators**

Now that all these quality indicators are developed, they are ready for use; to assess the quality of care in specific themes. Although several studies have been performed there is only one randomized clinical trial performed [15] during the first and second phase of ACOVE. In this RCT the effect of pharmaceutical care was investigated, the reason for this research was that a lot of medication errors occur in care of the vulnerable elderly people. GEM programs were created to decrease mortality and functional decline, but the effect on medication use is barely known. Researchers would like to know whether or not pharmaceutical care could also improve the quality of care of vulnerable elderly as within primary care settings [15].

The control group received GEM care only, while the intervention group received pharmaceutical care – supported by pharmacists – in addition to the GEM care. Several ACOVE-1 quality indicators were used to measure the underuse during the study. According to the quality indicators of underuse the intervention group was six times as likely to have at least one improvement [15]. Furthermore the GEM care with pharmaceutical care seems to reduce underuse, misuse and overuse. The study was performed in an acute GEM unit [15].

In addition to the previous study there was another study performed in two MCO's – an observational cohort study – to evaluate the broad range of pharmacological care. Forty-three quality indicators were assessed and the study came up with the following results: failures to prescribe indicated medications, monitoring medications appropriately, documenting necessary information, educating patients and maintaining continuity of care were shown to form more common problems than inappropriate drugs usage [57].

This is a disturbing result because vulnerable elderly did not receive the care that they were entitled to; the quality of care is very low. Because these care processes are not delivered, the patients who should receive these care processes will have an increased risk of serious injury or even death. The additional help from a pharmacist – like the intervention group of the previous study – would be greatly appreciated and is needed [15].

Several studies have performed quality of care assessments [19,59,61]. All these studies were performed in two MCO's and were cohort studies. One study tried to measure the overall quality of care [19], while another measured the quality of care in vulnerable elderly with chronic pain [59] and a third study tried to measure the quality of care with administrative data and medical records [61]. All patients who did not speak English were excluded.

With a short patient interview it was determined whether or not this patient should be classified as vulnerable. A patient was classified as vulnerable when he/she scored 3 points or higher on the VES-13 survey [19]. Of the vulnerable elderly the medical records were abstracted by nurses supported by a senior nurse and guidelines. Furthermore a physician was available to assess the quality indicators that required more detail in the assessment. Because not everything about the care process is recorded, a quality of care interview was conducted to get a





more complete picture about the care delivered [19].

The result of this study was that the pass-rates for the quality indicators for geriatric conditions was significantly lower than for quality indicators for medical conditions. Which is coherent with the results of studies performed during the third phase of ACOVE [12,14]. Besides the aforementioned treatment quality indicators are often adhered while quality indicators for prevention and diagnosis are not [19].

The same study setup was used in the quality of care assessment of vulnerable elderly with chronic pain [59]. The results are quite similar as the previous study; the adherence to treatment quality indicators is much higher than in all other domains of care, the adherence to screening quality indicators is very low. Although the adherence to treatment quality indicators is high, improvement is still needed on all domains of care for this theme.

A somewhat different approach has been used in another study which used only administrative data and data from medical records [61]. First was determined which quality indicators can be used with medical records – 140 in total – and which can be used with medical records and administrative data – 37 in total. Secondly these quality indicators were assessed and it seems that the quality indicators were adhered for 84%. Quality indicators for geriatric conditions were not that often adhered as quality indicators for medical conditions [61].

Another study tries to find out why there are so many differences in the provision of quality care. The study used the quality of care information collected by the ACOVE project, the relationship between sociodemographic characteristics, clinical factors and types of care processes and whether patients received better or worse than expected quality of care was evaluated [55]. The initial settings of the study were the same as in [19,59,61].

The difference with other studies is that this study also used the expected quality indicator score. The expected quality indicator score is the mean of the population quality indicator pass-rates for all quality indicators that each individual triggered (if an individual triggered two quality indicators, one commonly passed quality indicator with an average pass-rate of 75% and another with pass-rate of 65%; the expected score would be 70%). When a patient scored 77% the observed minus expected score would be  $77\% - 70\% = 7\%$ . A positive number would indicate a better-than-expected quality of care [55].

Patients whose conditions required more history-taking, counseling and medication prescribing care processes received lower-than-expected care. The more comorbid conditions the better the quality of care. Complexity, vulnerability and age do not influence the quality of care significantly [55]. Also the quality of care is not related to the rating of healthcare by the patient. The global care ratings of the patients were determined with the CAHPS and the technical quality of care was determined with the medical record abstraction and the patient interviews. After close investigation there was no significant relation between the patient health ratings and the technical quality of care [16].

What is related with the quality of care received is the survival of vulnerable elderly [60]. This study is an observational cohort study performed in the same setup as the other studies mentioned before [19,55,59,61]. The authors of this study found that a higher 3-year survival was associated with the better quality of care provided to the vulnerable elderly [60].

In general there are two ways to assess the quality of care in certain themes regarding to ACOVE. The first procedure is to determine the vulnerable elder population with the help of the VES-13 survey and then assess the quality of care with administrative data and/or medical data. The second procedure is to determine the vulnerable elder population with the help of the VES-13 survey and then assess the



quality of care with administrative data and/or medical data and patient quality of care interviews.

### 3.3.2 ACOVE-2

The ACOVE measures mentioned in the ACOVE-1 section were used to assess the care being provided to the vulnerable elderly by primary care professionals in several health care systems in the United States. In ACOVE-2 some quality indicators had to be adjusted, merged, removed or created [64]. Articles which elaborate on these processes regarding quality indicators [83-92] are using the exact same procedures as mentioned in the section about ACOVE-1. In stage 2 of the ACOVE project the researchers used the results of these quality of care assessments and the measures themselves to evaluate some practical interventions. These interventions in primary care practices aimed at the improvement of care of the most underperforming healthcare procedures that were defined in ACOVE-1 [94].

ACOVE-2 targeted three geriatric conditions of which the quality of care was very low [18,28]. These three conditions were urinary incontinence [58], falls and mobility problems [60] and cognitive impairment (dementia). The quality of care of urinary incontinence was below acceptable levels; examinations and treatments indicated by the quality indicators were merely given and it seems that guidelines are not adhered to [58]. Quality of care in falls did not score much better; most physicians did not even detect falls and gait disorders in many cases and when they are detected they receive inadequate evaluation. This leads to a paucity of recommendations and treatments. The quality of care was assessed by using medical record data and patient interviews [60]. Because of the poor care in these three conditions, four condition-specific interventions were developed [18,28,66]:

- Efficient collection of condition-specific clinical data
- Medical record prompts to encourage performance of essential care processes
- Patient education materials and activation of the patient his role in follow-up

- Physician decision support and physician education

#### Interventions

At first it is necessary to identify vulnerable elders who had at least one of the three conditions that were mentioned before. Patients who have an appointment were called in advance and some questions were asked to determine whether or not a patient has one of these three conditions and if the condition was bothersome enough for the patient that they would like to know something about the treatment options etc.[12,18,56].

The results of this short interview were placed on the chart of the patient at the time of the visit. When a patient scored positive on a certain condition, a specific structured visit note and condition specific materials were attached to the chart. Furthermore the conditions were prioritized, because when a patient had multiple conditions, the physician could start with the condition that has the highest priority. Another advantage of this prioritization is that a physician does not have to complete all forms within one visit and the visit becomes more structured [12,18,56].

Structured visit notes were developed and adjusted with literature reviews, quality indicators of the ACOVE-2 project and clinical judgment and physician input. Clinical judgment and input are important because it is known when physicians do not agree with the guidelines that exist, they will not adhere to it [97]. Input in the creation of the structured visit note can increase adherence and local influences can be incorporated [18,28]. Needless to say is that for each condition the entire process of creation of a structured visit note is repeated.

Besides the structured visit notes patient education materials were created for the three conditions. These materials were designed to enhance patient understanding of the condition and to augment adherence to the treatment plan (and therefore increasing the pass-rate of quality indicators which will result in better quality of care), while reducing



the effort required by physicians to educate and instruct the patient [18]. These materials were simple and short easy to understand folders.

An extension to the structured visit note is the follow-up sheet (also condition specific). This sheet was attached to the patient materials and patients were prompted to monitor the response to treatment and report problems to ultimately stimulate continuity of care for the specific condition.

The physician can be supported by educational sessions led by a geriatrician that demonstrated practical approaches to a certain condition. Furthermore physicians can arrange meetings to review charts of patients who triggered the intervention and make adjustments or modifications in the protocol to deliver better care and to fit better in the primary care practice [18,28].

Two practices that implemented these interventions showed that the quality of care was improved, but still further improvement is necessary [18]. It became clear that the success of these interventions is dependent on the commitment of physicians to improve the quality of care in these conditions. Therefore these interventions were designed to be low-tech, primary care practices do not have to buy expensive systems. Furthermore these interventions were relatively low-cost, using only existing personnel whose roles have been modified [18]. Finally these interventions are adjustable and modifiable to fit in a specific setting. Another important factor is that these interventions are adaptable in the future – in other words – to electronic medical records [18].

Particularly interesting is that an RCT has been performed in two other community medical groups to find out whether or not these interventions do negatively affect masked conditions. Masked conditions are conditions that are not targeted for intervention, but these conditions can be effected by interventions done for the targeted conditions. The interventions are focused on three conditions and

because of that it is possible that there are unintended negative side-effects on quality of care for other conditions. The control group only implemented the case-finding, screening intervention; while the intervention group received all the interventions of ACOVE-2 which are discussed in the previous paragraphs [28].

The quality of care was assessed by selecting and using quality indicators for these three specific conditions and check if the medical record reported that the desired processes were carried out. When a patient was eligible for a specific quality indicator and the medical record reported that the desired process was carried out, than the quality indicator was passed. Not all quality indicators can be assessed with medical record data and administrative data; therefore ACOVE has published an article about which quality indicators can be assessed by these two sources under ACOVE-2 [93].

The results and conclusions of the RCT were that the masked conditions were not negatively affected. While the pass-rates of quality indicators by the intervention group have raised with 15% [28]. Another RCT which has the same settings – in another population and primary care practices – for the control and intervention group; also reported that the intervention group had an increase of quality of care in each of the three conditions. However although the quality of care improved in the intervention group, the patients received only half of recommended care for these conditions [56].

Besides all these aforementioned studies there were three studies which reported on another type of primary care setting the so called nursing homes [80-82]. Although the setting is quite different and the authors drew upon the ACOVE-2 quality indicator set, but the development process and procedures are similar. Expert panels assessed the validity and feasibility of implementation and measurement of quality indicators, by examining the provided supportive evidence of all proposed quality indicators and voting about the quality indicators. 68 quality indicators seemed to be important in nursing



homes covering several geriatric conditions; dementia, end-of-life care, falls and mobility disorders, malnutrition, pressure ulcers and urinary incontinence. Of these 68 quality indicators, 29 quality indicators addressed specific interventions or follow-up of interventions the other – 39 – addressed screening and assessment. Still much remains to be done to design systems to efficiently and reliably implement care consistent with these measures [81].

The second study followed the exact same procedure to develop quality indicators for the management of medical conditions in nursing home residents [80]. The quality indicators were developed while keeping in mind that they – preferably – have to be assessed with medical records and patient interviews. In this study attention is also paid to the population of patients with advanced dementia and the population of patients with a poor prognosis. 114 quality indicators were identified across 11 conditions; depression, diabetes mellitus, hearing impairment, heart failure, hypertension, ischemic heart disease, osteoarthritis, osteoporosis, pneumonia and influenza, stroke and atrial fibrillation and vision impairment. One third of these quality indicators will not be applicable to patients with advanced dementia or poor prognosis [80].

The third study came up with 19 quality indicators, using the exact same procedure as the previous two studies that were mentioned. What is special about these quality indicators is that they address areas that were identified as important by the patients and proxies [82]. This study also reported that only well staffed nursing homes could implement all these quality indicators. Future research should be dedicated to develop staffing models and measurements systems that can be used as tools to monitor and improve nursing home care [82].

### 3.3.3 ACOVE-3 – THE CURRENT STAGE

At the end of 2007 it became clear to the ACOVE researchers that a more comprehensive set was necessary to reflect the progress in diagnosis and

treatment [68]. Therefore a new set of quality indicators was developed [27] and five conditions were added; COPD, colorectal cancer, breast cancer, sleep disorders and benign prostatic hypertrophy [5]. An overview of these quality indicators can be found in **Tables 4 and 7 in Appendix C**. All the quality indicators that were proposed were accompanied by supportive evidence [29-54].

The evidence is used by the ACOVE committees to judge whether or not a specific quality indicator is valid, but it can also be used by individual healthcare providers to compare these processes and evidence with their own care patterns. Furthermore with this evidence healthcare providers can improve their understanding of the stage of the medical literature concerning the care of vulnerable older patients and ultimately enhance their practice [10].

The ACOVE experts considered – while updating and extending existing quality indicators – the applicability of these newly developed quality indicators in patients with advanced dementia or poor prognosis. This resulted in exclusion of several quality indicators for both advanced dementia and poor prognosis [11,68].

The quality indicator development process is quite similar to the development of quality indicators of ACOVE-1. The ACOVE investigators used the VES-13 to identify the vulnerable elder population and – as mentioned earlier – the medical literature is constantly changing; the quality indicator set has to be revised or at least reviewed [10]. The developed quality indicators measure quality of care by processes rather than outcomes, because processes can be more efficiently measured and in most cases outcome measures cannot easily be adjusted for case-mix. Another advantage of process measures is that when a deficit is detected immediate action can be undertaken to improve the quality of care by intervention in the process [10].

A study has been performed to determine which quality indicators are applicable to patients with advanced dementia or poor prognosis [11]. This



study was not the first study to determine these quality indicators; a quite similar study has been performed four years earlier [20]. Because of the development of new quality indicators and the adjustment of existing quality indicators a new study was performed.

The ACOVE Committee constructed two principles in order to identify quality indicators that could be included or have to be excluded; these principles are [11]:

- Aim of the quality indicator care process
- Burden of the quality indicator care process

The aim of the quality indicator can be prevention, continuity and coordination and improvement of care. These aims have a time horizon of short (< 6 months), intermediate (6-24 months) or long (> 24 months). Burden of care ranged from light to moderate to heavy [11]. It was thought that care processes that provided short-term prevention, continuity or improvement and were light in burden would apply to vulnerable elderly with advanced dementia or poor prognosis.

Besides these two principles some quality indicators are impractical to be applied to a vulnerable elderly person with advanced dementia and were therefore excluded (e.g. participating in cardiac rehabilitation). Some care processes do not apply to both populations because the expected benefit is too small or low in probability. The results of this study were that 140 quality indicators were excluded for patients with advanced dementia and 135 quality indicators were excluded for patients with poor prognosis [11]. The quality indicators that were included were attributable to their characteristic of being low in burden and aimed at providing short-term prevention or improvement. An overview of all these quality indicators is given in this appendix [98].

Now that all the ACOVE-3 quality indicators have been developed or adjusted, they can be used in assessing the quality of care. Until today there are two studies done which have been assessing the quality of care with the ACOVE-3 quality

indicators [12,14]. Both studies were cohort studies, performed in healthcare settings in California.

The study that measured the quality of care in an academic medical center [12] used a common way to assess the quality of care – almost every study which has applied the ACOVE quality indicators – patient interviews and chart abstraction. First the quality indicators were selected, some of the quality indicators were excluded because they referred to themes that were not routinely admitted to the hospital, had a low likelihood of meaningful variation or were too costly to measure on a large scale. Moreover some quality indicators cannot be measured with patient interviews and medical records alone (e.g. continuity of care).

Vulnerable elderly were identified with VES-13 survey and medical charts were reviewed to assess the quality of care. Before charts could be reviewed these charts were abstracted with a computerized chart abstraction tool developed to measure the quality of care provided. Manual abstraction was also performed to handle the different kinds of records [12].

After the abstraction the quality indicators for each theme were assessed. A vulnerable elder patient was eligible for to a quality indicator when the IF statement of the quality indicator was satisfied. The patient passed the quality indicator when the indicated process – in the THEN statement – was delivered to the patient. In this study the adherence to quality indicators regarding to geriatric themes were compared with the adherence to quality indicators regarding to medical themes. Overall screening quality indicators were most likely to be adhered and the quality of care was better in medical themes than in geriatric themes [12].

Although the other study used only administrative data of patients who were enrolled in Medicare and Medicaid [100], the authors of this study came to the same conclusion; the quality of care in geriatric conditions is low. However in this study only 44 quality indicators could be used, because the authors



only used administrative data for the quality of care assessment [14].

The quality indicators developed by ACOVE – and other measurement sets – are usually measures for one condition only (e.g. breast cancer), but many patients have multiple conditions. It has to be mentioned that some ACOVE themes are multi-conditional (e.g. pain management). A concern emerges in the time when interest in public reporting and pay-for-performance programs grows, many people worry that providers who treat patients with more complex conditions will be unfairly penalized [13].

A group of researchers assessed measurements of the quality of care received by vulnerable elders in three cohorts; one of these cohorts was the ACOVE cohort. The medical records of these patients were abstracted by nurses and the pass-rates of the quality indicators were determined for each patient. As a result of this study patients with more medical conditions received better quality of care; the concerns proved to be invalid, the number of medical conditions seems to have no negative effect on the quality of care [13]. These results correspond with the results of a study performed earlier [55].

### 3.3.4 USE OF DECISION SUPPORT AND INFORMATION TECHNOLOGY

Of all the articles that have been published about ACOVE only a handful have been elaborating on decision support [12,14,18,28,56,57,60] or information technology in combination with decision support [12,14,18,57,102]. The interventions mentioned were mainly the same interventions that were developed in the second phase of ACOVE.

Most of these articles only mentioned the role of decision support and information technology in their discussion section concluding that computerized interventions merit more research and testing in the future. Furthermore some of the articles mentioned that the quality assessment could be improved when EPR's become available, it would be easier to

abstract medical and administrative data from this source in order to assess the quality of care. Even continually monitoring of quality of care may become possible; which can be a great asset for the pharmaceutical care by monitoring the quality by using the CPOE system and provide real-time feedback [57]. Currently this poses a problem because patient samples are sometimes not big enough to assess the quality of care properly [14].

Before implementing – nationwide – EPR's, small steps can be taken instead; some of the articles mentioned that structured visit notes could improve the quality of care for certain domains of care. However the quality of care can only be better when the intervention methods are properly used [12,18,56].

Other small steps that could be taken in the area of decision support are the use of patient education materials, physician education materials and decision support and effective collection of condition-specific clinical data. The types of intervention were developed with the idea that an intervention should be low-tech and low-cost, it should be doable with the already available personnel [18,28]. Besides the interventions; existing guidelines should be adhered and – when necessary – adjusted with the help of physicians [60].

One study reported on the use of computerized condition specific templates which can be used in the EPR. Two condition specific templates for falls and urinary incontinence were constructed; it was tested in a VAMC. The templates had a similar outlook as the paper templates that were constructed for the ACOVE-2 intervention [18].

These templates were constructed in such a way that ACOVE quality indicators for falls and urinary incontinence were adhered when the templates were correctly used by the physician. The templates had a form-based outlook which could be filled in; it was possible to add free text, all entries were active (no default values) and the prompts were in logical and clinical meaningful manner. The study showed





that – by introducing this intervention – that the quality of care in those conditions improved in the primary care setting. However the usability should be improved before widespread implementation [102].

### 3.3.5 WINGS

Another interesting development will be the transfer of the ACOVE quality indicators to other countries. Earlier studies tried to transfer the United States quality indicators to the primary care of the United Kingdom. In one study the quality indicator set used was developed by RAND and called QA Tools. They concluded that it was possible to transfer quality indicators, however with caution; every quality indicator has to be validated before it can be used in the United Kingdom. It might be necessary to discard, change, merge and develop quality indicators. Although another quality indicator set was used, the development cycle of quality indicators are quite similar as with ACOVE [105].

Another study reported on the transfer of the ACOVE-1 quality indicators from the United States to the United Kingdom. Again an expert panel was created to validate the 119 quality indicators covering 16 themes. 102 were considered valid, while 17 quality indicators were rejected. There were 79 quality indicators which remained unchanged or did undergo a minor change and 23 new quality indicators were added [106].

A third study tried to transfer quality indicators (for cognitive impairment or dementia) from ACOVE from the United States to Canada – the Quebec region. The selection and development procedures are similar as the other two studies that tried to transfer quality indicators from the United States and United Kingdom. 72 quality indicators of the initial 82 quality indicators – of which 62 quality indicators are from ACOVE – were accepted [107].

Very recently the Trimbos Institute has developed a set of quality indicators for vulnerable elders in the primary care setting in the Netherlands based on the ACOVE-3 quality indicators [103]. The aim was to identify the most important quality indicators per

theme, and to subsequently draw conclusions about transferability of quality indicators between countries by comparing both sets – the American set and the Dutch set.

In the Dutch study 8 of the 26 themes were selected for the development of quality indicators. These themes are: dementia, depression, diabetes, end of life care, falls & mobility, medication use, undernutrition and continuity & coordination of care.

The creation procedure of the Dutch quality indicators for general practice care is quite similar as the creation procedure of the ACOVE quality indicators. Literature has been reviewed by Dutch general practitioners, specialists and researchers. Furthermore an expert panel has been composed; five general practitioners, two nursing home practitioners and two clinical geriatricians participated. The scoring principle – of the quality indicators – was the same as the scoring principle of ACOVE. A quality indicator was accepted when it had a score of 7 or higher without disagreement within the panel.

Of the 108 quality indicators for general practice care 81 quality indicators were included in the final Dutch set; 32 quality indicators were discarded because they were not considered to be valid in the Dutch setting according to the panel, or no evidence is available, or the quality indicator was not important enough, or Dutch panelists did not agree with each other. Five quality indicators were added by the panel and 76 quality indicators remained unchanged.

The successor of this study could implement these – or at least some – quality indicators using proactive decision support. A proposed project in the Netherlands is the ICOVE-Pro project [104]. The idea is to systematically improve of primary and secondary care by using clinical decision support systems that use quality indicators in combination with patient and treatment data to proactively support healthcare professionals to make the right decisions at the right time. Furthermore ICOVE-Pro aims at empowering the patients and their relatives





by providing them with a web-based resource about the aspects of quality of their care coordination and management.

## 4 DISCUSSION

The discussion is divided in four subsections. First the main findings of this study will be reviewed. Second, the strengths and limitations of this study will be discussed. Third, some questions arose during this study which will be answered in this subsection. Finally, the relevance for patient care will be briefly discussed.

### 4.1 MAIN FINDINGS

The goal of this research was to give a description of the state of affairs concerning the ACOVE initiative. Therefore a literature search was conducted and the search results were categorized into features. Although ACOVE cannot measure every care process, it still forms a comprehensive set to measure the quality of care delivered to the vulnerable elderly. Furthermore it is one of the first comprehensive sets that targeted the vulnerable elder population.

The comprehensive set of quality indicators measures care processes (more information about process measurements can be found in [Appendix B](#)). With these quality indicators these processes can be easily assessed, by using sources such as medical records, administrative data and patient interviews. The quality indicators can also be used in computerized systems like the CPOE and EPR.

Some of the studies describe the development and validation process of the quality indicators. While several other studies have already assessed the quality of care; as a result of these studies the quality of care of vulnerable elderly is below acceptable levels, there are no exceptions across the themes, domains and medical intervention. Several interventions have been initialized, but still further improvement is necessary.

Another particularly interesting development is the transferability of the quality indicators to other

countries. It seems that they are transferable, although it might be necessary to adjust the quality indicators to the local healthcare setting and it has to be done with caution.

Although the ACOVE initiative comprises a comprehensive set, still there are some limitations or points of attention regarding to ACOVE and to the studies performed which have used the ACOVE initiative. These limitations and points of attention will be discussed in section 4.3.

### 4.2 STRENGTHS & LIMITATIONS OF THIS STUDY

This study has several strengths. First of all it is the first review in which the literature on ACOVE (the initiative and studies using the ACOVE criteria) is reviewed, and an outlook has been provided. Furthermore this study explicitly sought aspects of applying information technology and decision support. Second, several databases and web sources have been used to find information about the ACOVE initiative. Besides the several sources, there are also several queries used to adequately cover the subject. Third this study forms a complete overview of the ACOVE initiative and can be used as a guide to get familiar with the ACOVE topics – and furthermore – developing quality indicators and use them for assessing the quality of care

However this study has also several limitations. First of all only the articles written in Dutch or English were included in the literature review. Second, when it was possible to search only in the title-abstract-keywords, the search was limited to these three. The reason for this is that when articles do not match the query they probably do not discuss ACOVE topics, however it could be the case that ACOVE is extensively discussed in the article, but simply not in these three parts of the article. It is possible that such articles exist. Third, the categorization is subjective. The categorization has not been discussed with other people; no discussions have been taken place. It is just a categorization as I thought it was accurate.



## 4.3 WHAT ABOUT...

### ...the view of the patient?

Although the ACOVE Investigators have created a comprehensive set, the view of patients on their care processes is neglected in the creation of quality indicators [11,20]. One study reported explicitly that patient interviews should be included in quality assessment studies in order to get a more complete overview of the care processes delivered to the patients [55]. However it is impossible to reflect all the care processes in the quality indicators [28,82]. The patient could be more involved in the fourth phase of the ACOVE initiative; it may result in an even more comprehensive set of quality indicators which are important for the patient well being.

### ...subjectivity?

Besides the aforementioned, the creation of quality indicators remains partially subjective; despite all efforts to minimize this effect [20,80]. To minimize the subjectivity of the development of quality indicators several panels have been initialized and external peer review is used and a couple of other things have been done, which can be read in the previous sections of this paper. However one study reported that some experts were members of multiple panels, panels which should be entirely independent of each other [11]. It is possible due to subjectivity that some quality indicators that should be included in the comprehensive set were not included, because of experts who did not think that the quality indicators were valid.

### ...the procedure to assess the quality of care?

Almost every study which had assessed the quality of care used the medical records of the vulnerable elderly – explicitly mentioned by [12,14,57,58]. Mainly two limitations exist for this procedure; the medical record does not reflect and record the complete care process delivered to the vulnerable elder in question [12,14,19,60,62] and the measurement of quality of care is incomplete, because of missing information or even missing

records [14,16,19,28,59]. Other results might be found when the information was complete.

### ...the results of the ACOVE studies?

When the quality of care could be measured, some studies came up with results which do not have enough – statistical – power to detect differences in quality of care [15,19,57,58]. Some studies had enough power, but had some problems with the generalizability of the results; for example the study was performed in one or two settings or in a small population or with one physician [12,16,55,57]. In other words when the same study is performed in another setting the results might be completely different.

There were several other problems related to the quality assessment. A study in an RCT setting reported that the study was not double blinded and therefore prone to bias. However the study could not be blinded because of ethical objections [15]. Second, in two studies it was reported that bias occurred due to loss in the follow-up or selection of patients [17,19]. Third, the quality indicators are not weighted; while some conditions are much worse than others or when not adhered some effects on the quality of care for patients are much worse than others [13,61,62]. Fourth, although some studies used patient interviews to get a more complete overview of the quality of care it is mentioned by several studies that patient experience is very subjective [13,16,63].

Overall it might turn out that the quality of care is somewhat different than reported in all these studies, because of the limitations that were mentioned. Therefore the presented evidence that the quality of care is worse on all themes is not iron-hard, but multiple studies have reported the same results, the evidence might not be iron-hard but it is convincing. In the future better quality of care assessments can be done when the EPR and CPOE become available.



**...the generalizability?**

Only English speaking vulnerable elders were included in the studies which assessed the quality of care. These studies were performed in California and a significant part of the Californian population does not speak English, when these vulnerable elders were included in the studies the results might be completely different. Furthermore when other healthcare settings from different states were included or studied the results might also be different. Further research in this area is necessary.

**...transferability?**

All studies questioned the generalizability and transferability. It is doubted whether or not the same results will be accomplished in other settings. Furthermore it is mentioned that it may be necessary to adjust the quality indicators to the local settings in order to reflect the local care processes correctly. It is possible to transfer quality indicators between healthcare settings in other countries or geographical regions, but with caution [11-17,19,20,28,55,57-63,80,82,103,105-107]. The quality indicators have to be validated one by one in order to determine the validity of each quality indicator in the new country. Researchers and healthcare professionals can spare resources and money when they adjust the ACOVE initiative to their own country.

**...developing a set of quality indicators?**

When developing a quality indicator set like ACOVE's set, extensive (human) resources and money are required to create a new set from scratch. The different ACOVE phases did not rapidly succeed each other because it takes time to develop a set.

When using an existing set it is only needed to review the evidence on which each quality indicator builds and a team of experts can judge whether or not the supportive evidence and quality indicator are valid in their country. In case of rejection, or creation of a new quality indicator new evidence have to be found.

In case of creating a new set it is needed to advance through the entire development process which is

similar as the ACOVE-1 development process. The entire development process has been discussed in the ACOVE-1 section.

When researchers and healthcare professionals have the opportunity to use an existing quality indicator set (like ACOVE), they should grab it. Because it saves time and money and it is easier to create a local quality indicator set this way (compared with the option mentioned earlier).

## 4.4 MEDICAL RELEVANCE FOR PATIENT CARE

As mentioned earlier in this paper the vulnerable elderly receive a large portion of healthcare compared to the general population. Several studies reported that the quality of care of vulnerable elderly is very low and below acceptable levels. Therefore the quality assessment system ACOVE was developed.

Now that ACOVE has been developed the quality of care can be measured over 26 themes with 392 quality indicators. When the quality of care is assessed with these quality indicators the quality of care can be determined. The results of these assessments can be used for intervention in certain areas (for example: the care of diabetes mellitus scored most badly, than interventions can be taken), to improve the quality of care delivered.

When interventions are taken, the quality of care can be measured again. When the quality of care is good enough new interventions can be undertaken to improve the most badly scoring themes of care. The relevance for the patient will be that it is now possible to assess the quality of care of the vulnerable elderly, with the outcomes of these assessments appropriate action can be taken.

## 5 CONCLUSION

At this moment the ACOVE initiative has moved to the third stage – late 2007. It is possible to measure the quality of care in 26 themes, 14 medical care



processes and 4 domains of care on the healthcare level and not the individual level. Using these quality indicators for assessment showed that the quality of care of vulnerable elderly is below acceptable levels. Interventions – which have been developed under ACOVE-2 – could improve the quality of care. The interventions that were mentioned are low-tech and low-cost in order to remove possible limitations.

However the interventions are not used on a wide scale, only several studies reported on the usage of these interventions. The interventions also require commitment by the stakeholders, most notably the healthcare professionals.

Undoubtedly the quality indicators have to be updated in the future, so the ACOVE project will move onto stage 4. In this stage the ACOVE Investigators should focus on updating the quality indicators, usage of weighting principles and the usage of decision support and information technology.

Updating the quality indicators is needed, because the healthcare is changing; new discoveries are done which will lead to new treatments, diagnostic tools, some treatments will be replaced etcetera. In order to have a valid quality indicator set it is needed to update the set periodically.

New technical solutions emerge: new systems become available and some of these systems are evolving an EPR. New interventions should be developed to fit in CPOE systems or EPRs so that the quality of care could be continuously measured, some of the interventions mentioned in ACOVE-2 can be easily adapted to fit in information technology solutions. Decision support solutions like chart notification can also be implemented. However before implementing all kind of solutions it is needed to determine which solutions are the most profitable

with respect to the quality of care. In the fourth stage of ACOVE it could be investigated which solutions are effective.

A weighting scheme for the quality indicators could be developed. Several articles reported that there is a difference in adherence to quality indicators: when a quality indicator is not adhered to but it results, say, only in not receiving an exercise, this is less problematic than missing a crucial treatment. Therefore weighting quality indicators could give a more realistic overview of the quality of care delivered, the weighting of quality indicators can be determined by the same ACOVE expert panels.

The Trimbos institute has been working on translating the ACOVE quality indicators to the Dutch primary healthcare setting. The same is true about the WINGS project that aims at pharmacological care of hospitalized patients. Not only the quality indicators were translated to the Dutch language, but they were also adjusted to the Dutch setting (drugs, available treatment options and diagnostic/screening tools). A promising successor to the Trimbos and the WINGS efforts is the ICOVE-Pro project proposal on which the Trimbos Institute and AMC are working. Such a transition would mark a changing perception of using the ACOVE criteria: from auditing quality of care to improving quality of care by pro-actively supporting healthcare professionals to adhere to the indicators.

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## APPENDIX A – QUALITY INDICATORS

### What does a QI look like?

Most of the quality indicators developed for the ACOVE initiative have the same structure. The structure of a quality indicator is IF-THEN-BECAUSE. The IF statement describes the clinical characteristics of the patient eligible for the quality indicator. The THEN statement describes the care process that should or should not be performed, the BECAUSE statement refers to the expected health effect if the care is provided [10,14,21,23,55,66-68,82].

For example quality indicator 1 for dementia; cognitive and functional screening [66]:

- IF a vulnerable elder is admitted to a hospital or is new to a physician practice,
- THEN multidimensional assessment of cognitive ability and assessment of functional status should be documented,
- BECAUSE screening for dementia can lead to early detection and initiation of treatment that may delay further progression.

There is another structure type of quality indicators that has been used in ACOVE. The second structure is ALL. When a patient has a certain condition, disease or disorder (one of the 26 themes under ACOVE-3), then the patient is eligible for all quality indicators which start with the statement ALL.

For example quality indicator 2 for dementia; cognitive and functional screening [27]:

- ALL vulnerable elders should be evaluated annually for changes in memory and function.

### Differences between guidelines, quality indicators and protocols

Guidelines are directions or principles presenting current or future rules of policy – setting standards for the care. They can be developed by all existing healthcare levels [101]. Practice guidelines strive to define optimal care in the context of complex medical decision making. It is possible to assess which healthcare professional has not adhered to the guideline and is therefore responsible for the consequences the patient will experience [10,20,22,23,68].

Quality indicators describe when a patient is eligible then a certain process should be carried out. When the process is not carried out it; the standards of care set by the quality indicator are not met and that represents poor quality of care. Quality indicators describe standards that should be met in order to deliver acceptable quality of care while guidelines strives to define optimal care [10,20,22,23,68]. Guidelines are directions, while the main usage of quality indicators is to assess or to measure quality of care that has been delivered. The quality indicators developed by ACOVE are measuring quality of care at the healthcare level. Individual healthcare professionals could not responsible for the entire healthcare process as described by a quality indicator [10,22,23].

Protocols are at the level of treatments, it describes a set of steps that have to be taken to manage a condition in a patient. Protocols are somewhat similar to guidelines; protocols are more detailed and a realization of guidelines in specific interventions. In the world of healthcare it occurs that guidelines and protocols are melted together [101].



## APPENDIX B – PROCESS VERSUS OUTCOME MEASURES

There are several methods that can be used to assess quality, the methods that are relevant to this paper and to ACOVE are process measures versus outcome measures [96]. Both measures are implicit – in other words – there are no prior standards or agreements about what reflects good or poor quality. ACOVE created quality indicators that measures processes of care [96].

When using process measures different questions are asked than with using outcome measures. A process measure question could be: was the process of care adequate? A question for an outcome measure could be: could better care have improved the outcome? [96]. An outcome measure is a specified end result; parameters that are used are for example lowered mortality or mobility. A process measure focuses on how the care is delivered in which the specific actions taken, events occurring and human interactions are compared with accepted standards [101].

An advantage of process measures is that process measures are more sensitive measures of quality than outcome data. Because a poor outcome does not occur every time there is an error in the provision of care and – visa versa – when the mortality (outcome measure) is high, it does not

necessarily mean that it is related to an error in the provision of care [96]. Furthermore physicians themselves define quality of care preferably in terms of process rather than outcome.

In most cases outcome measures have to be adjusted for case-mix differences. While process measures have the luxury that case-mix adjustment is not necessary. Suppose there are two healthcare organizations who would like to compare the mortality (outcome measure). They will perform a study which will result in the outcome; the number of patients died. Before these two mortality rates could be compared, they have to be adjusted for comorbidities, age and ethnicity for example [96].

Suppose now that the same healthcare centers would like to assess the quality of care by using several quality indicators of ACOVE (process measures). Each quality indicator defines which patients are eligible for the quality indicator – IF statement. The IF statement is the same for both healthcare centers, therefore the patients that are eligible do have the same characteristics (that are of importance); otherwise they would not be included. As a result both populations do not have to be case-mix adjusted and the pass-rates of the quality indicators could be instantly compared [14,96].



## APPENDIX C – TABLES OF LITERATURE

In **Table 1** the search results are described.

In **Table 2** general information is given about the articles. In the table the following attributes are described:

- Authors: the first author is mentioned including the reference to the article.
- Publ. Year: the year of publication.
- Study: the type of study that has been performed by the authors. Study types are represented by codes, which are explained in the legend of the table.
- N: the number of patients included in the study.
- Intervention / Method: the interventions done, or methods used by the authors to perform the study.
- Popul.: characteristics of the population studied. Characteristics are represented by codes, which are explained in the legend of the table.
- Results: the main results of the study, in case of many results only the most important results are mentioned in the table.
- Conclusion: the conclusions of the study, sometimes discussion points are mentioned.
- Limitations: the limitations of the study reported by the authors, when no limitations are reported it will be reported as 'none mentioned' in the table.

In **Table 3** ACOVE specific information is given about the articles, there are articles which have only general information about the study, these articles are not mentioned in this table. ACOVE specific information is information about ACOVE; an article can elaborate on different aspects of ACOVE, like the development process of the quality indicators or the usage of quality indicators for assessing care. Articles can elaborate on specific themes and or domains as defined by ACOVE. Furthermore the sources of information are mentioned, which are characteristic

for ACOVE. In the table the following attributes are described:

- Authors
- Measures: description of the measurements done by the authors; these can be outcome measures (like mortality), process measures (quality of care of a certain treatment) or measures are of both types.
- QI Domains: ACOVE uses four domains of care, which are covered by QI's. These domains are represented with codes which are explained in the legend of the table.
- QI Themes: ACOVE has introduced several themes; these themes can be conditions, syndromes, diseases or processes. These themes are also represented with codes which are also explained in the legend of the table.
- QI Phase: the phase of the QI's which are described by the authors. Some articles mentioned the development of the QI's while others discussing the usage of the QI's to assess the quality of care. These phases are represented with codes and explained in the legend of the table; however some extra information about some codes is needed, comparison means that QI's are compared to another method (like assessing care with QI's vs. assessing care with the information about patient feelings), in/exclusion rules means that authors have developed criteria for including QI's for a specific theme and they explain why these rules exists, selection means that the authors give specific information about how QI's were selected.
- QI's Used vs. Total: it is possible that not all QI's for a condition are used; the ratio is presented in this section. The reasons why some of the QI's are excluded can be found in the specific articles.
- Sol: describes where the authors get their information from (source of information).



These sources are represented with codes which are explained in the legend of the table.

- Use of IT/DS: some authors mentioned some possibilities to use ACOVE in combination with IT and/or DS, these possibilities are reported under this header.

**Table 4** is an extension of **Table 3** it reports on all articles which have been published in the Journal of the American Geriatrics Society supplement published in 2007. The aforementioned – regarding to **Table 4** – also applies to **Table 5** which reports on all articles which are working papers and published on the RAND Health website and for **Table 6** which reports on all articles which have been published in the Annals of Internal Medicine supplement published in 2001. All these articles have the same structure and methods only the QI Themes and the number of QI's Used vs. Total are different.

The reason why these articles are reported in separate tables is that these articles have the same research setup. They all report on quality indicators and each quality indicator is supported with evidence which has been reported in the articles. The methods that are used by the researchers are the same; they have searched the literature for evidence and voted on the quality indicators, the quality indicators that are included by the expert panels are reported in these articles. One difference exists between these articles, they all report on another theme. Articles in **Table 4** are elaborating on quality indicators of ACOVE-3, **Table 5** reports on quality indicators of ACOVE-2 and **Table 6** reports on the ACOVE-1 quality indicators.

**Table 7** reports on the ACOVE quality indicators for the three different states. It gives an overview which themes, domains of care and medical processes are covered.

Search query	Database	# Articles	# Articles selected	Reason not selected	Search Date
1,4	Scopus	16	16		June 2, 2008
2	Scopus	25	11	2 L, 1 NA, 10 NAR, 1 NAC	June 2, 2008
1	PubMed – MEDLINE	15	14	1 NA	June 2, 2008
2	PubMed – MEDLINE	13	9	2L, 1NA, 1NAC	June 2, 2008
4	PubMed – MEDLINE	20	16	2L, 1NA, 1NAC	June 3, 2008
3	RAND	85	85		June 2, 2008
5	Google	406	1	*	June 10, 2008
6	Google	372	0	*	June 10, 2008

**Table 1 – Search overview**

**Reason not selected** – there are several reasons why articles were not selected

<b>L</b>	article was written in a language I do not master; article was written in Spanish
<b>NA</b>	article mentioned ACOVE only as a sidestep
<b>NAC</b>	article was not accessible
<b>NAR</b>	article was not ACOVE related
<b>*</b>	Google found articles that were already found by other sources. Furthermore most of the hits in Google were irrelevant (only parts of the query were found in the hits). Besides this limitation the other limitation of Google is that it is not possible to search in titles, keywords and abstracts; it is possible that the query has been found somewhere in the article while the rest of the article is not related to ACOVE (which happens quite often)



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Authors	Publ. Year	Study	N	Intervention / Method	Popul.	Results	Conclusion	Limitations
Wenger NS et al. [10]	2007	LR	N/A	Literature review, and expert panels to create QI's.	VE1	ACOVE-3 contains 392 QI's; covering all 4 domains, covering 26 conditions and 14 types of medical interventions (care processes).	ACOVE-3 contains a set of QI's to comprehensively measure the care provided to VE at different levels.	None mentioned.
Wenger NS et al. [11]	2007	LR	N/A	Clinical experts rated ACOVE-3 QI's whether they could be applied to VE with advanced dementia or poor prognosis. Includes voting about QI's.	VE1, AD, PP	QI's excluded which have a long-term aim or have a heavy burden. 140 QI's excluded in case of advanced dementia, 135 for patients with poor prognosis.	Measurement of quality of care for VE's with advanced dementia or poor prognoses should include only a subset of the ACOVE-3 QI's.	View of patients neglected. Four experts were in both groups, therefore assessments were not entirely independent.
Arora V et al. [12]	2007	C	328	Selecting VE by VES-13. Using chart review (chart abstraction) to assess the quality of care in hospitals.	VE1	328 of 845 patients participated. QI's for general care were met at a higher rate than for pressure ulcer care. Nurses responsible for high rates of adherence to some screening indicators.	Adherence to geriatric-specific QI's is lower than adherence to general hospital care QI's.	ACOVE QI's are not externally validated. Study based solely on medical records, not everything about the care process is stored. One institution.
Higashi T et al. [13]	2007	C	372	Assessment of quality by using the CQI, ACOVE (using VES-13 to identify VE) and VHA. Chart review	VE1	Quality of care increased as the number of conditions increased. Each condition was associated with 1.7% increase of the quality score of ACOVE.	The quality of care increases as a patient's number of conditions increases.	No ranking of conditions and severity. Under-estimation of the total disease burden and cannot draw conclusions on patient experience.
Zingmond DS et al. [14]	2007	C	100,528	Measure quality of care using administrative data to apply QI's.	VE3, MA, MC	The overall QI pass rate was 65%. Few QI's aimed at geriatric care could be measured.	Several care areas needs improvement. Use of QI's seems feasible.	Only 44 of 230 QI's implemented, medical records required for other QI's.
Spinewine A et al. [15]	2007	RCT	203	Evaluate the effect of pharmaceutical care. I: pharmaceutical care additional to the GEM care, C: only GEM care.	VE2, GU	Improvement of ACOVE underuse criteria; odds ratio of 9.1 intervention group and 6.1 in control group.	Pharmaceutical care improved the appropriate usage of medicines during stay and after discharge.	Study was not double blinded. Not enough power to detect an effect on clinical outcomes. Only one pharmacist provided the intervention.
Chang JT et al. [16]	2006	C	236	Select VE by VES-13. Use ACOVE QI's to determine the quality of care by medical record abstraction and patient interviews.	VE1, 2 MCO's	Technical quality is seems not to be associated with patient ratings.	Patient reports about personal quality were distinct from technical quality of care measured by medical records and patient interviews. Communication can improve quality of care.	Missing data, patients tempt to have high ratings for care, generalization might be difficult because only two MCO's were studied.
Lillian C et al. [17] <sup>†</sup>	2006	C	240	VES-13, medical record	VE1	Higher VES-13 scores	The VES-13 score is useful as	Only a VES-13 score of 3



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Authors	Publ. Year	Study	N	Intervention / Method	Popul.	Results	Conclusion	Limitations
				view and in-depth interview.		predicted greater decline and death in the multinomial logistic model. The odds of decline were multiplied by 1.18 for each one point on the VES-13 scale.	a screening tool to detect risk of decline and death in vulnerable older populations.	or higher are included. Bias due to loss in follow-up.
Reuben DB et al. [18]	2003	C	N/M	Description about the ACOVE-2 Intervention. The history from start to end.	VE3, D, F, UI	It seems that the intervention improves the quality of care. There are positive signals in the field.	Costs of interventions is low. Further research is required to determine the effectiveness of the interventions. Providers must be committed.	No natural change. Economic factors of less importance in research than in a real-world practice.
Wenger NS et al. [19]	2003	C	372	Literature review, VES-13, medical record abstraction and patient interview.	VE1	Patients eligible for 10,711 QI's (55% passed), adherence varied widely; adherence to QI's for geriatric care was low.	Care for VE's falls short of acceptable levels for a wide variety of conditions.	Fall-out in selection process, unavailability of some medical records, medical records imperfect reflection of care process and study lacks statistical power.
Solomon DH et al. [20]	2003	C	372	Clinical Committee, voting, classification & evaluation of QI's and QI acceptance process.	VE1, AD, PP	18 QI's excluded due to patient preferences. 81,5 QI's excluded in advanced dementia and 70 QI's in poor prognosis.	Caution is required in applying QI's to VE's. Identification of (in)applicable QI's is feasible. Comfort & safety is more important than prolonging life.	No input of patients when QI's were selected. The decisions about approving QI's is feasible, but (partly) subjective.
Shekelle PD et al. [21]	2001	LR	N/A	Development of QI's by using literature reviews, guidelines, protocols, existing QI's, expert opinion and expert panels.	VE1	236 QI's of the 420 QI's were ultimately accepted.	Although not all QI's were accepted, it does not imply that these processes do not represent good care.	None mentioned.
Wenger NS et al. [22]	2001	LR	N/A	Clinical experts developed QI's, validity (by provided evidence in literature) and feasibility tested. Use medical records, patient interviews and administrative data to assess the quality of care with QI's.	VE1	236 QI's were developed for 22 conditions.	ACOVE is designed to produce an aggregate score that measures quality at the health system or plan level.	ACOVE cannot be used at the individual level.
Westropp JC [23]	2002	LR	N/A	Description of the ACOVE project.	VE1	236 QI's were developed for 22 conditions (ACOVE-1).	When quality assessment is embraced, it can have a very important effect. ACOVE can	None mentioned.





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Authors	Publ. Year	Study	N	Intervention / Method	Popul.	Results	Conclusion	Limitations
Callahan CM [24]	2001	LR	N/A	Description of the ACOVE project. Quick overview of literature.	VE1	ACOVE is step forward. Process variables are a practical method.	be used. More evidence of relationship between adherence to QI's and improvement of quality of care is needed.	None mentioned.
Webster Jr. JR [25]	2001	LR	N/A	Description of the ACOVE project. Quick overview of literature in the supplement.	VE1	Papers in supplement do address several conditions and judge quality of care with QI's.	In all conditions the care for VE is below acceptable levels, it should be improved.	None mentioned.
ACOVE Investigators [26]	2001	LR	N/A	Description of all QI's of ACOVE-1.	?	236 QI's were developed for 22 conditions (ACOVE-1).	N/A	None mentioned.
ACOVE Investigators [27]	2007	LR	N/A	Description of all QI's of ACOVE-3.	?	392 QI's were developed for 26 conditions (ACOVE-3).	N/A	None mentioned.
Ganz DA et al. [28]	2007	RCT	644	Does intervention on conditions, also affect quality of care for masked conditions use interviews and record abstraction. I: multi-component practice-change intervention, C: only case-finding for target conditions.	VE3, D, F, UI	QI's satisfied in intervention group was 69%, control group was 67%. During intervention these percentages did not change. Improvement of quality of care by 15% for practice-change intervention.	Improvement of 15% for targeted conditions, does not seem to negatively affect masked conditions.	ACOVE-2 is still a partial measure of quality of care. No direct observation of care delivered.
Various authors[29]-[54]	See table about JAGS Supplement.							
MinLC et al. [55]	2005	C	362	Analysis of 15 core processes was performed. Use of predictor variables to measure influence of these variables. Expected-Outcome quality score evaluated.	VE1	Patients whose conditions take more time receive less than expected care. The more conditions the higher quality of care received. 55% of recommended care was delivered.	Complexity, vulnerability and age do not predispose older persons to receive poorer-quality care.	To generalize these results may be difficult. Interviewing patients about care is necessary to get a complete overview of care.
Wenger NS et al. [56] (abstract only)	2005	RCT	644	Test a practice-based intervention. I: physician education, visit notes, condition-specific materials for patients and physicians and case-finding, C: only case-finding.	VE3, D, F, UI	Intervention versus control: falls (44% vs. 23%), incontinence (49% vs. 36%) and dementia (49% vs. 52%).	Primary care can be improved with interventions, however further improvement is necessary.	None mentioned.
Higashi T et al. [57]	2004	C	372	Use of ACOVE QI's, assess them with abstracted medical records and patient	VE1, 2 MCO's	Avoid inappropriate medications (97%), prescribing medications (50%), education & continuity	Failures are more common in prescribing drugs than the use of inappropriate drugs.	≤ 10 patients were eligible for many of the QI's, generalization may be a problem. Mainly



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Authors	Publ. Year	Study	N	Intervention / Method	Popul.	Results	Conclusion	Limitations
				interviews.		(81%) and medication monitoring (64%).		based on medical records.
Gnanadesigan N et al. [58]	2004	C	372	Use medical records and patient interviews to assess the quality of care with QI's.	VE1, 2 MCO's	Used QI's had a pass-rate between 13 – 59%.	Quality of care for UI provided to VE's, particularly by primary care providers alone, is inadequate.	Judgment mainly based on medical records and small samples of patients.
Chodosh J et al. [59]	2004	C	372	Use medical records and patient interviews to assess the quality of care with QI's.	VE1, 2 MCO's	39% of patients is screened for pain, relevant examination offered to 68% of the patients, treatment offered to 86% of patients and follow-up occurred in 66%.	Chronic pain management in older vulnerable patients is inadequate.	Direct observation might have yielded different results and only a small set of QI's is used to assess the quality.
Rubenstein LZ et al. [60]	2004	C	372	Use medical records and patient interviews to assess the quality of care with QI's.	VE1, 2 MCO's	Clinical history is reported in 47% of the records, documentation about examination varied from 6% to 28%.	Community physicians appear to under detect falls and gait disorders.	Many processes performed may be unreported.
Higashi T et al. [61]	2005	C	372	Use medical records and patient interviews to assess the quality of care with QI's.	VE1, 2 MCO's	On average 53% of the care processes is prescribed. There was a positive relationship between quality score and 3-year survival.	Better performance on process quality measures is strongly associated with better survival among vulnerable elderly.	Focused on survival, not on functional capability, all QI's are rated with the same importance.
MacLean CH et al. [62]	2006	C	399	Use medical records and administrative data to assess the quality of care with QI's.	VE1	The overall performance yielded 55% (medical records) and 83% (administrative data).	The number and spectrum of QI's that can be measured is far greater for medical records than administrative data.	No weighting used for QI's, QI's do only measure parts of care and not all care. Records do not capture the whole process.
Saliba D et al. [63] †	2001	C	6,205	Selecting several items from different surveys and systems and with bivariate and multivariate analysis to take steps to develop the VES-13 including a scoring system.	65, MC	A multivariate model using function, self-rated health and age to predict death or functional decline was improved when self-reported diagnoses and conditions were included.	A function-based targeting system effectively and efficiently identifies older people at risk of functional decline and death. It relies on self-report and is easily transported across care settings.	Self-report format may underestimate the prevalence of under-diagnosed conditions and surveys may be time consuming to administer.
ACOVE Investigators [64]	2001	LR	N/A	Description of all QI's of ACOVE-2.	?	236 QI's were developed for 22 conditions (ACOVE-2).	N/A	None mentioned.
ACOVE Investigators [65]	2007	LR	N/A	Description of all rejected QI's of ACOVE-3.	?	100 QI's were rejected over 25 different conditions (ACOVE-3).	N/A	None mentioned.
ACOVE Investigators [66]	2004	LR	N/A	Summery about the ACOVE project,	?	236 QI's were developed for 22 conditions (ACOVE-1).	ACOVE project is now in the second phase. ACOVE-2	None mentioned.



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Authors	Publ. Year	Study	N	Intervention / Method	Popul.	Results	Conclusion	Limitations
				describing the current state of the project.			aims at developing and testing interventions to increase performance on selected QI's.	
ACOVE Investigators [67]	2004	LR	N/A	Summery about the ACOVE project, describing the current state of the project.	?	81% adherence to treatment QI's, 43% adherence to preventive care QI's and 46% adherence to diagnostic QI's.	Vulnerable elders receive the half of recommended care and preventive care suffers the most.	None mentioned.
ACOVE Investigator [68]	2008	LR	N/A	Summary of results ACOVE-2 and description of ACOVE-3.	?	Patients with incontinence, chronic pain or cognitive impairment receive less than 33% of recommended care. ACOVE-3 QI's were updated.	Updated ACOVE-3 QI's take into account the burden of care and weighted the burden of care to the expected outcome of the care.	None mentioned.
Various authors[69]-[79]	See table about AIM Supplement.							
Saliba D et al. [80] †	2004	LR	N/A	Describing the development& validationprocess (expert panels, literature search, interviews, field experts, nurse panels)of QI's in several themes in the area of NH's.	65	114 QI's were selected in 11 medical conditions in long-stay NH residents of 65 years and older	The set of QI's gives providers a set of care processes that span a wide range of conditions important in caring for VE residing in NH's. Further research should focus on best practices to implement the full set of QI's.	Expert panel methodology relies on existing research and knowledge as the metric for validity, new research should contribute more information to develop new QI's.
Saliba D et al. [81] †	2004	LR	N/A	Describing the development & validation process (expert panels, literature search, interviews, field experts, nurse panels) of QI's in a couple of themes in the area of NH's.	65	86 QI's were selected in 6 medical conditions.	Steps of care critical to the assessment and management of geriatric syndromes in NH's are identified.	Not determined the extent of the benefits or costs that will accrue from full implementation of the QI's. RCT's in this area are seldom, therefore the real effect of QI's is not known.
Saliba D et al. [82] †	2002	LR	N/A	Describing the development & validation process (expert panels, literature search, interviews, field experts, nurse panels) of QI's which can be used to measure the quality of care in NH's.		19 QI's were developed for the use in NH's.	Almost half of the QI's were viewed as discriminating between average and better NH's. Only a well-staffed NH could consistently implement 9 of the QI's.	There have been a few RCT's conducted to determine the effect of QI's and 19 QI's are not a comprehensive set to measure all the processes of care in NH's. QI's focuses on processes and not on side-issues (like staffing etc.)
Various authors [83]-[92]	See table about ACOVE-2 Website.							

**Table 2 – General information about the studies**

<b>Study</b> – type of study					
<b>C</b>	cohort study	<b>LR</b>	(literature) review	<b>RCT</b>	randomized controlled trial
<b>N</b> – the number of patients, <b>Conclusion</b> – the conclusion of the study					
<b>N/A</b>	not applicable	<b>N/M</b>	not mentioned		
<b>Intervention/Method</b> – methods used or interventions done by the authors/researchers of the study					
<b>C</b>	the control measure	<b>I</b>	the intervention done		
<b>Popul.</b> – characteristics of the population					
<b>65</b>	≥ 65 years	<b>VE1</b>	VE ≥ 65 years	<b>VE2</b>	VE ≥ 70 years
<b>VE3</b>	VE ≥ 75 years	<b>AD</b>	patients with advanced dementia	<b>D</b>	patients with dementia
<b>F</b>	patients with falls	<b>GU</b>	patients of a GEM unit	<b>MA</b>	enrolled in Medicaid
<b>MC</b>	enrolled in Medicare	<b>MCO</b>	Managed Care Organization	<b>PP</b>	patients with poor prognosis
<b>UI</b>	patients with urinary incontinence	<b>?</b>	no characteristics mentioned		
† are articles which are not directly connected to ACOVE, but hold important background information					

Authors	Measures	QI Domains	QI Themes	QI Phase	QI's Used vs. Total	Sol	Use of IT/DS
Wenger NS et al. [10]	Create QI's (P), votes for QI's (O), selecting QI's on basis of a score (O).	ALL	ALL (26)	D, V	392/486 (81)	EP+D+V, FE, G, LR, PR	Not mentioned.
Wenger NS et al. [11]	Vote for QI's (O), selecting QI's on basis of a score (O), selection of processes that will be measured (P).	NONE	ALL (26)	S, U	252/392 (64) for advanced dementia 257/392 (66) for poor prognosis.	12 FE, AF1	Not mentioned.
Aurora V et al. [12]	Select QI's (P), Measure QI's (P), QI's triggered (B), QI's passed (B), VES-13 calculation (O), measure processes (P)	SP	D, HC, PF, PU	S, U	16/71 (23)	D, MR, N, VES-13	Computerized tool for chart abstraction (IT). In-depth training and education for physicians. Use of standard forms (DS).
Higashi T et al. [13]	Number of chronic conditions (O), QI's triggered (B), QI's passed (B), Measure quality of care by measure processes (P).	ALL	ALL (22)	S, U	236/236 (100)	D, N, MR, S, VES-13	Not mentioned.
Zingmond DS et al. [14]	QI's triggered (B), QI's passed (B), measure quality of care by measure the process (P).	NONE	CC, D, DE, DM, HF, HY, IHD, MU, O, S, VC	S, U	43/230 (19)	AD	Healthcare systems, databases, which can implement some of the QI's (IT and DS).
Spinewine A et al. [15]	Measurement of underuse (P), measurement of unnecessary drug use (P), re-admissions after discharge (O), mortality (O), visits to emergency department (O).	T	DM, O, HF, IHD, MI, S	S, U	7/7 (100)	PA	Not mentioned.
Chang JT et al. [16]	Patient ratings according to the CAHPS (O). Overall quality score (P), QI's triggered (B), QI's passed (B).	NONE	ALL (22)	C (patient feelings), S, U	207/236 (88)	MR, PA, S, SF-12, VES-13	Not mentioned.
Reuben DB et al. [18]	Costs (O), no further measures reported, intervention methods seem to work.	ALL	D, F, UI	U	31/236 (13)	2 HCP	EPR, medical record prompts, databases (IT). Prioritization of conditions. Structured visit note. Condition specific patient information, follow-up sheet. Modify protocols, education sessions for physicians, discussion with other physicians. Medical record prompts to encourage performance (DS).
Wenger NS et al. [19]	QI's triggered (B), QI's passed (B), measure quality of care by measure processes by domain and condition (P).	ALL	ALL	U	207/236 (88)	MR, PA, VES-13	Not mentioned.
Solomon DH et al. [20]	Frequency & type of QI's excluded (O), effect of excluding QI's on quality	ALL	ALL (22)	IE, S, U	203/236 (86)	2 R, CC, MR, PI	Not mentioned.

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Authors	Measures	QI Domains	QI Themes	QI Phase	QI's Used vs. Total	Sol	Use of IT/DS
	of care scores (P). QI's triggered (B), QI's passed (B), measure quality of care (P).						
Shekelle PD et al. [21]	Create QI's (P), votes for QI's (O), selecting QI's (P),	ALL	ALL (22)	D	236/420 (56)	EO, FE , G, LR,OQI, PM, SD	Not mentioned.
Wenger NS et al. [22]	Create QI's (P), votes for QI's (O), selecting QI's (P).	ALL	ALL (22)	D	236/NONE	CC, PAC, AI, AS, VES-13	Not mentioned.
Westropp JC [23]	None mentioned.	ALL	ALL (22)	D	236/NONE	LR, some AI, FE	Not mentioned.
Callahan CM [24]	None mentioned.	NONE	NONE	D	NONE	LR	Not mentioned.
Webster Jr. JR [25]	None mentioned.	NONE	D, E, F, HF, I, O, P, PU, UI	S, U	NONE	AIS	Not mentioned.
ACOVE Investigators [26]	QI's for measuring quality of care (P).	ALL	ALL (22)	D	236/NONE	AI	Not mentioned.
ACOVE Investigators [27]	QI's for measuring quality of care (P).	ALL	ALL (26)	D	392/NONE	AI	Not mentioned.
Ganz DA et al. [28]	QI's triggered (B), QI's passed (B), measure quality of care by measure processes by condition (P). Number of outpatient visits (O). Overall pass-rates of masked conditions to assess quality of care (P).	ALL	D, F, UI (targeted conditions), C, DE, DM, HL, M, MU, O, PM (masked conditions).	S, U	21/NONE for targeted conditions, 47/NONE for masked conditions.	AD, MR, SN, VES-13	Structured visit form. Refers to [18] for more decision support that can be applied (DS).
Various authors[29]-[54]	See table about JAGS Supplement.						
MinLC et al. [55]	Patients' observed minus expected overall quality score (P), QI's triggered (B) and QI's passed (B).	ALL	ALL	U	207/207 (100)	AI, MR, MSP, LR, PA, VES-13	Not mentioned.
Wenger NS et al. [56] (abstract only)	QI's triggered (B), QI's passed (B) and measure quality of processes in several conditions (P).	ALL	D, F, UI	U	NONE	I: CF,EM, PBI, SN, C: CF, Both: MR, P, PI	Structured visit notes, patient and physician education ad physician condition-specific materials (DS).
Higashi T et al. [57]	Pass-rates of QI's (B), measure quality of processes in several conditions (P).	ALL	DE, DM, HC, HF, HY, IHD, MI, MU, O, OA, P, PM, PU, S, VC	U	43/NONE	MR, N, PI, VES-13	CPOE systems for real time feedback (IT and DS).
Gnanadesigan N et al. [58]	Pass-rates of QI's in UI (B) and measure quality of processes in urinary incontinence (P).	NONE	UI	U	7/10 (70)	AD, MR, N, PI, VES-13	None mentioned.
Chodosh J et al. [59]	Pass-rates of QI's in chronic pain (B) and measure quality of processes in chronic pain (P).	ALL	MU, OA, PM	U	11/11 (100)	AD, MR, N, PI, VES-13	None mentioned.
Rubenstein LZ et al. [60]	Pass-rates of QI's in falls and instability (B) and measure quality of processes in falls and instability (P).	SP, D, T	F	U	8/10 (80)	AD, MR, N, PI, VES-13	Guideline adherence (DS).
Higashi T et al. [61]	Pass-rates of QI's in several comorbidities (B) and measure quality of care received by patients	ALL	ALL	U	207/236 (88)	AD, BOMC, MR, N, PI, PC, SF-36, VES-13	None mentioned.

Authors	Measures	QI Domains	QI Themes	QI Phase	QI's Used vs. Total	Sol	Use of IT/DS
MacLean CH et al. [62]	(P). Pass-rates of QI's in several conditions	ALL	ALL	U	182/236 (77)	AD, MR	None mentioned.
ACOVE Investigators [64]	QI's for measuring quality of care (P).	ALL	ALL (22)	D	236/NONE	AI	None mentioned.
ACOVE Investigators [65]	Rejected QI's for measuring quality of care (P).	ALL	ALL (22)	D	100/100 (100)	AI	None mentioned.
ACOVE Investigators [66]	None mentioned.	ALL	ALL (22)	D, V	236/236 (100)	AI, LR	None mentioned.
ACOVE Investigators [67]	Adherence/pass-rates of QI's in several domains and conditions (P).	ALL	ALL (22)	U	236/236 (100)	AI, LR	None mentioned.
ACOVE Investigators [68]	Adherence/pass-rates of QI's in several conditions (P).	ALL	ALL (26)	A, D, U, V	NONE	AI, LR	None mentioned.
Various authors[69]-[79]	See table about AIM Supplement.						
Various authors [83]-[92]	See table about ACOVE-2 Website.						

**Table 3 – ACOVE-related information about the studies****Measures** – which measures have been taken in the study

**B** both **O** outcome measure **P** process measure

**QI Domains** – there are four domains which can be covered by QI's

**ALL** all domains are covered **D** diagnosis **FC** follow-up and continuity  
**SP** screening and prevention **T** Treatment **NONE** domains are not mentioned or actively studied

**QI Themes** – several themes have been introduced in ACOVE, a theme can be a condition, disease, syndrome or process

**ALL** All themes are covered **BC** breast cancer **BPH** benign prostatic hyperplasia  
**C** cardiovascular **CC** continuity of care **COC** colorectal cancer  
**COPD** chronic obstructive pulmonary disease **D** dementia **DE** depression  
**DM** diabetes mellitus **E** end-of-life care **F** falls, mobility problems  
**HC** hospital care **HF** heart failure **HL** hearing loss  
**HY** hypertension **I** iatrogenesis **IHD** ischemic heart disease  
**M** malnutrition **MI** myocardial infarction **MU** medication use  
**O** osteoporosis **OA** osteoarthritis **P** pneumonia  
**PF** physical function **PM** pain management **PU** pressure ulcers  
**S** stroke and atrial fibrillation **SD** sleeping disorders **SP** screening and prevention  
**U** undernutrition **UI** urinary incontinence **VC** vision care  
**VI** vision impairment **NONE** the themes are not mentioned or actively studied

**QI Phase** – phase of QI's, is the study about the development of QI's or about applying the QI's

**A** adjustment (change a QI) **C** comparison **D** development  
**IE** inclusion/exclusion rules **S** selection **U** usage (assess processes of care)  
**V** validation

**QI's Used vs. Total** – QI's used divided by the total amount of QI's (percentage); **NONE**: the QI's are not mentioned, 236/NONE = original (total) amount is not



mentioned

**SoI** – where is the information coming from; source of information

<b>AD</b>	administrative data	<b>AF1</b>	ACOVE-1 framework	<b>AI</b>	ACOVE Investigators
<b>AIS</b>	articles in supplement	<b>AQI</b>	ACOVE quality indicators	<b>AS</b>	ACOVE staff
<b>CC</b>	clinical committee	<b>CF</b>	case-finding	<b>D</b>	doctors
<b>DI</b>	discussion	<b>EM</b>	education materials	<b>EO</b>	expert opinion
<b>EP</b>	expert panels	<b>EP+DI+V</b>	expert panels who have discussed and voted the quality indicators	<b>HCP</b>	healthcare centers + professionals
<b>FE</b>	field experts	<b>G</b>	guidelines	<b>MSP</b>	mean scores of patients
<b>LR</b>	literature review and research	<b>MR</b>	medical records	<b>P</b>	physicians
<b>N</b>	nurses	<b>OQI</b>	other quality indicators	<b>PBI</b>	practice-based interventions
<b>PA</b>	patients	<b>PAC</b>	police advisory committee	<b>PM</b>	project members
<b>PC</b>	patient characteristics	<b>PI</b>	patient interviews	<b>S</b>	specialists
<b>PR</b>	protocols	<b>R</b>	reviewer (human)	<b>V</b>	voting about quality indicators
<b>SD</b>	scientific databases	<b>SN</b>	structured (visit) notes		

**Use of IT/DS** – the use of ACOVE in IT and decision support, interventions mentioned in IT and DS are denoted as (IT) and (DS)

Authors	QI Themes	QI's Used vs. Total
Arora VM et al. [29]	HC	30/35 (86)
Naeim A et al. [30]	BC	23/24 (96)
Kleerup E [31]	COPD	10/13 (77)
McGory ML [32]	COC	21/22 (95)
Wenger NS et al. [33]	CC	16/17 (94)
Feil DG et al. [34]	D	16/22 (73)
Nakajima GA et al. [35]	DE	19/20 (95)
Shekelle PD et al. [36]	DM	10/10 (100)
Lorenz KA et al. [37]	E	21/24 (88)
Chang JT et al. [38]	F	12/15 (80)
Yueh B et al. [39]	HL	7/10 (70)
Heidenreich PA et al. [40]	HF	12/17 (71)
Lillian C et al. [41]	HY	14/22 (64)
Watson K et al. [42]	IHD	17/21 (81)
Shrank WH et al. [43]	MU	19/22 (86)
MacLean CH et al. [44]	OA	13/23 (57)
Grossman J et al. [45]	O	13/19 (68)
Etzioni S et al. [46]	PM	8/11 (73)
Bates-Jensen BM et al. [47]	PU	13/15 (87)
Gnanadesigan N et al. [48]	SP	17/20 (75)
Martin JL et al. [49]	SD	10/13 (77)
Cheng EM et al. [50]	S	21/30 (70)
Saigal CS et al. [51]	BPH	13/19 (68)
Reuben DB [52]	U	9/13 (69)
Rowe S [53]	VI	11/11 (100)
Fung CH et al. [54]	UI	14/15 (93)

**Table 4 – Articles in the Journal of the American Geriatrics Society Supplement published in 2007**

These authors describe (descriptive overview) the QI adjustment/development/validation process for a certain condition, for each condition QI's were developed for all the domains of care. They all have the same setup; based on literature reviews, protocols, guidelines and expert opinion QI's were created and validated by an expert panel. For all studies the target group was vulnerable elders of 65 years and older defined as vulnerable by the VES-13 score. None of the studies has mentioned anything about the use of IT or decision support.

The abbreviations of QI Themes are explained in the legend of **Table 3**.

Authors	QI Themes	QI's Used vs. Total
Nakajima GA et al. [83]	DE	10/15 (67)
Wenger NS et al. [84]	CC	13/15 (87)
Young R et al. [85]	HY	9/18 (50)
Reuben D et al. [86]	U	8/14 (57)
Shekelle PG et al. [87]	DM	10/15 (67)
Shapiro NL et al. [88]	HL	6/10 (60)
Budoff MJ et al. [89]	IHD	13/18 (72)
Rowe S et al. [90]	VI	15/26 (58)
Rhew DC et al. [91]	SP	8/15 (53)
Kleerup EC et al. [92]	HC	9/23 (39)

**Table 5 – Articles about QI's for specific conditions published in 2004 on the RAND Health website**

These authors describe (descriptive overview) the QI adjustment/development/validation process for a certain condition, for each condition QI's were developed for all the domains of care. They all have the same setup; based on literature reviews, protocols, guidelines and expert opinion QI's were created and validated by an expert panel. For all studies the target group was vulnerable elders of 65 years and older defined as vulnerable by the VES-13 score. None of the studies has mentioned anything about the use of IT or decision support.

The abbreviations of QI Themes are explained in the legend of **Table 3**.

Authors	QI Themes	QI's Used vs. Total
Knight EL [69]	MU	12/16 (75)
Chow TW et al. [70]	D	14/30 (47)
Wenger NS et al. [71]	E	14/21 (67)
Fonarow GC [72]	HF	14/19 (74)
MacLean CH [73]	OA	11/18 (61)
Grossman JM et al. [74]	O	12/24 (50)
Rhew DC [75]	P	11/17 (65)
Rubenstein LZ et al. [76]	F	6/10 (60)
Schnelle JF et al. [77]	UI	11/16 (69)
Chodosh J et al. [78]	PM	8/16 (50)
Bates-Jensen BM et al. [79]	PU	11/15 (73)

**Table 6 – Articles in the Annals of Internal Medicine Supplement published in 2001**

These authors describe (descriptive overview) the QI adjustment/development/validation process for a certain condition, for each condition QI's were developed for all the domains of care. They all have the same setup; based on literature reviews, protocols, guidelines and expert opinion QI's were created and validated by an expert panel. For all studies the target group was vulnerable elders of 65 years and older defined as vulnerable by the VES-13 score. None of the studies has mentioned anything about the use of IT or decision support.

The abbreviations of QI Themes are explained in the legend of **Table 3**.



State	Theme	# QI's	Domain	# QI's	Medical Intervention	# QI's
ACOVE-1	Continuity of care	13/15	Screening	21	Assistive device	5
	Dementia	13/15	Prevention	40	Counseling	20
	Depression	17/32	Diagnosis	50	Diet	4
	Diabetes Mellitus	10/15	Treatment	84	Physical examination	30
	End-of-life care	14/21	Follow-up	21	Information continuity	24
	Falls and mobility disorders	6/10	Continuity	20	History	29
	Hearing impairment	6/10			Laboratory test	12
	Heart failure	14/19			Medication	68
	Hospital care	9/23			Nursing procedure	6
	Hypertension	8/18			Referral	6
	Ischemic heart disease	13/18			Surgery	7
	Malnutrition	8/14			Complex testing/procedure	17
	Medication management	12/16			Visit to physician	1
	Osteoarthritis	11/18			Exercise	7
	Osteoporosis	9/24				
	Pain management	7/17				
	Pneumonia and influenza	11/17				
	Pressure ulcers	11/16				
	Screening and prevention	8/15				
	Stroke and atrial fibrillation	10/29				
	Urinary incontinence	10/17				
	Vision impairment	15/26				
ACOVE-2	Continuity of care	13	No information given		No information given	
	Dementia	15				
	Depression	17				
	Diabetes Mellitus	10				
	End-of-life care	14				
	Falls and mobility disorders	6				
	Hearing loss	6				
	Heart failure	12				
	Hospital care	9				
	Hypertension	9				
	Ischemic heart disease	13				
	Malnutrition	8				
	Medication use	14				
	Osteoarthritis	11				
	Osteoporosis	8				
	Pain management	7				
	Pneumonia	11				
	Pressure ulcers	11				
	Screening and prevention	8				
	Stroke and atrial fibrillation	11				
	Urinary incontinence	10				
	Vision impairment	15				
ACOVE-3	Benign prostatic hypertrophy	12/19	Screening	&	Assistive device	8
	Breast cancer	23/24	prevention		Counseling	50
	COPD	11/13	Diagnosis	80	Dietary advice	5
	Colorectal cancer	21/22	Treatment	135	Exercise/physical therapy	10
	Continuity and coordination of care	16/17	Follow-up	&	History	66
	Dementia	17/22	continuity		Information continuity	40
	Depression	20/20			Laboratory test	26
	Diabetes	11/10			Medication	98
	End-of-life care	21/24			Nursing procedure	5
	Falls and mobility disorders	12/15			Physical examination	29
	Hearing impairment	7/10			Procedure, complex	24
	Heart failure	12/17			Referral	14
	Hospital care and surgery	30/35			Surgery	8
	Hypertension	14/22			Test, simple	9
	Ischemic heart disease	18/20				
	Medication use	23/24				
	Osteoarthritis	7/23				
	Osteoporosis	13/19				
	Pain management	8/11				



State	Theme	# QI's	Domain	# QI's	Medical Intervention	# QI's
	Pressure ulcers	13/15				
	Screening and prevention	17/20				
	Sleep disorders	10/13				
	Stroke and atrial fibrillation	21/30				
	Undernutrition	9/16				
	Urinary incontinence	15/15				
	Vision impairment	10/11				

**Table 7 – Overview of ACOVE's QI's, classified according to theme, domain and medical interventions**

ACOVE-2 does not differ (that much) from ACOVE-1. The reason for this is that ACOVE-2 is more focused on the interventions that could be applied to improve the quality of care, while ACOVE-1 is more focused on the development of measurements that could be taken in order to assess the quality of care.

## APPENDIX D – FIGURES

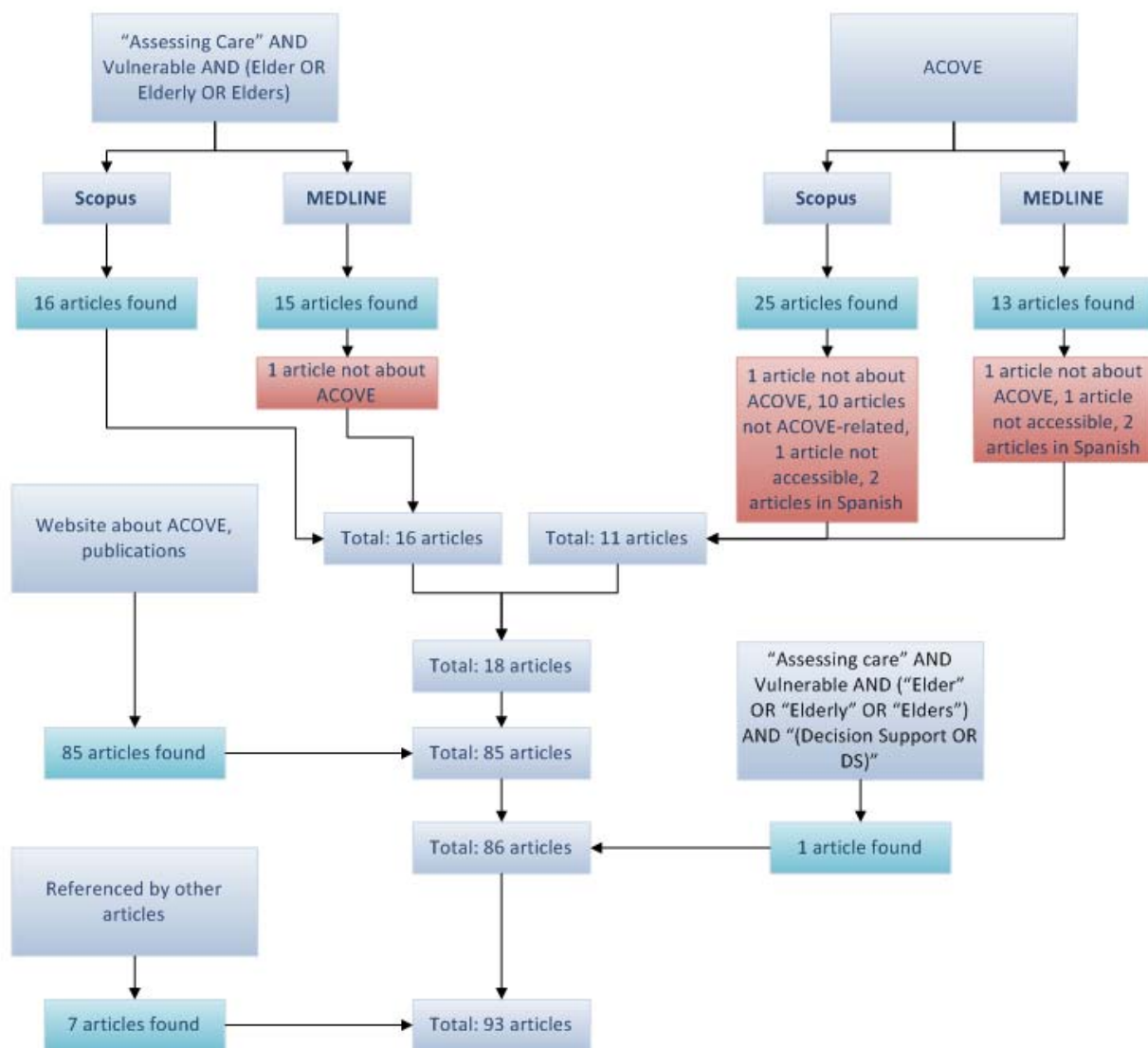


Figure 1 – The search strategy





**Figure 2– The ACOVE-1 project structure**

## APPENDIX E – ABBREVIATIONS

Abbreviation	Meaning
ACOVE	Assessing Care Of Vulnerable Elders
ACOVE-1	Assessing Care Of Vulnerable Elders (first state)
ACOVE-2	Assessing Care Of Vulnerable Elders (second state)
ACOVE-3	Assessing Care Of Vulnerable Elders (third state)
BOMC	Blessed Orientation Memory Concentration Test
CAHPS	Consumer Assessment of Healthcare Providers and Systems survey
CBS	Central Bureau of Statistics
CC	Clinical Committee
CPOE	Computerized Physician Order Entry
CQI	Community Quality Index
DS	Decision Support
EPR	Electronic Patient Record
GEM	Geriatric Evaluation Management
IADL	Instrumental Activities of Daily Living
ICOVE-Pro	Improving Care of the Vulnerable Elder using Proactive Decision Support
IT	Information Technology
MCO	Managed Care Organization
NH	Nursing Home
PAC	Policy Advisory Committee
QI	Quality Indicator
SF-12	Short-Form Health Survey-12
SF-36	Short-Form Health Survey-36
VAMC	Veterans Affairs Medical Center
VHA	Veterans Health Association
VE	Vulnerable Elders, as defined by the VES-13
VES-13	Vulnerable Elders Survey-13

**Table 8 – Abbreviations and their meaning**

When the abbreviation ACOVE is used it refers to ACOVE in general and not to a specific state of ACOVE. On the other hand; when the abbreviation ACOVE-2 is used, the information given is confined to the second state of ACOVE only. In other words, the abbreviations ACOVE and ACOVE-1 do not have the same meaning.