Quality of hospital care and health outcomes after stroke
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QUALITY OF HOSPITAL CARE FOR STROKE PATIENTS IN THE NETHERLANDS
ABSTRACT

Background and Purpose
To assess the quality of some aspects of medical hospital care an explicit review instrument (a 'criteria map') was developed on the basis of available evidence and consensus statements.

Methods
The criteria are represented as 'optimal care trajectories', which depend on the patient's clinical profile. The criteria map was applied in a study of 738 stroke patients over 45 years of age.

Results
We observed for 44% of the 738 studied patients one or more deviations from the optimal care trajectory with respect to at least one of five important aspects of medical care (CT scan, reversal of anticoagulation, treatment of hypertension, antiplatelet therapy, and evaluation of carotid arteries). The frequency of deviations from optimal care increased with patients' age and level of disability.

Conclusions
We conclude that the criteria map is a reliable tool for case-by-case review of the quality of care.
2.1 Introduction

During recent years, clinicians have become increasingly aware of the need to account for health care services that they deliver to their patients. This resulted in a growing concern about the quality of care in everyday clinical practice. One approach in this respect is to study the appropriateness of performed diagnostic or therapeutic procedures. Another approach is to address the question whether known effective and efficient medical procedures are actually applied to patients for whom they are considered to be appropriate. The last mentioned approach is also relevant for stroke patients, since the effectiveness of a number of medical and surgical measures to prevent new vascular events after ischemic stroke has been convincingly demonstrated.

From this perspective we developed an explicit review instrument to evaluate some aspects of quality of care for stroke patients admitted to hospital in the Netherlands. The instrument we developed registered the use of effective medical procedures for individual patients with regard to (1) the ascertainment of the diagnosis with a CT scan; (2) the reversal of anticoagulant treatment in patients with intracerebral hemorrhage, and (3) several measures to prevent new vascular events in patients with ischemic stroke. All other elements of quality of care (e.g. nursing care, skills or attitudes of physicians, organizational aspects of care) were not evaluated. The instrument may be used to analyze institutional or national profiles of practice patterns of (sub)optimal care. These analyses may lead to identify causes for suboptimal care and subsequently to set up measures to improve care for future patients.

A recent example of measuring quality of care according to prespecified criteria for optimal care is the British Stroke Audit Package. However, their 'shopping list' method does not take into account differences between patients. We developed our review instrument in the form of a 'criteria map'. This criteria map presents the sequential progress of the workup for stroke patients with specific clinical profiles. Patients with different profiles have to follow different 'care trajectories', and therefore encounter different criteria for optimal care. Deviations from these optimal care trajectories may indicate suboptimal care. It can be completed by trained nonmedical research assistants.
The criteria map was used to evaluate the main aspects of hospital care for 738 consecutively admitted stroke patients in the Netherlands. Simultaneously, we studied the reliability and validity of the instrument.

2.2 Methods

Patients and methods
The study group consisted of 738 consecutively admitted stroke patients older than 45 years. Patients younger than 45 years were excluded from this study, because optimal care is different for these patients. All patients were admitted within 1 week after stroke onset to one of 23 hospitals in the Netherlands, selected from both an urban (n=17) and a rural (n=6) region. Within each region, the hospitals were randomly selected after stratification for hospital size. Five small hospitals (< 200 beds), 9 intermediate size hospitals (200-400 beds) and 9 large hospitals (>400 beds) participated. Four of the 9 large hospitals were teaching hospitals. Patients were traced by use of administrative records. Patients were considered to have had a stroke, if there was a focal neurological deficit of sudden onset that lasted at least 24 h with no known alternative to a vascular cause. Both first and recurrent strokes were included. Patients with a transient ischemic attack (duration of symptoms shorter than 24 hours), a subarachnoid hemorrhage, or non-stroke pathology were excluded.

The data collection took place shortly after hospital discharge in order to minimize the influence that the performance of the study itself might have on patient care. Trained nonmedical research assistants completed a criteria map on average in about 15 min, using the medical and nursing charts. Each criteria map was checked by the neurologist (M.L.) and the scores were revised if necessary.

The patient's prognosis was based on his level of consciousness at hospital admission and was assessed with the Glasgow Coma Scale. A patient's prognosis was considered to be poor, if the score was 2 or less on the 'Eyes scale' (the patient does not open his/her eyes spontaneously nor in response to speech) as well as 3 or less on the 'Motor scale' (the patient does not obey commands nor localize pain). We did not use the verbal scale of the instrument because many stroke patients suffer from aphasia. The level of
disability at discharge was measured with the Barthel Index, using the 20-
point scale version. It was used as a measure of stroke severity for those
patients who were discharged alive. Disability was graded as severe,
moderate and mild, if the Barthel Index was 9 or lower, between 10 and 14,
and 15 or higher, respectively.

The study was approved by the medical ethical committees of the
participating hospitals. The data collection was carried out between June

Development of the Criteria Map
The criteria map was developed by the authors and 8 expert physicians,
using all available knowledge as presented in the WHO recommendations,
and English and Dutch guidelines for the diagnosis and treatment of
stroke patients. Some of the criteria we incorporated into the criteria map
were evidence-based while others were based on expert opinions.

The criteria map consists of four 'pages' (fig. 1a-d). Figure 1a applies to
all patients and checks whether a computerized tomography (CT) scan of the
brain was performed. Care for nonscanned patients is not evaluated further.

Figure 1b specifies, for patients with an intracerebral hemorrhage, the
performance of a number of laboratory tests (hemoglobin, glucose, and
creatinine or BUN), reversal of anticoagulant therapy within the 1st day
after admission for those patients who received warfarin at admission
(unless INR is lower than 1.8), consultation of a neurosurgeon in patients
with a cerebellar hemorrhage, and antihypertensive medication for patients
with hypertension (hypertension in medical history, or two measurements of
diastolic blood pressure higher than 100 mmHg within the first 24 h after
admission). Figure 1c specifies, for patients with a cerebral infarction, the
performance of laboratory tests (see above), a lumbar puncture for patients
admitted with fever (body temperature of 39°C or above), a diagnostic
evaluation of the heart (ECG and consultation of a cardiologist in case of
ECG abnormalities or other cardiac signs and symptoms), antihypertensive
medication for patients with hypertension (see above), and the prescription
of antiplatelet therapy (a daily dosage of aspirin of at least 38 mg, an
equivalent dosage of ticlopidine in case of aspirin intolerance, or the use of
oral anticoagulants). Figure 1d specifies, for patients with an infarction in
the territory of the carotid artery, a diagnostic evaluation with
ultrasonography of the carotid arteries, an angiography in case relevant abnormalities are shown by ultrasonography, and consultation of a vascular surgeon in case a relevant stenosis (70% - 99%) is shown. All above-mentioned care components directed at secondary prevention do not apply to patients with a poor prognosis (i.e. comatose at hospital admission) or who died in hospital.

In this article we present detailed results for five important aspects of care. These five aspects are (1) performance of a CT scan; (2) reversal of anticoagulant treatment; (3) treatment of hypertension; (4) prescription of antiplatelet therapy, and (5) diagnostic evaluation of the carotid arteries with ultrasonography.

To study interobserver reliability, the criteria maps of 71 randomly chosen patients (10%) were scored independently by 2 research assistants without interference of a neurologist. Validity was assessed by sending a structured postal questionnaire to the patient's neurologist, if one or more deviations from optimal care had been observed. The neurologists were asked to indicate the reasons(s) for deviating from the optimal care trajectory as represented in the criteria map.

### 2.3 Results

The mean age of the 738 stroke patients was 73 years (SD 12 years), 52% were men, and 33% had had a previous stroke or transient ischemic attack (Table 1).

A CT scan was performed in 682 patients (92%). Of these 682 patients, 123 (18%) had an intracerebral hemorrhage and 559 (82%) a cerebral infarction. Of the 559 patients with a cerebral infarction, 387 (69%) had a carotid territory infarction. Of all 738 patients, 199 (27%) died during hospitalization (Table 1).
Table 1. Characteristics of 738 consecutively admitted stroke patients, older than 45 years, in the 23 participating Dutch hospitals.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>381</td>
<td>52</td>
</tr>
<tr>
<td>Female</td>
<td>357</td>
<td>48</td>
</tr>
<tr>
<td>Age, years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-59</td>
<td>66</td>
<td>9</td>
</tr>
<tr>
<td>60-69</td>
<td>155</td>
<td>21</td>
</tr>
<tr>
<td>70-79</td>
<td>305</td>
<td>41</td>
</tr>
<tr>
<td>80 and older</td>
<td>212</td>
<td>29</td>
</tr>
<tr>
<td>Stroke/TIA history</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>492</td>
<td>67</td>
</tr>
<tr>
<td>Yes</td>
<td>246</td>
<td>33</td>
</tr>
<tr>
<td>Coronary heart disease*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>543</td>
<td>74</td>
</tr>
<tr>
<td>Yes</td>
<td>195</td>
<td>26</td>
</tr>
<tr>
<td>Hypertension**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>389</td>
<td>53</td>
</tr>
<tr>
<td>Yes</td>
<td>349</td>
<td>47</td>
</tr>
<tr>
<td>Type of stroke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infarction</td>
<td>560</td>
<td>76</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>122</td>
<td>16</td>
</tr>
<tr>
<td>Unknown (no CT performed)</td>
<td>56</td>
<td>8</td>
</tr>
<tr>
<td>Prognosis at hospital admission***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>678</td>
<td>92</td>
</tr>
<tr>
<td>Poor</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>Hospital mortality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharged alive</td>
<td>539</td>
<td>73</td>
</tr>
<tr>
<td>Deceased</td>
<td>199</td>
<td>27</td>
</tr>
</tbody>
</table>

Medical care deviated from the optimal care trajectory in 323 of the 738 patients (44%) for at least one of the five important aspects of care presented in this article (CT scan, reversal of anticoagulants, treatment of hypertension, antiplatelet therapy, and evaluation of carotids; Figure 1a-1d). The most frequently occurring deviation from optimal care related to the evaluation of the carotid arteries. In 209 of the 378 patients (55%) with an infarction in the carotid artery territory, no carotid screening had been performed (Figure 1d).
Figure 1a - d. The criteria map which was used to evaluate some aspects of quality of care for 738 hospitalized stroke patients in the Netherlands.

1a All admitted stroke patients
1b Hemorrhage

II.1 Lab performed?  
- yes → goto II.2  
- no → 104

II.2 Use of anticoagulants?  
- yes → 31  
- no → 91

II.4 Cerebellar hemorrhage?  
- yes → 9  
- no → 113

II.6 Poor prognosis? Deceased in hosp.?  
- yes → STOP  
- no → 67

II.7 Hypertension?  
- yes → 29  
- no → 38

II.3 Coagulat. study? Reversal?  
- yes → goto II.4  
- no → II.4

II.5 Neurosurgeon consulted?  
- yes → goto II.6  
- no → II.6

II.8 Hypertension treatment?  
- yes → STOP  
- no → 8  
- STOP
CHAPTER 2

1c Infarction

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III.1 Lab performed?

- yes → goto III.2

- no → DEVIATION No 54

III.2 Fever?

- yes → III.3

- no → DEVIATION No 557

III.3 Lumbar puncture?

- yes → goto III.4

- no → STOP

III.4 Poor prognosis? Deceased in hosp.?

- yes → STOP

- no → DEVIATION No 107

III.5 Hypertension?

- yes → III.6

- no → DEVIATION No 153

III.6 Hypertension treatment?

- yes → goto III.7

- no → DEVIATION No 138

III.7 ECG performed?

- yes → III.8

- no → DEVIATION No 315

III.8 ECG abnormalities?

- yes → goto III.10

- no → DEVIATION No 403

III.9 Cardiac abnormalities

- yes → III.10

- no → DEVIATION No 20

III.10 Cardiologist consulted?

- yes → goto III.11

- no → DEVIATION No 121

III.11 Carotid stroke?

- yes → CAR

- no → DEVIATION No 5

III.12 Antiplatelet treatment?

- yes → STOP

- no → DEVIATION No 378
1d Carotid stroke

IV.1 Carotid U.S. performed?
- yes → IV.2 Carotid U.S. abnormalities?
  - yes → goto IV.5
  - no → IV.3
- no → goto IV.3

IV.3 Angiography performed?
- yes → IV.4 Angiographic abnormalities?
  - yes → goto IV.7
  - no → goto IV.8
- no → goto IV.8

IV.5 Angiography performed?
- yes → IV.6 Angiographic abnormalities?
  - yes → goto IV.7
  - no → goto IV.8
- no → goto IV.8

IV.7 Vascular surgeon consulted?
- yes → goto IV.8
- no → goto IV.8

IV.8 Antiplatelet treatment?
- yes → STOP
- no → goto IV.8

STOP
In 11 of the 31 patients (35%) with a hemorrhage who used anticoagulants prior to hospitalization, reversal of anticoagulant therapy had not been performed adequately (Figure 1b). Furthermore, 36 of the 167 hypertensive patients (22%) were not treated with antihypertensive medication (Figure 1b and 1c), 61 of the 453 patients (13%) with ischemic strokes did not receive any antiplatelet therapy at hospital discharge (Figure 1c and 1d), and 56 of all 738 patients (8%) did not have a CT scan (Figure 1a).

In Table 2 we present the frequency of deviations from optimal care for the five important aspects of care broken down by age and level of disability at discharge for the 535 patients who did not have a poor prognosis at admission (see Methods) and who were discharged alive.

Table 2. Number of patients with one or more deviations from the optimal care trajectory with respect to five aspects of care* as a function of age and level of disability at discharge

<table>
<thead>
<tr>
<th>Age, years</th>
<th>None</th>
<th>Minor-moderate</th>
<th>Severe-very severe</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>45-70</td>
<td>16/84 (19)</td>
<td>39/94 (41)</td>
<td>15/22 (68)</td>
<td>70/200 (35)</td>
</tr>
<tr>
<td>71-77</td>
<td>25/48 (52)</td>
<td>34/73 (47)</td>
<td>33/45 (73)</td>
<td>92/166 (55)</td>
</tr>
<tr>
<td>78 and older</td>
<td>12/21 (57)</td>
<td>55/83 (66)</td>
<td>47/65 (72)</td>
<td>114/169 (68)</td>
</tr>
<tr>
<td>Total</td>
<td>53/153 (35)</td>
<td>128/250 (51)</td>
<td>95/132 (72)</td>
<td>276/535 (52)</td>
</tr>
</tbody>
</table>

Percentages in parentheses
* Performance of a CT scan, reversal of anticoagulant treatment, treatment of hypertension, prescription of antiplatelet treatment and diagnostic evaluation of the carotid arteries with ultrasonography.

Deviations from optimal care were more frequent in patients who were older or more severely disabled at discharge (multivariate test for trend, \( P < 0.01 \) and \( P < 0.01 \) for age and disability, respectively). Deviations occurred in 16 of the 84 youngest and least severely disabled patients (19%) and in 47 of the 65 oldest and most disabled patients (72%).

The criteria maps of 71 patients were scored independently by 2 research assistants to study interobserver reliability.
Table 3. Agreement between 2 observers about the presence or absence of deviations from the optimal care trajectories as presented in our criteria map concerning five aspects of care* (n=71)

<table>
<thead>
<tr>
<th>Observations</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreement</td>
<td></td>
</tr>
<tr>
<td>Both observers: no deviations</td>
<td>39</td>
</tr>
<tr>
<td>Both observers: same deviation(s)</td>
<td>24</td>
</tr>
<tr>
<td>Disagreement</td>
<td></td>
</tr>
<tr>
<td>Observer 1: deviation</td>
<td>6</td>
</tr>
<tr>
<td>Observer 2: no deviation</td>
<td></td>
</tr>
<tr>
<td>Observer 1: deviation</td>
<td>2</td>
</tr>
<tr>
<td>Observer 2: different deviation</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
</tr>
</tbody>
</table>

* Performance of a CT scan, reversal of anticoagulant treatment, treatment of hypertension, prescription of antiplatelet treatment and diagnostic evaluation of the carotid arteries with ultrasonography.

There was full agreement in 63 of the 71 patients (89%) on the five important aspects of care presented in this article (Table 3). In 4 of the 8 patients with disagreement, different interpretations of missing or ambiguous data had occurred. In the other 4 patients, disagreement was due to mistakes.

Validity of the criteria map was assessed by sending a structured postal questionnaire to the patient's neurologist, if one or more deviations from optimal care had been observed. Five neurologists treated all their patients according to the optimal care trajectory as presented in the criteria map. A questionnaire was sent to the remaining 59 neurologists. Of these, 37 neurologists (63%) returned the questionnaires. We could not demonstrate any systematic differences between responding and non-responding neurologists with respect to age and the type or size of hospital.

The returned questionnaires referred to 202 of the 311 patients (65%) with one or more deviations from the optimal care trajectory and to 227 of the 345 observed deviations (66%). The neurologists did not provide any
reasons for 33 of the 227 deviations of care (15%). Stroke severity was given as a reason for 65 deviations (29%), severe comorbidity for 44 deviations (19%), old age for 35 deviations (15%), the explicit wish from patient or relatives not to be treated for 10 (4%), and miscellaneous reasons for 40 deviations (18%).

2.4 Discussion

In this study we present criteria to evaluate the quality of some aspects of medical hospital care for individual stroke patients. These criteria are presented as care trajectories in a criteria map. The criteria depend on elements of the patients' clinical profile (prognosis or level of consciousness at admission, in-hospital death, and stroke type). We observed for 44% of the 738 studied patients one or more deviations from the optimal trajectory with respect to five important aspects of medical care (CT scan, reversal of anticoagulants, treatment of hypertension, antiplatelet therapy, and evaluation of carotids). The frequency of these deviations from optimal care increased strongly with the patients' age as well as with the level of disability at discharge.

In the criteria map that we present in this study, we incorporated only a limited number of elements of the patients' clinical profile. Although we were aware that other factors such as age, level of disability or comorbidity may play a prominent role in identifying patients who are most likely to benefit from a medical procedure\textsuperscript{12}, we did not include them for two reasons. First, it is impossible to define conclusive cutoff values, below or above which some diagnostic or therapeutic procedures need to be performed. There is for example no evidence that can be used to estimate quantitatively how the diagnostic effectiveness of carotid surgery decreases with patient age and, in addition, how other clinical factors may modify this age effect. This implies that establishing cutoffs for age would be arbitrary and debatable. Second, for other clinical factors difficulties arise even before establishing cutoffs, when trying to measure these factors. There are for instance no generally accepted measures that reflect the severity of stroke or comorbid disease.\textsuperscript{13} All this indicates that empirical evidence to support clinical decision making as well as assessing the quality of care will always be incomplete. In these 'grey zones' of stroke care, where evidence is deficient or conflicting, one will
have to rely on the art of medicine rather than on empirical evidence when reviewing the care for stroke patients. Consequently, it is impossible to incorporate this process in an explicit review method for quality assessment. The association between patient's age and level of disability on the one hand, and the number of deviations from the optimal care trajectories on the other, clearly showed the influence of incorporating such factors on the interpretations about quality of care.

The criteria map was introduced by Greenfield and et al. in the seventies. They designed criteria maps for patients with diabetes mellitus and chest pain. Other groups used criteria maps to study the care for patients in need of occupational therapy and for patients at risk for skin break down. Recently care for patients with an acute myocardial infarction (AMI) was reviewed by Ellerbeck et al., using a similar method albeit without a graphical representation in the form of a criteria map. They used all elements of the clinical profile that were empirically proven to be relevant to select 'ideal candidates' for a procedure. Ideal candidates are the patients most likely to benefit. Depending on the procedure under study, the proportion of ideal candidates ranged from 10% to 72%. They noted whether these ideal candidates actually received the procedure. This approach allowed them to conclude that in a subgroup of patients standard AMI treatments were underused. The advantage of their method of selecting ideal candidates is that the conclusions about quality of care can be made with some certainty. However, the disadvantage of this method is that the conclusions are only applicable to a very small proportion of patients. The criteria map we developed uses a somewhat different approach. Since our aim was to detect all possible deviations from optimal care, we tested whether all patients who might benefit from a procedure (the 'potential candidates') received this procedure. The disadvantage of our method is that some deviations of optimal care may have been falsely detected.

The responses of the neurologists reflected the consequences of our approach. For the majority of observed deviations from optimal care, the neurologists tried to provide valid reasons thereby often referring to stroke severity, age and comorbidity. However, their responses also illustrated the uncertainties we mentioned earlier, with regard to cutoff points. For example, dementia, cardiac disease, diabetes mellitus, depression and behavioral disorders were, among other things, called severe comorbidity.
Old age was defined by the neurologists as ranging from 72 to 92 years. Therefore, although these neurologists' responses provided us with insight in the nature of the decisions not to treat their patients, their responses did not assure us that quality indeed always had been as optimal as suggested by them.

What can we conclude about the quality of hospital care for stroke patients in the Netherlands? The results showed that for a substantial number of stroke patients in the Netherlands (44%) underuse of potentially beneficial treatments might have occurred.

Furthermore the study showed that the number of deviations from optimal care trajectories varied considerably for different components of care, from 8% for CT scanning to 55% for evaluation of the carotid arteries. However, the last mentioned percentage might also be explained by our study period: during the data collection of our study the results of two major trials demonstrating the beneficial effects of the carotid endarterectomy for patients with a severe stenosis were published.\textsuperscript{15,20} Finally, most deviations from optimal care were found among the oldest and most disabled patients. Further research about the effectiveness and efficiency of treatment in those patient groups is needed in order to be able to judge the quality of care they receive.

We conclude that the criteria map is a reliable tool for an explicit case-by-case review of the quality of care and it can be used to identify all patients who could have received suboptimal care.

2.5 References


QUALITY OF HOSPITAL CARE


