An Integrated System for Multidisciplinary Assessments in Stroke Rehabilitation

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**Background and Purpose** There is increasing emphasis on the use of integrated systems for timely, accurate, and efficient data collection for a range of service, audit, quality, and research applications. The present study evaluates the acceptability and the quality of data collected on a ward-based system over a 6-month period.

**Methods** A multidisciplinary system specific for stroke rehabilitation was used. Members of each discipline were required to enter demographic, medical, nursing, therapy, and psychosocial data as appropriate to their speciality. A users' survey was undertaken at the beginning and at the end of the study. The quality and completeness of data entry were assessed by a "snapshot" of the database at the end of the study period. Primary users (n=13) included physicians, nurses, and therapists.

**Results** The user survey at the end of the evaluation showed a significant increase in confidence in using the system. Although the frequency of use had increased, the time spent in data entry had decreased significantly. The increase in workload, estimated at 15 to 60 minutes per week, was considered to be balanced by the benefits in patient care, audit, and research. There were 67 medical and 1046 other assessments on 67 patients entered into the system. Seven patients (11%) had incomplete medical records. Nursing and therapy assessments had been entered for all patients at admission and on discharge, with more than 95% of all possible assessments monitoring recovery being recorded accurately compared with conventional records.

**Conclusions** The study showed that it was possible to introduce a computerized multidisciplinary assessment system on rehabilitation wards as a part of day-to-day work without the need for significant extra resources. (Stroke. 1994;25:2210-2214.)

**Key Words** • computer systems • data collection • rehabilitation • stroke assessment

Comprehensive measurement of recovery after stroke is essential for optimal clinical management of patients as well as rehabilitation research. Unfortunately, multidisciplinary assessments have received little attention from physicians, principally because many of these assessments fall outside traditional clinical evaluation. The importance of combining assessments of impairment and disability with formal medical evaluation in managing stroke patients has been emphasized in several overviews.

Despite the large number of neurological, physical, and functional assessments available, there is little consensus on their use in stroke rehabilitation. A review of 50 major studies has shown the predominance of activities of daily living (ADL) scales for capturing complex treatment outcomes of multidisciplinary team input. However, the multiplicity of scales and the domains of ADL measured made meaningful comparisons difficult, leading to the recommendation that it may be more appropriate to select a few measures that are central to the goals of the rehabilitation program and to concentrate on their continuing development.

The reliable collection, storage, and retrieval of data have been another major problem in stroke rehabilitation research. Data available to date are considered to be of limited value, being incomplete and of poor quality. This is not surprising considering the multidisciplinary nature of the data, which are often collected by a number of different professionals in different formats and sites who are often remote from the patients. Access to data also is limited by problems of perceived ownership, which further restrict dissemination of information and often encourage duplication.

These considerations lead to the development of an integrated computerized multidisciplinary data collection system that would (1) incorporate a small number of validated assessments considered to be important in managing stroke patients by the multidisciplinary team; (2) be ward based, so that it was in close proximity to the patients on whom the data were being collected; and (3) store data in an easily retrievable format that could be accessed by appropriate members of the multidisciplinary team as well as be used for studies on stroke rehabilitation.

This study describes the acceptability and the functioning of the system on a stroke rehabilitation unit over a 6-month period.

**Methods** The integrated data collection system was called the Orpington Stroke Management System (OSMS) and designed for multidisciplinary use by people with little or no computing background. The program was installed on an IBM-compatible 486 personal computer. The primary components of OSMS included the patient assessment module, which consisted of data sets containing validated and frequently used multidisciplinary assessments of disabilities (Table 1) included after discussion with the multidisciplinary team (assessments were grouped according to the perceived roles of rehabilitation staff for simplicity in data entry and to
Physicians, seven nurses, two physical therapists, and two occupational therapists who were recruited regardless of their computer literacy or enthusiasm for the system. Primary users undertook individual 30-minute training sessions, after which their proficiency was verified. Further training was available if necessary.

The 6-month study period was preceded by a 3-month training period for familiarization with day-to-day operation of the system and resolving software problems. A record of software problems or difficulties encountered in data entry was kept, which were resolved by modifying the program.

A survey of the identified primary users of the integrated system was undertaken at the beginning and end of the 6-month study period. The questionnaire covered areas ranging from ease of data entry to increase in work load and the perceived benefits of the system in patient care and research. The perceived ratio of work load to benefit of the system was also assessed. The data collected in the two assessments were analyzed using the Wilcoxon signed rank test for paired data.

A "snapshot" review of databases was undertaken at the end of the 6-month period for completion and accuracy of "index" assessments. The index assessments that needed to be completed by relevant professionals are given in Table 3.

**Results**

**User Survey**

The first survey showed that most users had some previous, although limited, experience on the integrated data management system (Table 4). Most felt confident operating the system and considered on-screen instructions and training facilities to be adequate (Table 4). Although all users thought that their work load had increased, estimates varied from less than 15 minutes per week to more than 1 hour per week. There also were doubts about this information being relevant to patient care, audit, or research (Table 4).

The second survey at the end of the evaluation period showed that confidence in operating the integrated assessments system had increased significantly during the evaluation period (Table 4). The frequency of use of the system had increased, but users were spending significantly less time per session than previously (Table 4). The increase in work load was less than reported in the previous survey (P < .02) and appeared to be balanced by the benefits in patient care, audit, and research applications. The greatest benefits appeared to be in areas of patient care (Table 4). It was not possible to assess interprofessional differences because of the small number of users in each group. Comparison of nurses with all other groups, however, did not show any significant differences. The information retrieved was seen as a positive benefit with research potential for individual disciplines. Most users wanted to increase the amount of information collected for their discipline.

**"Snapshot" of Data Entry**

The "snapshot" of databases at the end of the 6-month evaluation period showed that 67 patients had been entered onto the system during the study. Basic demographic data (age, sex, marital status, residence) had been accurately recorded for all patients. The layout and formatting of names, addresses, postal codes, and telephone numbers were very variable, but essential information was nevertheless present. One address was incomplete, and adequate information on next of kin was missing in eight records. Three in-patient records had no dates for any of the events from stroke onset through

### Table 1. Assessments in the Orpington Stroke Management System Battery

<table>
<thead>
<tr>
<th>Domain</th>
<th>Assessment</th>
</tr>
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<tbody>
<tr>
<td>Consciousness</td>
<td>Glasgow Coma Scale</td>
</tr>
<tr>
<td>Medical</td>
<td>Extent and severity of neurological deficit</td>
</tr>
<tr>
<td></td>
<td>Anatomic localization</td>
</tr>
<tr>
<td>Risk factors</td>
<td>Additional disability</td>
</tr>
<tr>
<td>Prognosis</td>
<td>Edinburgh Prognostic Scale</td>
</tr>
<tr>
<td></td>
<td>Orpington Prognostic Scale</td>
</tr>
<tr>
<td>Self-care</td>
<td>Barthel ADL Index</td>
</tr>
<tr>
<td>Social functioning</td>
<td>Frenchay Activities Index</td>
</tr>
<tr>
<td>Cognition</td>
<td>Hodkinson's MTS</td>
</tr>
<tr>
<td>Dysphasia</td>
<td>Frenchay Aphasia Screening Test</td>
</tr>
<tr>
<td>Perception</td>
<td>Modified version of RPAB</td>
</tr>
<tr>
<td>Motor power</td>
<td>Motoricity Index</td>
</tr>
<tr>
<td>Mobility</td>
<td>Functional Ambulation Categories</td>
</tr>
<tr>
<td>Mood</td>
<td>Hospital Anxiety and Depression State</td>
</tr>
</tbody>
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ADL indicates activities of daily living; MTS, Mental Test Score; and RPAB, Rivermead Perceptual Assessment Battery.

*The battery included is an abbreviated version of the RPAB and is being validated on the unit.

### Table 2. Standard Quality Parameters Measured by the Orpington Stroke Management System

- Number of patients admitted to the setting for the period
- Number of patients discharged for the period
- Length of stay of these patients (mean and median)
- Delay between referral and transfer of patients (mean and median)
- Percentage of patients with Orpington score 3 to 5 at 2 weeks who are discharged home
- Percentage of discharged patients with a Barthel score of >11
- Percentage of discharged patients improving their Barthel score by >5
- Percentage of discharges to institutional or long-term care facility
- Median (or mean) length of stay for:
  - Patients discharged home or to a relative's care
  - Patients discharged to institutional care
- Bed occupancy in the specialist setting

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transfer to the stroke unit (eg, date of referral, date of assessment, or date of transfer to the stroke unit).

The medical history file database contained details of medical history, clinical examination, and stroke risk assessment and management. Seven of the 67 stroke patients (11%) had incomplete medical records on the integrated database despite complete conventional medical records being available. Six patients had more than one medical history entered. Of these, one was due to a duplicate in-patient record, and another was a reassessment. There were four avoidable duplicates. All the medical history records were properly attached to the patient and in-patient records.

There were 1046 multidisciplinary assessments entered into the system on the 67 patients. These included 67 Frenchay Activities Index (FAI) assessments, 67 assessments of prognostic scores, 467 Barthel ADL scores, and 445 Functional Ambulation Categories (FAC) scores. All patients had appropriate nursing and therapy data entered at admission and on discharge, with no errors in the information. Discharge arrangements entered on the integrated database agreed with conventional records and were accurately incorporated into the multidisciplinary discharge summaries.

FAI had been recorded in both the integrated database and conventional notes for all except two patients, in whom this assessment was apparently not undertaken (100% complete data). One patient had duplicate FAI records in the integrated database, entered by two different nurses on two different occasions. The integrated system had complete records of Barthel scores on admission and at discharge for all patients that corresponded with conventional records. Of the 359 other Barthel assessments possible, 338 (94%) had been undertaken, of which 333 (98%) had been recorded on the integrated database. Scores recorded on the integrated database were similar to those on conventional records.

Correct prognostic scores had been entered into the system at the time of admission for all patients. The integrated system had complete records of FAC on admission and at discharge for all patients that corresponded with conventional records. Of the other 359 FAC scores possible, 311 (87%) had been recorded on
the integrated database. Conventional records were only available for 308 assessments (86%) and agreed with computer records.

Discussion

The evaluation showed that it was possible to introduce an integrated computer-based multidisciplinary assessment system for patient management on rehabilitation wards without significant extra resources. The user survey showed a high level of acceptability to all professionals involved in rehabilitation. The completeness and accuracy of data entry also were similar to conventional records maintained by individual professions, with very few omissions (<5%) compared with conventional records.

Choice of Assessments

Stroke causes a wide range of disabilities, making it difficult to compare different patients or even monitor overall progress in individual patients. This has resulted in several scales for measuring global disease severity, often using composite scoring systems.\(^{7,10}\) Composite scores of global disease severity are, however, unreliable because of the dominance of speech and language function over other indexes that combine various disabilities into one score.\(^{10,19}\) Most scores also mix a variety of impairments without considering their interactions, making interpretation difficult.\(^{10}\) Simple and specific measures of disability may be more appropriate than composite scores in monitoring stroke rehabilitation, and assessment protocols based on a small selection of easy-to-use measures relevant to the goals of the field have been recommended for more widespread use.\(^{4,7-10}\) This approach has been adopted in developing the integrated stroke assessments system, which includes one or two well-validated, simple measures for important areas in stroke rehabilitation (motor impairment, speech and language function, activities of daily living, perceptual problems, and emotional status).

Repeated assessments of Barthel ADL index and mobility have been used for monitoring progress in the integrated system. There is consensus on the "core" activities necessary to achieve "independent living,"\(^{20-24}\) all of which are included in the Barthel ADL scale.\(^{20-24}\) In addition, the Barthel score is well validated,\(^{25}\) correlates with clinical impression, and is reliable on test-retest, between observers and within different settings.\(^{10,26}\) It is also the most widely used and probably the best standard monitoring and outcome measure of ADL.\(^{10}\) Mobility is another crucial issue in stroke rehabilitation,\(^{27,28}\) but methods of assessment remain controversial.\(^{29}\) The FAC, incorporated into the integrated assessment system, was specifically designed for use in therapeutic environments such as the stroke unit.\(^{17,30}\) This categorization gives the detail on physical support needed by patients when walking and therefore is most useful in active rehabilitation.\(^{10}\) The scale is simple to use and sensitive to changes during the transition from being immobile to walking, with established validity and reliability.\(^{17,30}\)

Although achieving independence in basic activities of living and mobility are not equivalent to complete success in rehabilitation, without these further progress would be difficult.\(^{10}\) Most studies have used these measures in assessing outcome in stroke rehabilitation, and most of the quality-of-life measures are also primarily concerned with ADL.\(^{4,10}\) In addition to ADL and mobility, the integrated system has the capacity to record a range of other assessments for impairment and disability. The inclusion of these assessments gives the system the flexibility to be used as a research tool when investigating pharmacologic or therapy interventions. The number of assessments undertaken for routine purposes means that the need to be kept to a minimum to ensure complete and accurate data entry, and the Barthel ADL index and FAC are recommended for routine use. The use of other assessments included in the system depends on the specific needs of individual patients.

Integrated Assessment Systems in Clinical Practice

Despite the need for integrated assessments systems to be well accepted, their introduction in clinical practice has been slow.\(^{32}\) This has been due to technical problems in developing adequate systems in the past,\(^{33}\) as well as personal perceptions of eventual users, ranging from outright suspicion to doubts about their ratio of "cost" (work load) to benefit.\(^{37}\) These problems have been overcome in recent years by advances in the development of clinical systems\(^{32}\) and the increasing acceptance of computers in clinical medicine, which is essential for the successful implementation of integrated systems in clinical practice.\(^{38}\)

Certain guidelines were observed in the development of the integrated assessments system. The system needed to be nonthreatening,\(^{29}\) simple to use, and concerned with perceived "core activities" in clinical management.\(^{32}\) Practical assessments that were relevant in day-to-day practice rather than comprehensive and often complex scales were included to improve user acceptability. There was multidisciplinary involvement in the development of the system, promoting a sense of co-ownership and commitment from all professions. Finally, adequate training was provided, the reasons for use and potential benefits were explained, and an opportunity for experimentation with the system was provided before its formal introduction. These factors may have contributed significantly to the successful implementation of the system in day-to-day practice.

The acceptability and applicability of the integrated assessments system to clinical settings were reflected in the completeness and accuracy of data collected. In contrast to previous studies showing more positive attitudes and compliance among medical staff,\(^{30,42}\) this study showed a more positive attitude and better data completion by the nonmedical staff. This may have been due to changing attitudes since the previous studies were conducted,\(^{44,45}\) involvement of nonmedical staff in the development of the program, and the structured implementation of the system in clinical areas.\(^{38,46}\)

Conclusion

This study has shown that it is possible to combine a selection of well-validated multidisciplinary assessments into an integrated assessments system for monitoring recovery and outcome in stroke rehabilitation. A successful system, such as the OSMS, has a high level of acceptability among multiprofessional users and facilitates high-quality data collection. Such systems not only have applications in patient care but also can facilitate research (eg, changes in abilities or outcomes after...
medical, therapy, or service interventions, which can be further stratified according to deficits and prognosis) and provide information for purchasing of stroke rehabilitation services. 47-49

References
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The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/25/11/2210