INJURIES CAUSED BY BIOMECHANICAL IMPACTS - CONTINUOUS EVALUATION OF HOSPITAL DATA

by

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INTRODUCTION

The present study has been influenced by developments common to all countries of the industrialized world: altered distributions of age groups, growing unemployment and technological progress are factors that create new demands on society. In these radically changing circumstances we must analyse critically things that we have taken for granted in a welfare society, with a new awareness of costs and alternatives for all aspects of social care. With health care being the heaviest, and fastest growing cost in every modern society, all analyses of costs for medical care are of vital importance.

The planning of accident prevention and injury protection requires detailed information on accidents, injuries, costs for medical care, and other consequences for the individual and society. This information should be available continuously since important changes may occur over short periods of time.

In Sweden the following information is collected each year from most hospitals due to request from the Swedish Medical Council; the number of patients and their age, the length of hospital stay, diagnosis (according to the International Classification of Injuries, ICD, (4)), type of operation and cause of injury (ICD E-nr). It has been recognized, however, that the terminology on injuries and accidents in ICD, particulary in its present form (9th revision) is quite insufficient as a basis for a thorough analysis. Moreover, data on costs of medical care determining the resources available for the individual patient is in practice nonexistent.

Therefore we have started a study of the present situation with a longterm goal to contribute to the development of an appropriate system for continuous and relevant information from the hospitals regarding patients treated for injuries.

The aims of the present part of the project are:

- to elaborate a method to collect data from hospital records regarding the accident, the injuries and the consumption of medical resources for patients who have sustained impact injuries
- to assess the occurrence and the quality of the information in question
- to improve the quality of such information
- to test the usefulness of the method in a pilot study

THE INFORMATION SYSTEM

General considerations

In medical care no cases are alike. They differ with respect to background, trauma, diagnostic routines, therapy and outcome. Re-operations

and repeated transfers between hospitals frequently occur which cause the same kind of data to appear iteratively. The information system therefore has to be very flexible indeed so that such data can be handled appropriately.

Medical data are often uncertain; diagnostic procedures and therapy seem to have occurred according to subsequent data but the specific events are not documented. Vague verbal statements in the patient files indicate the occurrence of actions taken but do not specifically state details. In the search for combined causes and actions taken these uncertainties may or may not affect the statistical treatment depending on the combinations being inclusive or exclusive.

The practical information system has therefore been somewhat changed from what is normally used. In short it can be characterized as a set of labelled boxes containing the information and placed on the storage shelf in some not too rigorous scheme in contrast to the ordinary way in which each postition on the shelf is assigned to a specific question. The system chosen allows a large variety of data to be contained in the same data pool.

The uncertainty in data is taken into account by a ´quality label system´ with three levels: data correct, data uncertain, and data missing.

The large variety of data has forced us to use different schemes of questions for different subgroups of patients and also to include the possibility to repeat the same questions on different occasions for the same patient. This has been implemented through the use of general input programs controlled by a set of text files containing different sets of questions which are brought into action in various combinations depending on the contents of previous data.

The statistical evaluation is performed by the formulation of a search profile containing the variables wanted as well as the contents of data pertaining to these variables. The procedure resembles the one used in scientific literature search although much more linking between questions and data contents are allowed. In particular, the use of so-called wild cards can be used in cases where certain aspects are to be neglected in the search. Also, a mathematical scheme for the logical combination of uncertain data has been included.

Specific features

The information system is evolved to meet the following demands:

- the structure of the system is general
  - -- basically the same system can be expanded for use within the areas of other diseases and injuries
  - -- within the same system it is possible to freely add further variables of any category
  - -- the data base created by this system is fully compatible with another data base with head injury patients (3)
- description of injuries, type and severity, allows for international comparison; ICD and AIS systems are used
- established codes (clinics hospitals(7), geographical mail codes (8), ICD- codes, codes within administrative and economic systems) are used for smooth communication with other databases
- reference to time and space (geographically and anatomically) is possible for any type of event
- data on consumption of medical resources is organized for automatic calculation of economic costs
- the system is designed to handle "soft", uncertain data
- the programs are designed for interactive working and their structure will after further elaboration allow for repeated data entering

Selection of variables

The variables are arranged into groups according to table 1.

Table 1. Groups of variables with respect to information content.

individual
accident
injury
medical care - transportation
- hospital care -- administration
-- diagnostic procedures
-- therapeutic procedures
- post hospital care

In the tables 2 - 7 are listed the variable names in the respective groups.

Table 2. Data on the individual.

* personal identification number

* age
* sex
* profession
* civil status
* social status

* pretraumatic medical status
- specification of longterm diseases
- occurrence of head injuries
- abuse of alcohol (chronic and acute) and drugs

Table 3. Data on the accident.

* site
* date
* hour

* type of activity - work, leisure, play, sport, traffic, assault
* accident mechanics - fall (various kind), injuried by object
* traffic accident - type of vehicle, collision and direction
* environment - in- and outdoor and other specified
* protective equipment
* status at scene of accident; unconsciousness

Table 4. Injury description.

* type of lesion - AIS 80-nomenclature (1)
* AIS - severity number (1)
* Injury Severity Score, ISS (1)
* anatomical code - body-region, AIS (1)
- functional system, Nominae anat (5)
- specific organ and part of organ (5)
* site of injury - sup-inf, ventr-post, right-left
* ICD - code (4)

Table 5. Transportation.

* date
* hour
* duration
* distance
* type of vehicle

* status during transport
* treatment " "

Table 6. Administrative data.

* date of arrival and discharge
* hospital-clinic code (7)
* discharged to
* registered diagnosis - ICD (4)
" cause of injury-ICD E-ser (4)
" type of operation (9)

Table 7. Consumption of hospital medical resources.

* length of stay at hospital
* " " " " intensiv care unit

* surgical operations - organ operated
  - duration
  - type of anesthesia
  - type of operation

* consultations
* X-ray investigations
* dialysis
* intubation
* tracheostomy
* blood units
* drugs

Table 8. Medical data.

* status - arrival, discharge

* Complications - thrombo-embolic
  - infectious
  - pulmonary
  - cardiac
  - DIC

Table 9. Post hospital care.

* medical attendance
* length of sick leave
* status after 6-12 mths
* " " 2 years
* " " 3 "

Sources of information.

Most of the data were collected from the hospital records and in addition some information was received from the health insurance office.

Collection and entering of data.

The data were recorded on a form by personnel of various qualifications; a hospital nurse, a medical student, two registrars and an assistant professor (BB). The data were entered into the computer via a terminal by a technician and a student.

PATIENT MATERIAL

Patients from the following hospitals were included in the pilot study: Sahlgrens hospital, East hospital and Childrens hospital in Göteborg Huddinge hospital in Stockholm. See table 10.

Table 10. Patient material in pilot study.

selection criterion	No	male	female	mean age
Traffic injuries, Göteborg				
in-patients	71	43	28	28
out-patients	136	85	51	30
Huddinge Hospital				
"abdominal inj", in-patients	63	48	15	33
"thoracic inj" "	61	42	19	43

RESULTS

The information system

Data collection

The form was primarily designed with a very spacious and simple layout. Annotations were made by simple markings. No figure codes were used in order to make the form filling as easy as possible and to minimize errors at data collection by personnel unacquainted with this type of work.

The time required for transfer of information from the records to the form varied considerably (15 min to 4 hours) according to:
- type and size of the medical record
- qualification and experience of the personnel
- type of data; most time consuming were: lab-tests, drug consumption and injury coding

During the latter part of the study an out-patient record required 15 - 30 min and an in-patient record required 30 - 90 min.

Data entering.

After successive improvements of the procedure it was possible to reduce the average time for data entering by a rather unexperienced person to 10 - 20 min per form.

Errors

Data collection.

120 completed forms were compared directly with the medical records by an assistant professor (BB) for most of the variables; totally about 4800.

- 80 deviations were found (1.7 %)
  - 12 of these (0.3 %) due to data entering errors
  - 16 " " (0.3 %) " " misinterpretation
  - 52 " " (1.1 %) " " misreading

Data entering.

Two studies were made separately to control data entering errors.

1. For the first part of the study 4450 variables as appearing in the records were controlled by comparison against a list from the computer:
   - 43 deviations were found (1 %)
     - 12 of these (0.3 %) errors regarding data quality
     - 16 " " (0.4 %) " " figures
     - 15 " " (0.3 %) " " other data

2. During the latter period of the study 2772 variables were controlled and totally 8 errors (0.3 %) were found.

Data quality.

Due to the type of data and the type of patient, missing or uncertain information in the records is found in table 11.

Table 11. Data quality. The maximum percentage of missing and uncertain data occurring within a group of variables (c f table 2-9).

Type of data	indiv	pre trauma	acci-dent	injury descr	transp	status arr/dc	surg op
in-pat							
uncert	0	10	5	0	3	0	3
missing	40	23	23	6	15	0	11
out-pat							
uncert	0	20	7	0	5	0	-
missing	13	70	16	7	20	0	-

Findings in the pilot study

The details of this study will be presented elsewhere c f (2). A general description of the material is given in tables 12 - 15.

Table 12. Cause of accident.

	traffic	assault	sport	play	other
Gbg,traffic,in-pat	69	0	0	1	2
" " ,out-pat	136	-	-	-	-
HS,"abdominal inj"	23	25	1	-	20
" ,"thoracic inj"	21	20	2	-	30

Table 13. Distribution on various body-regions, according to AIS.

	extern	head	neck	thor	abdom	spine	extrem
Gbg,traffic,in-pat	114	38	1	9	16	5	71
" " ,out-pat	174	26	1	2	1	13	27
HS,"abdominal inj"	14	11	0	31	113	0	28
" ,"thoracic inj"	35	8	0	61	4	4	16

Table 14. Number of patients with various ISS

ISS range	Göteborg traffic in-pat	Göteborg traffic out-pat	Huddinge abdominal injuries	Huddinge thoracic injuries
0 - 5	30	131	8	0
- 10	26	6	6	37
- 15	5		1	19
- 20	2		18	1
- 25	2		13	1
- 30	3		8	3
- 35	2		7	
- 40	0		1	
- 45	1		1	

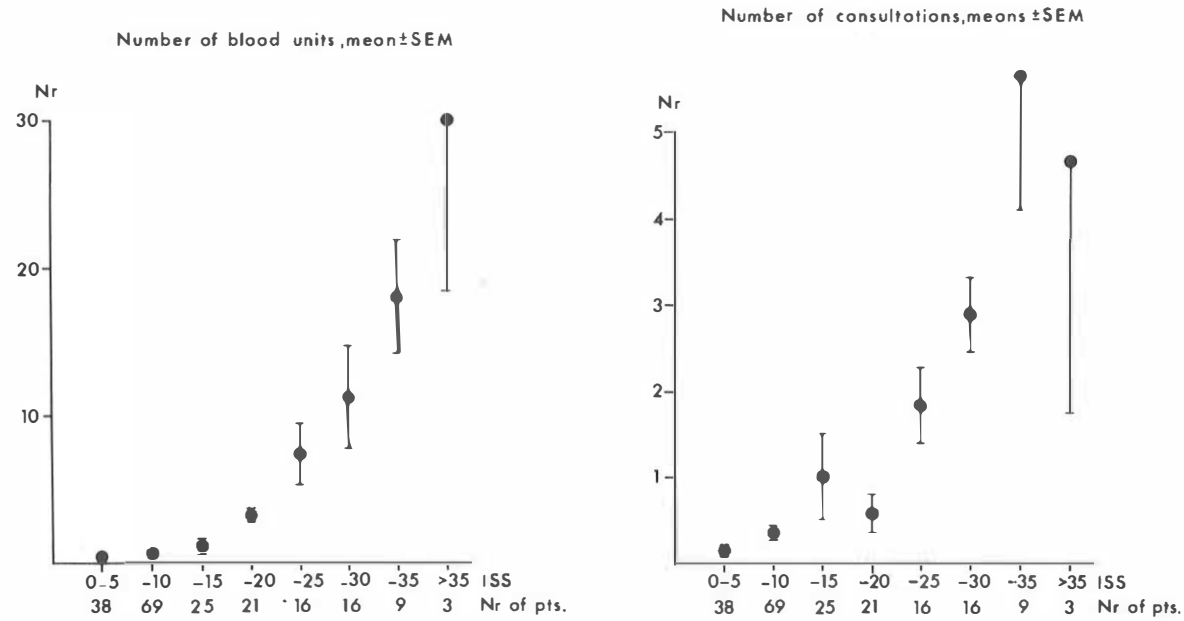

Fig 2. Number of blood units and consultations for groups of in-patients with injuries of different severity, ISS (1).

Fig 3 presents the average total hospital costs for in-patients differing in degree of severity. Table 16 presents the hospital costs and consumption of specific medical resources for patients involved in certain types of motor vehicle accidents. The calculation of hospital costs is based on the number of days at an ordinary ward (1500 Sw cr per day) and at an intensive care unit (6000 Sw cr per day).

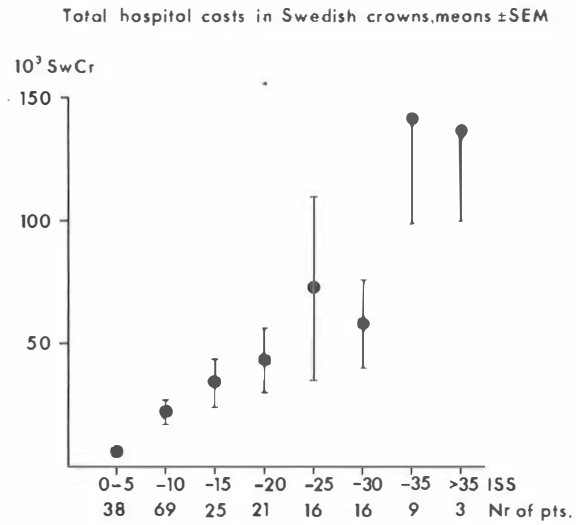

Fig 3. Total hospital costs for in-patients differing in degree of injury severity in terms of ISS (1). Means and SEM.

Table 16. Consumption of medical resources for patients involved in motor-vehicle accidents. Numbers of X-ray investigations and blood units. Hospital costs in Swedish Crowns. Means and SEM.

ISS-range	No	X-ray ⩽9	X-ray >9	blood ⩽9	blood >9	hospital costs ⩽9	hospital costs >9
Cardriver	(10+11)	4.5±1.7	11±3.5	0	7.3±4.7	10±4	56±27
MC-driver	(5+7)	3.4±1.9	16±6	0.4±0.4	10±7.2	15±10	52±27
Pedestrian	(6+11)	2±1	14±2.3	0	5±2.8	7±3	80±28

COMMENTS

Our experience points towards certain goals to aim for: an inclusive system for information must be formed, incorporating the following qualities: the information registered in the medical records must be complete, verifiable, easily and reliably registered. To fulfil these requirements we must construct forms which may be used by personnel of different qualifications. Emphasis must be put on the information and education of all personnel concerned. Present classification systems which have proved inadequate must be revised for the present purpose. Similar attempts are currently carried out in the primary medical care in Sweden and have met with approval on all levels from politicians to patients.

Registration of information must thus be a firmly established routine. The next step will be to widen the perspective of health care to include further costs carried by society. One way will be to use the information registered by the insurance companies concerning sickness and accidents. The costs of post-medical care, pensions etc, must be incorporated with costs of medical care on all levels in order to obtain figures of total costs to society.

Costs for medical care must be strictly and consistently separated to form an adequate basis for cost-effect and cost-benefit analyses. All relevant costs must be attributed to each stage in the care of each individual patient. Bearing in mind that staff costs are the most important (70-90%), special efforts must be directed to measure these in a proper way by estimation of work load.

Consequently, the separation of costs is of utmost importance both in discussions of capital investments and organization of medical care as well as in debates concerning alternative methods of health care.

SUMMARY AND CONCLUSIONS

A method has been elaborated to collect and systematize information about persons who after having sustained impact injury have applied for hospital care. Hospital records, for in- and out-patients, constituted the main source of information which included data on the accident, the injury and the consumption of medical resources.

The percentage of errors at collection and entering of data was found to be low; about 1 % and 0.4 % respectivly. The information system, although sophisticated and versatile, has yet proved possible to be smoothly run by rather unexperienced personnel.

It was shown that data on pretraumatic circumstances, on type of accident and on transportation were very often incomplete; missing for important variables in 15-70 % and uncertain in 5 - 20 %.

For the out-patient there is no hospital statistics at all. For the in-patients only 73 % of the injuries found in the study were officially registered.

For the in-patients, there was good correlation between the injury severity, as measured by ISS, and the consumption of medical resources.

In conclusion, our present official system for hospital statistics seems to be too insufficient and unreliable to produce an overall picture of the medical care of injuried patients regarding medical as well as economic data.

By the method elaborated it will be possible to collect such data to a low cost - corresponding to less than 0.5 % of the average hospital cost per admitted patient. However we consider it necessary to perform a prospective study to obtain more complete and valid data.

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