

**Development of A Hospital Information System to Improve
Patient's Admission, Transfer and Discharge Activities
Within the Ministry of Health in Bahrain**

By

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TABLE OF CONTENTS

	PAGE NUMBER
TABLE OF CONTENTS	iii
LIST OF TABLES	vii
LIST OF FIGURES	vii
ACKNOWLEDGEMENTS	xiv
ABSTRACT	xv
Chapter 1: Introduction	1
1. Introduction	2
 Chapter 2: Literature Review	 5
2.1 Information Systems	6
2.1.1 Information Systems Definition	6
2.1.2 Information Systems Development Methodologies	7
2.1.2.1 Themes in ISDM	8
2.1.2.1.1 Systems Approach	9
2.1.2.1.2 Planning Approach	10
2.1.2.1.3 Participative Approach	11
2.1.2.1.4 Prototyping	12
2.1.2.1.5 Structured Approaches	13
2.1.2.1.6 Data Analysis	13
2.1.2.2 Contingency Approach	14
2.1.2.3 Multiview Methodology	16
2.1.2.3.1 Stage 1 - Analysis of Human Activity	20
2.1.2.3.2 Stage 2 - Analysis of Information (Entities and Functions)	21
2.1.2.3.3 Analysis and Design of Socio-Technical Aspects	22
2.1.2.3.4 Design of Human-Computer Interface	22
2.1.2.3.5 Design of the Technical Aspects	26
 Chapter 3: Review of Hospital Information Systems Already in Place	 35
3.1 Hospital Information Systems	36
3.1.1 Historical Background	36
3.1.2 The Coding System	37
3.1.3 Hospital Software Packages	38
3.1.3.1 Northern Region	39

	iv
3.1.3.2 Yorkshire Region	41
3.1.3.3 Trent Region	43
3.1.3.4 North West Thames Region	45
3.1.3.5 North East Thames Region	46
3.1.3.6 South East Thames Region	48
3.1.3.7 Oxford Region	48
3.1.3.8 South Western Region	49
3.1.3.9 West Midlands Region	49
3.1.3.10 North Western Region	50
3.1.3.11 Wales Region	51
3.1.3.12 Scotland Region	54
Chapter 4: Application Analysis	57
4.1 Stage 1: Analysis of Human Activity System	58
4.1.1 Drawing the Boundaries of the system	58
4.1.2 The Rich Picture of the Problem Situation	61
4.1.3 Constructing the Root Definition	62
4.1.4 Building the Conceptual Model	66
4.2 Stage 2: Information Analysis	67
4.2.1 The Function Chart	68
4.2.2 Events and Data Flows	69
4.2.3 Analysis of Entities	70
4.2.3.1 Entities and Relationships	70
4.2.3.2 Verifying the Entity Model	72
Chapter 5: Application Design	128
5.1 Stage 3: Analysis and Design of Socio-Technical Aspects	129
5.1.1 Social Objectives	129
5.1.2 Technical Objectives	129
5.1.3 Social Alternatives	130
5.1.4 Technical Alternatives	130
5.1.5 Advantages and Disadvantages of Social Alternatives	131
5.1.5.1 Advantages of S1	131
5.1.5.2 Disadvantages of S1	132
5.1.5.3 Advantages of S2	132
5.1.5.4 Disadvantages of S2	132
5.1.5.5 Advantages of S3	133

5.1.5.6 Disadvantages of S3	133
5.1.6 Advantages and Disadvantages of Technical Alternatives	134
5.1.6.1 Advantages of T1	134
5.1.6.2 Disadvantages of T1	134
5.1.6.3 Advantages of T2	135
5.1.6.4 Disadvantages of T2	136
5.1.6.5 Advantages of T3 & T4	136
5.1.6.6 Disadvantages of T3 & T4	137
5.1.6.7 Advantages of T5	138
5.1.6.8 Disadvantages of T5	138
5.1.6.9 Advantages of T6	139
5.1.6.10 Disadvantages of T6	139
5.1.7 Options Selection	140
5.1.8 Recommendations	141
5.1.9 Social Costs	142
5.2 Stage 4: Human-Computer Interaction	145
5.2.1 Human-Computer Dialogues	145
5.2.2 The ATD System Menus	145
5.2.3 Users Responsible for Running the System	167
5.2.4 Reference File Maintenance	170
5.2.5 Error Prevention	172
5.2.6 Responsible Time	173
5.3 Stage 5: Design of the Technical Aspects	174
5.3.1 The Application	174
5.3.2 Information Retrieval	180
5.3.2.1 Reports	181
5.3.2.2 Queries	182
5.3.2.3 Reference Files	182
5.3.3 The Database	183
5.3.4 Database Maintenance	184
5.3.5 Control	184
5.3.5.1 Control on Data Entry	184
5.3.5.1.1 Items of specified data type	185
5.3.5.1.2 Items within specific boundaries (range check)	185
5.3.5.1.3 Limits on the actual values that may be used	185
5.3.5.1.4 Items with checking mechanism	186
5.3.5.1.5 Items with cross-checks	186

5.3.5.1.6 Missed out data	186
5.3.5.2 Control on program errors	186
5.3.5.3 Operator Error	187
5.3.5.4 Machine Malfunctions	188
5.3.6 Recovery	188
5.3.7 Monitoring	188
 Chapter 6: Application Prototype	 191
6.1 Introduction	192
6.2 Evaluating RDMS Products	192
6.3 Evaluating of Some Actual Products	193
6.4 Features in Oracle	195
6.5 ATD System Prototype	195
 Chapter7: Conclusions and Recommendations For Further Work	 207
7.1 Conclusions	208
7.1.1 The Information System	208
7.1.2 Meeting User Requirements	209
7.1.3 Testing the System	209
7.1.4 Assessing the System	209
7.1.5 Continuing Change	210
7.1.6 The Multiview Methodology	210
7.2 Recommendations For Further Work	211
References	212
Abbreviations	218
Appendix: Study of User Requirements	221

LIST OF TABLES

	PAGE NUMBER
CHAPTER 5	
5.1 Function, responsible user and location	167
5.2 Functions, transaction and outcomes	174
CHAPTER 6	
6.1 Some of the prototype products	194

LIST OF FIGURES

CHAPTER 2	
2.1 Learning cycle of action research	23
2.2 The Multiview framework	24
2.3 Methodology outputs	25
2.4 The Multiview methodology	29
2.5 Analysis of human activity systems to depict processes and products	30
2.6 Problem situations and abstract systems thinking	31
2.7 Outline of socio-technical analysis and design	32
2.8 Outline of the requirements for the technical specification	33
2.9 The overall process of technical design	34
CHAPTER 4	
4.1 The rich picture of the problem situation	63
4.2 Conceptual model level 1	87
4.3 Conceptual model level 2 - patient information system	88
4.4 Conceptual model level 2 - appointment system	89
4.5 Conceptual model level 2 - administration system	90
4.6 Conceptual model level 2 - medical record system	91
4.7 Conceptual model level 2 - file maintenance system	92
4.8 Conceptual model level 2 - treatment system	93
4.9 Conceptual model level 2 - report & enquiry system	94
4.10 Function model	95
4.11 Functional model: patient information	95
4.12 Functional model: appointment	96
4.13 Functional model: administration	97

4.14 Functional model: medical record	98
4.15 Functional model: file maintenance	98
4.16 Functional model: treatment	99
4.17 Functional model: report & enquiry	99
4.18 Functional mode: enquiry	100
4.19 Functional model: yearly report	100
4.20 Functional model: daily report	101
4.21 Functional model: monthly report	102
4.22 The system data flow diagram	103
4.23 Data flow diagram for registration	104
4.24 Data flow diagram for patient examination	105
4.25 Data flow diagram for admission details	106
4.26 Data flow diagram for patient admission assignment	107
4.27 Data flow diagram for patient admission	108
4.28 Data flow diagram for patient transfer	109
4.29 Data flow diagram for patient discharge	110
4.30 Data flow diagram for patient treatment	111
4.31 Data flow diagram for appointment booking	112
4.32 Data flow diagram for file maintenance	113
4.33 Data flow diagram for reports & enquiry	114
4.34 Data flow diagram for payment slip	115
4.35 Data flow diagram for medical record	116
4.36 Lower level data flow diagram for patient admission	117
4.37 Lower level data flow diagram for appointment booking	118
4.38 Lower level data flow diagram for file maintenance	119
4.39 Lower level data flow diagram for coding data	120
4.40 Lower level data flow diagram for enquiry	122
4.41 Lower level data flow diagram for type of payment	123
4.42 Lower level data flow diagram for patient admission	124
4.43 Lower level data flow diagram for patient admission	125
4.44 ATD entity relationship	126
 CHAPTER 5	
5.1 Socio-technical outline of the proposed system	143
5.2 Main menu	145
5.3 Second level of main menu;first level of ATD information menu	146

5.4 Third level of main menu; second level of ATD information menu; first level of patient menu	146
5.5 Fourth level of main menu; third level of ATD information menu; second level of patient menu; first level of patient details menu	146
5.6 Fourth level of main menu; third level of ATD information menu; second level of patient menu; first level of patient alias menu	147
5.7 Fourth level of main menu; third level of ATD information menu; second level of patient menu; first level of employer details menu	147
5.8 Fourth level of main menu; third level of ATD information menu; second level of patient menu; first level of informer details menu	147
5.9 Fourth level of main menu; third level of ATD information menu; second level of patient menu; first level of contact details menu	148
5.10 Third level of main menu; second level of ATD information menu; first level of registration menu	148
5.11 Fourth level of main menu, third level of ATD information menu; second level of registration menu; first level of patient registration menu	148
5.12 Fourth level of main menu, third level of ATD information menu; second level of registration menu; first level of delivery registration menu	149
5.13 Fourth level of main menu, third level of ATD information menu second level of registration menu; first level of birth registration menu	149
5.14 Third level of main menu; second level of ATD information menu; first level of admission menu	149
5.15 Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of patient admission menu	150
5.16 Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of admission assignment menu	150

5.17	Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of diagnosis menu	150
5.18	Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level diagnosis menu; first level of provisional diagnosis menu	151
5.19	Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level diagnosis menu; first level of diagnosis menu	151
5.20	Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of diagnosis menu; first level of other diagnosis menu	151
5.21	Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of accommodation menu	152
5.22	Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of accommodation menu; first level of patient accommodation menu	152
5.23	Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of accommodation menu; first level of change of accommodation menu	152
5.24	Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of operation menu	153
5.25	Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of operation menu; first level of patient operation menu	153
5.26	Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of operation menu; first level of other operation menu	153
5.27	Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of patient leave menu	154

5.28	Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of patient leave menu; first level of patient leave menu	154
5.29	Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of patient leave menu; first level of patient last leave menu	154
5.30	Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of special treatment menu	155
5.31	Fourth level of main menu; third level of ATD information Menu; second level of admission menu; first level of non-operative procedure menu	155
5.32	Third level of main menu; second level of ATD information menu; first level of transfer menu	155
5.33	Fourth level of main menu; third level of ATD information menu; second level of patient transfer menu; first level of ward transfer menu	156
5.34	Fourth level of main menu; third level of ATD information menu; second level of patient transfer menu; first level of unit transfer menu	156
5.35	Third level of main menu; second level of ATD information menu; first level of discharge menu	156
5.36	Fourth level of main menu; third level of ATD information menu; second level of discharge menu; first level of patient discharge menu	157
5.37	Fourth level of main menu; third level of ATD information menu; second level of discharge menu; first level of patient stay menu	157
5.38	Second level of main menu; first level of medical record menu	157
5.39	Third level of mainmenu; second level of medical record menu; first level of issue M R menu	158
5.40	Fourth level of main menu; third level of medical record menu; second level of issue M R menu; first level of issue M R menu	158

5.41	Fourth level of main menu; third level of medical record menu; second level of issue M R menu; first level of issue M R against appointment menu	158
5.42	Third level of main menu; second level of medical record menu; first level of receive M R menu	159
5.43	Fourth level of main menu; third level of medical record menu; second level of receive M R menu; first level of receive M R of individual patient menu	159
5.44	Fourth level of main menu; third level of medical record menu; second level of receive M R menu; first level of receive M R of individual patient menu	159
5.45	Second level of main menu; first level of appointment booking menu	160
5.46	Third level of main menu; second level of appointment booking menu; first level of admission booking menu	160
5.47	Third level of main menu; second level of appointment booking menu; first level of maternity booking menu	160
5.48	Third level of main menu; second level of appointment booking menu; first level of LP/OP booking menu	161
5.49	Second level of main menu; first level of administration menu	161
5.50	Second level of main menu; first level of reference file maintenance menu	162
5.51	Second level of main menu; first level of report menu	163
5.52	Third level of main menu; second level of report menu; first level of daily report menu	163
5.53	Third level of main menu; second level of report Menu; first level of monthly report menu	163
5.54	Fourth level of main menu; third level of report Menu; second level of monthly report menu; first level of in-patient report menu	164
5.55	Fourth level of main menu; third level of report menu; second level of monthly report menu; first level of ATD report menu	164
5.56	Fourth level of main menu; third level of report menu; second level of monthly report menu; first level of discharge report menu	164

5.57 Third level of main menu; second level of report menu; first level of yearly report menu	165
5.58 Fourth level of main menu; third level of report menu; second level of yearly report menu; first level of discharge report menu	165
5.59 Second level of main menu; first level of query menu	165
5.60 Third level of main menu; second level of query menu; first level of patient's details menu	166
5.61 Third level of main menu; second level of query menu; first level of patient's name menu	166
5.62 Third level of main menu; second level of query menu; first level of discharge menu	166
5.63 Admission label	181
5.64 Daily admission report by ward	189
5.65 Daily discharge report by ward	189
5.66 Monthly admission report	190
5.67 Monthly discharge report	190

CHAPTER 6

6.1 ATD system menu	199
6.2 Medical record, appointment booking and administration menus	200
6.3 Reference file maintenance menu	201
6.4 Report menu	202
6.5 Inpatient report and discharge report menus	203
6.6 Yearly report menu	204
6.7 Query menu	205
6.8 Entity relationship for entities involved in the prototype	206

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ABSTRACT

This study aims to develop a prototype hospital information system to be used for patient's admission, transfer and discharge activities such as the management of patient, admission, transfer, discharge and outpatient encounters at the various hospitals of the Ministry of Health in the State of Bahrain. The purpose of the Information System is to substitute the presently implemented system which is mainly based on manual methods that require extensive paperwork and vast quantities of duplicated and redundant data. The operational Information System should deliver an improved patient service by, for example, reducing the amount of paperwork, reducing the interdepartmental communications time, etc.

Salmaniya Medical Centre - the main hospital in Bahrain is taken as an example for the development of the System since all of the admission, transfer and discharge activities are performed in this hospital. The proposed system is to operate in this hospital as a basis towards future integration of the Patient Care System.

Multiview (a blended methodology drawing aspects from a number of methodologies) is used to develop the Information System. Multiview includes stages which relate to the human and social dimensions as well as the technical aspect. The techniques and tools provided within the framework of the methodology are selected and adjusted according to the problem situation.

Chapter 1: Introduction

1. Introduction

The State of Bahrain is located centrally on the southern shores of the Arabian Gulf between latitude 25° 32` & 26° 20` North and longitude 50° 20` & 50° 50` East. It lies some 22 km off the Eastern Coast of Saudi Arabia and slightly further from the Western Coast of the Qatar Peninsula. It is linked with Saudi Arabia through a causeway which has been opened since November 1986.

The State comprises a group of some 36 islands, with a total area of approximately 693.15 square km. The largest of these is Bahrain where the capital city Manama is situated. Bahrain Island accounts for nearly 85% of the total area of the State.

The State of Bahrain declared independence in 1971, before which Bahrain was a protectorate of the British. Since then the country has made rapid economic progress. Some of the major achievements of Bahrain are a reduction of its dependence on oil production and the development of a large workforce skilled in diverse fields.

Hence, the economy of the State is not entirely dependent on oil production. Bahrain has a diversified industrial base and is a major banking centre in the region with a large number of reputed international banks having their offshore banking services on the island. The country is served by an excellent telecommunications system which offers services both in the voice and data communications areas.

Computerisation in Bahrain started during the oil boom years of the seventies. Computers are now widely used in the private sector areas such as banking, industries etc.

The State of Bahrain has a population of 516,444 (Alayam 1992). One third of the population is Non-Bahraini. The crude birth rate is 40/1000 for Bahrainis and 17.4/1000 for Non-Bahrainis (DS 1990).

The Health Service in Bahrain started in the early 1900's. Since then, the Government is working very hard to provide advanced free medical care to all inhabitants of Bahrain. The Government has adopted the World Health Organisation goal to achieve "Health for All in the Year 2000". As a result of the health development experienced by Bahrain, the expectation of life at birth for both sexes rose dramatically from 55 years in 1977 to 66 years in 1988.

The Government of Bahrain, through the Ministry of Health, provides free and total Health Care to all residents of Bahrain. The long term goal of the Ministry is to provide both curative and preventative Primary Health Care through the Health Centres. Increasing emphasis is placed on the integration of the Primary, Secondary, Environmental and Occupational Health Care aspects.

The information system presently implemented in the Ministry of Health (MOH) is mainly based on manual methods. These systems require extensive paperwork and vast quantities of duplicated and redundant data. The MOH aims to implement computerised systems integrating all key areas within the Ministry. This will include extended computerisation of present manual and semiautomated procedures to speed up the flow of services offered and to provide information based on data available, to give improved patient care, management information and decision support.

The purpose of the study is to develop an information system to be used for patient's admission, transfer and discharge (ATD) activities such as the management of patient, registration, admission, transfer, discharge and outpatient encounters at the various hospitals of the MOH. This information system should provide a basis towards future integration of the Patient Care System.

Multiview (a blended methodology drawing aspects from a number of methodologies) is used to develop the information system. The techniques and tools provided within the framework of the methodology are selected and adjusted according to the problem situation.

The thesis is divided into seven chapters: Chapter 1: Introduction; Chapter 2: Literature Review; Chapter 3: Review of Hospital Information Systems Already in Place; Chapter 4: Application Analysis (Multiview stages 1 and 2); Chapter 5: Application Design (Multiview stages 3, 4 and 5); Chapter 6: Application Prototype; Chapter 7: Conclusions and Recommendations For Further Work.

Chapter 2: Literature Review

2.1 Information Systems

2.1.1 Information Systems Definition:

A number of scholars have given several definitions of information systems (IS). The following is a summary of some of these definitions.

Davis (1974) defines the term IS as an integrated man/machine system for utilizing information to support the operations, management and decision-making functions in an organisation. The system utilizes computer hardware, software, manual procedures, management and decision models and a database. He (Davis 1983) further elaborates on some of the points he uses in his definition. Thus, according to Davis, a man/machine system consists of information technology and people's activities in preparing and using information. Support, operations management and decision making functions gives the context of IS. Computer hardware and software provide the facilities in which IS give complex and more useful and interesting information. Davis goes on to explain that manual procedures give the design of user procedures which are essential for the success of the operation of computer-based IS. Management and decision models provide a gamut of models which support the decisions from highly structured to unstructured situations and from the operations level to strategic decisions (cf. Keen & Scott Morton 1978). Finally, Davis explains that databases are based on the concept of data as an organisational resource, where the concept is operationalised by database technology.

According to Senn (1985), an IS is the means by which data flows from one person or department to another, and it can contain every thing from inter-office mail and telephone lines to a computer system that generates periodic reports for various users.

An IS, as defined by Hicks (1987), is a formalised computer IS that can integrate data from various sources to provide the information necessary for management decision making.

Buckingham et al (1987) define IS as: a system which assembles, stores, processes and delivers information relevant to an organisation (or to society), in such a way that information is accessible and useful to those who wish to use it, including managers, staff, clients and citizens. It is a human activity (social) system which may or may not involve the use of computer systems.

Avison & Fitzgerald's (1988) view is that an IS provides information concerning the organisation and its environment. This information is useful to the members and clients of that organisation, and concerns its customers, suppliers, products, equipment, and so on. The organisation may be a business, university, hospital and so on.

Barker (1990b) argues that an IS is often thought of as a collection of computer processes that satisfy some functional need; for example payroll, general ledger and order processing systems. He further argues that the ideal systems are a combination of both manual and computer processes that elegantly fit into the way the business needs to run. Such systems take into account the needs of many functional areas, especially duplication of data. They also take into consideration day-to-day and the management information needs of the organisation.

2.1.2 Information Systems Development Methodologies (ISDM)

A number of scholars have given several definitions of ISDM. The following is a summary of some of these definitions:

A methodology is defined by Avison & Fitzgerald (1988:8) as " a collection of procedures, techniques, tools, and documentation aids which will help the systems developers in their efforts to implement a new IS".

Lehman (1991) views a methodology as: an integrated selection of methods used to solve certain type of problems.

Olle et al (1991) define an IS methodology as: a methodical approach to IS planning, analysis, design construction and evolution. They further argue that the term methodology should be used to mean 'a study of method'.

Although, the above definitions of a methodology are all, in my view, correct. Avison & Fitzgerald's definition is the one which I support. Further, I think that Olle et al's and Avison & Fitzgerald's definitions are complementary.

2.1.2.1 Themes in ISDM

It is worth noting that computers were used in administrative data processing since 1954 (Lyytinen 1987). But it was not until the 1960's that people started to realize the success and failures of IS. Since that time, a tremendous number of methodologies for use in the process of IS have been developed (Ter Hofstede & Vander Weide 1992). They are estimated at hundreds if not thousands (Bubenko 1986). They vary in scope, complexity, sophistication, and approach (Long 1989). However, Cornes (1990) argues that most development methods, whether traditional, structured methodologies or any of the varieties of prototyping, fail to distinguish between the concept on which they are based and the tools and procedures that they provide to implement it. Avison & Fitzgerald (1988) have identified six themes of these ISDM (systems approach, participation, planning, structured, data prototyping approaches). Each of these themes, in turn, address one or more weaknesses of the conventional approach such as the National Computing Centre (NCC) approach, which was designed in the late 1960's, and is still being used in a number of data processing departments (Avison & Wood-Harper 1991). The six steps of the conventional approach are:

- . Feasibility study.
- . System investigation.
- . Systems analysis.
- . Systems design (known also as general design (Saldarini 1989)).
- . Implementation.
- . Review and maintenance.

The above stages are called 'conventional systems analysis', 'traditional systems analysis', 'systems development life-cycle' or 'waterfall model' (Avison & Fitzgerald 1988).

The weaknesses of the conventional approach (Avison & Wood-Harper 1991) include:

- . The failure to meet the needs of management.
- . Unambitious systems design.
- . The inherent instability of models of processes.
- . Inflexibility due to the output driven design.
- . User dissatisfaction.
- . Problems with documentation.
- . Maintenance workload.
- . Application backlog.
- . Labour intensive, time-consuming and requiring a long time span (Hicks 1984).

The six ISD themes, identified by Avison & Fitzgerald (1988) are:

2.1.2.1.1 Systems Approach

Many of the systems approach principles have been considered by the IS community, and are integral features of a number of IS methodologies, in particular Soft Systems Methodology (SSM) (Checkland 1981). SSM, resting on a strong theoretical base of system theory (Angell & Smithson 1991), was developed expressly to cope with the more normal situation in which people with a problem situation play an important role in perceiving and interpreting the world in their own ways, making judgements about it using standards and values which may not be shared by others (Checkland & Scholes 1990). SSM consists of a seven-stage model, which makes a distinction between activities which are related directly to the real world of the people situation and activities which relate to the real world of systems thinking (Davies & Ledington 1991). SSM involves formulating a root definition based on a rich and comprehensive understanding of the people situations, then building conceptual models and comparing

these with the problem situation, and finally suggesting actions to improve the problem situation (Checkland 1981). SSM principles suggest that developing IS for the widest possible context would be advantageous (Avison & Wood-Harper 1991), and the whole may be greater than the sum of its parts. SSM supporters argue that a system developed using more traditional 'hard' methodologies pay little attention to the social and political factors which are controlling the environment in which the system is to be used (Vidgen & Hepworth 1990).

Other approaches have used systems principles in their design, such as Beer's Viable System Model, which provides a tool to study organisations historically and analyze from many viewpoints their structure and their IS (Avison & Fitzgerald 1988).

2.1.2.1.2 Planning Approaches

The planning approach stresses the involvement of planning in the development of IS (Avison & Fitzgerald 1988). It attempts to identify management needs, and plans the ways of achieving these needs. It stresses the involvement of senior management in IS planning (Martin 1982; Medly 1987). The planning approach philosophy is to combine the top-down planning and bottom-up design of individual subsystems with maximum encouragement for local initiative in creating such subsystems (Martin 1982). Planning IS is a stage of activity in which decisions should be taken on which systems, if any, need to be designed and built. It covers an area of business. The output from an IS planning stage is a collection of components which is referred to as a planning product (Olle et al 1991). Many information systems approaches have a separate stage which is called business analysis (Avison & Fitzgerald 1988). This stage is performed earlier in the ISD (Olle et al 1991). There are a number of methodologies with emphasis on IS planning such as: AXIAL, Conceptual Information Analysis Methodology (CIAM), and DATA oriented DESIGN (DADES) (Olle et al 1991). There are a number of planning approaches such as: Business Information Analysis and Integration Technique (BIAIT) (Burnstine 1986) and Business Systems Planning (BSP) (Martin 1980;1982 ; IBM Corp 1978).

2.1.2.1.3 Participative Approaches

In these approaches users are involved in the development process of IS, resulting in an increased likelihood of its success (Avison & Wood-Harper 1991). However, participation of users is not always successful. It has its risks for users. Users run the risk of becoming hostages, when participation is used as a means of ensuring design experts have access to information and knowledge necessary for building an IS. Furthermore, participation has often been naive and innocent in conception, especially with regard to power and influence (Olerup 1991). It is also argued (Avison & Fitzgerald 1988) that participation of users is not always successful due to some people not asking to be involved. Users, if they feel that the implementation of the new systems will make their job less demanding, less secure, affect their relationship with others, or result in loss of independence they enjoyed before, may do their best to make the implementation fail (Avison & Fitzgerald 1988). Avison & Fitzgerald further address three views regarding users' reactions:

- . Users may regard the computer department as having too much influence over user departments through technology.
- . Users may regard computer people as having too great a status in the organization, and they may not seem to be governed by the same conditions of work as the rest of the organization.
- . Users may consider the pay scales of computer staff to be higher than their own and that the poor track record of computer applications should have led to reduced salaries and status. Avison & Fitzgerald (1988) furthermore, suggest a useful way of encouraging user involvement is by improving the human-computer interface which can be achieved by a number of measures such as visibility, simplicity, consistency and flexibility.

There are methodologies based on the participative approaches such as Effective Technical and Human Implementation of Computer-based Systems (ETHICS) (Mumford & Weir 1979). ETHICS has been developed by Enid Mumford and Mary Weir (Mumford & Hensall 1979) and has been used in a number of different settings since

the 1970s. Its purpose has been to allow users to participate in systems design (Noble 1991), to ensure the new system is acceptable to users. This also assists users to become increasingly competent in the management of their own organization (Mumford 1983). Another methodology which is based on the participative approaches is Information Systems Work and Analysis of Change (ISAC), which has been used in Scandinavia (Vidgen & Hepworth 1990). ISAC is a process oriented methodology which is concerned with IS planning, business analysis and design (Olle et al 1991). It is based on a theoretical framework as well as practical applications (Olerup 1991).

2.1.2.1.4 Prototyping

Prototyping (Martin 1984) is a very useful technique, which can be used throughout a system development life-cycle (Barker 1990b; Brathwaite 1990). It is founded on the belief that people understand physical models better than logical models and will naturally be able to suggest refinements (Boar 1984). Prototyping (which usually includes users' participation (Olerup 1991)) is quicker and less expensive than traditional systems development, allowing an organization to build a tentative system, test it, make changes based on the tests, and finally arrive at an operational system with less risk and investment (Thomson 1984). It assumes that the development of an application is primary an exercise to provide the management and end user with an application that they like in the shortest possible time (Cornes 1990). Prior to the early 1980s, a prototype system would probably cost almost as much as a completed full-scale IS. But, the cost have been reduced because of the availability of fourth-generation languages, application generators, and Computer Aided Systems Engineering (CASE) tools (Connel & Shafer 1989) to create a subset of the proposed system that, to the user, appears and acts very much like the finished product (Long 1989). Prototypes can be classified in different ways (Brathwaite 1990). Some are meant to be discarded as they are not developed to be part of the final operational systems (Avison & Fitzgerald 1988). Prototypes have many advantages such as taking less time to produce an IS; errors in judgement and oversights can be quickly remedied without costly redesigning or programming; users are better informed, and, therefore, the

feedback to the project team is of a high quality; users can get exactly what they requested; and it is a way of demonstrating the IS to the users before they buy it (Long 1989). Prototyping is not always without risk (Connel & Shafer 1989). Uncontrolled prototyping can be positively bad for the health of a system (Barker 1990b). The disadvantages are that it assumes full cooperation on the part of the users who will ultimately be affected by the new IS, and the finished system may not be efficient from a hardware perspective (Long 1989).

2.1.2.1.5 Structured Approaches

Structured approaches are based upon a reduction process in which complex situation are broken down into their constituent parts of analysis (Vidgen & Hepworth 1990). They are based on the assumption that the development of an application is primary an exercise in applied engineering and provide tools to ensure that a good engineering practice is followed (Cornes 1990). They use some techniques in the analysis and design such as functional decomposition, decision trees, data flow diagrams, data structure diagrams, structured English and data dictionaries (Avison & Wood-Harper 1991). 'Structured Walkthrough' (Paulson 1987; Marshal 1986) is usually used in structured methodologies (Avison & Fitzgerald 1988). As with most development methods, structured methodologies fail to distinguish adequately between the concepts on which they are based and the tools and procedures that they provide to develop applications.

2.1.2.1.6 Data Analysis

The primary purpose of data analysis is to determine the fundamental nature of data resources in an organization and to organize and document all relevant facts concerning this data (Brathwaite 1990). It is a useful technique stressed in many methodologies (Avison & Fitzgerald 1988), and it is used by many large corporations in business systems planning, strategic systems planning, and data modelling (Brathwaite 1990).

Data modelling (higher-level description of data) is independent of any database management system (DBMS), and also seen as the basic building block for all database design. In defining data models a data administrator need not be concerned with the peculiarities of DBMS, so he/she concentrate exclusively on the properties of the data. Data models will also make it easier to compare the merits of different DBMS meeting an enterprise's requirements (Howe 1989).

There are many methodologies such as Structured Analysis and Design Methodology (SSADM) which are a blend of the data and structured approaches (Avison & Wood-Harper 1991). SSADM (Coutts 1987; Downs et al 1988; Ashworth & Goodland 1990) is claimed to be the largest followed methodology in the UK (Reeves & Brooks 1987) and follows the structured approach. It is UK government sponsored methodology, and has been promoted in all UK central government projects since 1983 (Olle et al 1991). SSADM is the standard methodology for use in the NHS (Wood & Smith 1991a;b;c) for many years (Vidgen & Hepworth 1990). It has been reviewed many times, and the fourth version, SSADM4, was released in mid-1990. SSADM has weaknesses, such as 'it says what to do' but 'not how to do it' (Hammersley 1991). Other methodologies following the blend of the data and structured approaches include Merise, which is the best-known and used methodology in France both in the public and private sectors (Hammersley 1991), and CASE*Method (Barker 1991b).

2.1.2.2 Contingency Approach

Lucey (1991) argues that, although there is a natural yearning for the certainties and simplicities of the classic approach, it is nowadays generally accepted that there are no universal solutions to organisation problems; what is right for one organisation may not be right for another and what is right for a given organisation at one time may not suit the organisation at a different stage of development when the environment changes. It may be sensible for organisations to avoid standardizing on a methodology (Avison & Wood-Harper 1991). Wood-Harper (1989) argues that no single methodology is best or sufficient.

Avison & Fitzgerald (1988) show that a number of commentators have suggested an alternative approach to an overall analysis when selecting methodologies. Many authors and practitioners have argued that a more flexible approach to ISD is likely to be a more useful approach than a 'one best way' model which can lead to 'elaborate and bureaucratic methodologies' (Avison and Wood-Harper 1991).

Davis (1982) supports the contingency approach where the chosen methodology will depend on the particular circumstances in which it will be used, and suggests that the chosen methodology depends critically on the level of uncertainty in a situation. Davis viewed four components affecting the level of uncertainty. The four components are:

- . the complexity and ill-structuredness of the system,
- . its current state of flux,
- . the number of users affected, skills needed and skills processed, and
- . the level of experience and skill of the analyst.

Iivari (1989) presents a contingency framework with the emphasis on a contingency approach within a methodology. He suggested that in an application, the choice of tools and techniques will depend on three factors. Firstly, the comprehensiveness and depth of the ISs design process required. Secondly, the strategy chosen by the designer, either goal-oriented strategy or alternative-oriented strategy. Finally, the choice of an appropriate implementation strategy.

Olle et al (1988;1991) assume that contributing factors to formulate a contingency-based approach would be:

- . the scope of the problem to be solved,
- . the extent to which existing systems are already structured,
- . the size of the project,
- . the experience of the users, and
- . the quality of the design staff.

They argue that one way of describing 'contingency' is to list all factors of significance in a table and assign an appropriate value for each. They further argue that the factor's

value might be positive (causing little uncertainty or potential overrun) or, might be negative and therefore suggest a high risk.

Wood-Harper (1989) argues that contingency frameworks along with detailed analysis of the critical theory provides a deeper awareness of the other factors at work in the situation beside the methodology.

2.1.2.3 Multiview Methodology

Downs et al (1988) argue for the possibility of a 'super' or 'meta' methodology, which could be developed to integrate a variety of approaches to different aspects of ISD. They also argue that Multiview (Avison and Wood-Harper, 1990) is an attempt to tackle the problems of system definition.

Multiview is a contingency approach (following Iivari) which provides a flexible framework as an alternative to choosing between different methodologies or standardising on one particular methodology (Avison & Wood-Harper 1991). Multiview attempts to combine the human activity systems and the socio-technical approach along with more structured techniques developed from the work of Yourdon and DeMarco (Hammersley 1991). It "largely addresses problems associated with analysis and design activities of information systems definition" (Avison & Wood-Harper 1990:9). Multiview is a blended methodology drawing aspects from a number of methodologies. The techniques and tools provided within the framework of the methodology are selected and adjusted according to the particular situation. The introduction of social aspects of systems development, which is so lacking in some other methodologies such as SSADM, make Multiview interesting (Hammersley 1991). Multiview is offering alternatives, but it has been developed so that the techniques and tools hang together within a framework. It has been developed using action research methods (see Figure 2.1), where there is a close interaction between theory and practice, the framework being modified frequently according to the experience gained in using it (Avison & Wood-Harper 1990).

Multiview has been used in a number of case studies. These case studies were real examples of Multiview in use. The following are outlines of six case studies in which Multiview has been used. Details of the cases can be found in Avison and Wood-Harper (1990).

1. The Professional Association

This case study provides an example of an organisation which has problems with its clerical systems. It constituted the first application of the methodology in the practical world. The work had three phases: an initial study, a full requirements analysis and finally the development of some computer applications. In the case study the political, social, and organisational aspects of information systems concerning the human rather than the technical dimension, are highlighted. Further details about this case study can be found in Wood-Harper (1989).

2. The Polytechnic Distance Learning Unit

This case study describes the early phases involved in creating a computerised system related to learning materials for students taking a vocational course at distance from a polytechnic. The users in this case had experience with computers. Further details about this case study can be found in Wood-Harper et al (1985) and Wood-Harper (1989).

3. The Freight Import Agency

This case concerns a freight import agency situated at a small airport. Systems requirements and possible solutions are suggested. A major feature of the problem is uncertainty. The persons involved in this case study are naive systems analysts. They have no previous experience with the systems analysis and design. Further details of

this case study can be found in Wood-Harper (1989).

4. The Computer Consulting Company

This case study concerns a small newly established computer company. The Multiview methodology was used to identify possible problems areas and solutions. This case was used by students as practical work. This formed part of their course on systems analysis. Further details about this case study can be found in (Episkopou & Wood-Harper (1984) and Wood-Harper (1989).

5. The District Health Authority

This case concerns the analysis, design and prototyping of an IS which fulfils some of the local needs of fourteen nursing and paramedical professions working in the community in a district health authority, whilst satisfying the statutory requirements of the UK National Health Service (NHS) Korner steering group for those professions. This case involves the development of a prototype computer system. Further details about this case study can be found in Avison & Catchpole (1987).

6. The Academic Department

This case concerns the development of an IS for an academic department of a university. The case study is used to bring together all aspects of Multiview. Further details of this case study can be found in Avison (1989 and 1990).

Multiview largely addresses problems associated with the **analysis** and **design** activities of **information system definition**. It is a methodology to **structure the tasks** for the **analysts** and **users** during these analysis and design activities. Multiview helps in providing answers to the following questions:

1. How is the information system supposed to further the aims of the organisation using it?
2. How can it be fitted into the working lives of the people in the organisation who are going to use it?
3. How can the individuals concerned best relate to the computer in terms of operating it and using the output from it?
4. What information processing function is the system to perform?
5. What is the technical specification of the system that will come close enough to doing the things that you have written down in the answers to the other four questions?

Multiview includes stages which relate to the human and social dimension as well as the technical aspect which is emphasised only in the latter part of the framework. The stages of the Multiview methodology and the inter-relationships between them are shown in Figure 2.2. The boxes refer to the analysis stages and the circles to the design stages. The arrows between them describe the inter-relationships. Some of the outputs of one stage will be used in a following stage. The dotted arrows show other major outputs. The five stages incorporate five different views which are appropriate to the progressive development of analysis and design projects, covering all aspects required to answer the vital questions of users. These five views are necessary to a system which is complete in both technical and human terms. The output of the methodology shown as dotted arrows in Figure 2.2 are listed in Figure 2.3 together with the information that they provide and the questions that they answer.

Because it is a multiview approach, it covers computer-related questions and also matters relating to people and business functions. It is part **issue-related** and part **task-related**. An issue related question is: "What do we hope to achieve for the company as a result of installing a computer?". A task-related question is: What jobs is the computer going to have to do?

Issue-related aspects, in particular those occurring at stage 1 of Multiview, are concerned with the debate on the definition of system requirements in the broadest sense, that is 'what real world problems is the system to solve?'. Task-related aspects,

in particular stages 2-5, work towards forming the system that has been defined with appropriate emphasis on complete technical and human views. The system once created, is not just a computer system, it is also composed of people performing jobs.

Figure 2.4 gives an overview of the methodology. Working from the middle outwards we see a widening of focus and increase in an understanding of the problem situation and its related technical and human characteristics and needs. Working from the outside in, we see an increased concentration of focus, an increase in structure and the progressive development of an IS. Each stage addresses one of the five questions mentioned earlier.

2.1.2.3.1 Stage 1 - Analysis of Human Activity.

This stage in Multiview concerns the search for views of the organisation. Figure 2.5 shows the phases within the methodology of this stage. These substages can be grouped into four main ones:

1. Perceiving the problem situation (substages 1-3)
2. Constructing systems models (4-7)
3. Comparing the systems models to perceived reality (substage 8)
4. Deciding on the comparison and then implementing the consequences of these decisions (substages 9 to 10).

There are several iterations not appearing in the diagram. The problem owner, forms a **rich picture** which represents a subjective and objective perception of the problem situation in diagrammatic and pictorial form, showing the structures of the processes and their relationship to each other. The rich picture can be used to identify the problem themes. It is also a very useful tool from which to stimulate debate and to possibly identify relevant systems which may relieve the problem themes.

After forming the rich picture the problem solver extracts problem themes, that is, things noticed in the picture that are, or may be, causing problems and/or it is felt worth

looking at in more detail. Several different relevant systems should be explored to see which is the most useful. The problem solver and the problem owner must decide which view to focus on, that is how to describe their relevant systems. Once a particular view or **root definition** (which is a description of the major relevant system on which to focus attention). A criteria called CATWOE is used for the analysis of the elements, that is, the Owner of the system, the Actors involved, the Client or the Customer, the Transformation that takes place, the Environment in which it takes place, and the world view (or Weltanschauung). The CATWOE is mnemonic, formed as the first letter of each of the six parts.

When the problem owner and the problem solver are satisfied that the root definition is well formed, a **conceptual model** (or activity model) of the system is constructed by listing the minimum list of verbs covering the activities which are necessary in a system defined in the root definition. At this stage, we have a description in words of **what** the system will be (the root definition) and an inference diagram of the activities of **what** the system will **do** (the conceptual model). The conceptual model is an abstract process. The purpose of going into this abstract world of systems thinking is to develop an alternative view of the problem situation. When this alternative view has been developed, we can return to the real world and test the model. It is constructed in terms of what must go into the system, and it can therefore be set alongside the real world. Figure 2.6 shows how the conceptual model is compared with what is actually happening, in order to uncover discrepancies and to recommend changes.

2.1.2.3.2 Stage 2 - Analysis of Information (Entities and Functions).

The purpose of this stage, which is also known as information modelling, is to analyse the entities and functions of the system described, independent of any consideration of how the application system will eventually develop. Its input will be the root definition/conceptual model of the proposed system which was established in stage 1 of the process.

Two phases are performed in this stage (a) the development of a functional model, and (b) the development of an entity model. By using functional decomposition, it is possible to break down progressively the main functions, and by using data flow diagrams, the sequence of events and data flows are analysed. In developing an entity model, the problem solver extracts and names entities (anything you want to keep records about); relationships between entities; and the attributes which describe the entities.

2.1.2.3.3 Analysis and Design of Socio-Technical Aspects

The task at this stage is to produce a design from an analysis of people and their needs and the working environment on the one hand, and the organisational structure, computers, and the necessary work tasks on the other. Thus social and technical objectives are set and alternatives specified and compared so that the best socio-technical solution can be selected and the corresponding computer tasks, role-sets and people tasks can be defined. The emphasis at this stage is not on development, but on a statement of alternatives, according to important social and technical considerations. An outline of this stage is shown in Figure 2.7.

2.1.2.3.4 Design of Human-Computer Interface.

The inputs of this stage are the entity model derived in stage 2 of the methodology, and the computer tasks, role-set and people tasks derived in stage 3. Decisions are made at this stage on the technical design of the human-computer interface, for example batch or on-line and menus, command or form-driven. Specific conversation and interactions are then designed. The ways in which the users will interact with the computer will have an important influence on whether the users accept the system. Once the human-computer interfaces have been defined, the technical requirements to fulfil these can also be designed. The technical requirements become the output of this stage and the input to stage 5.

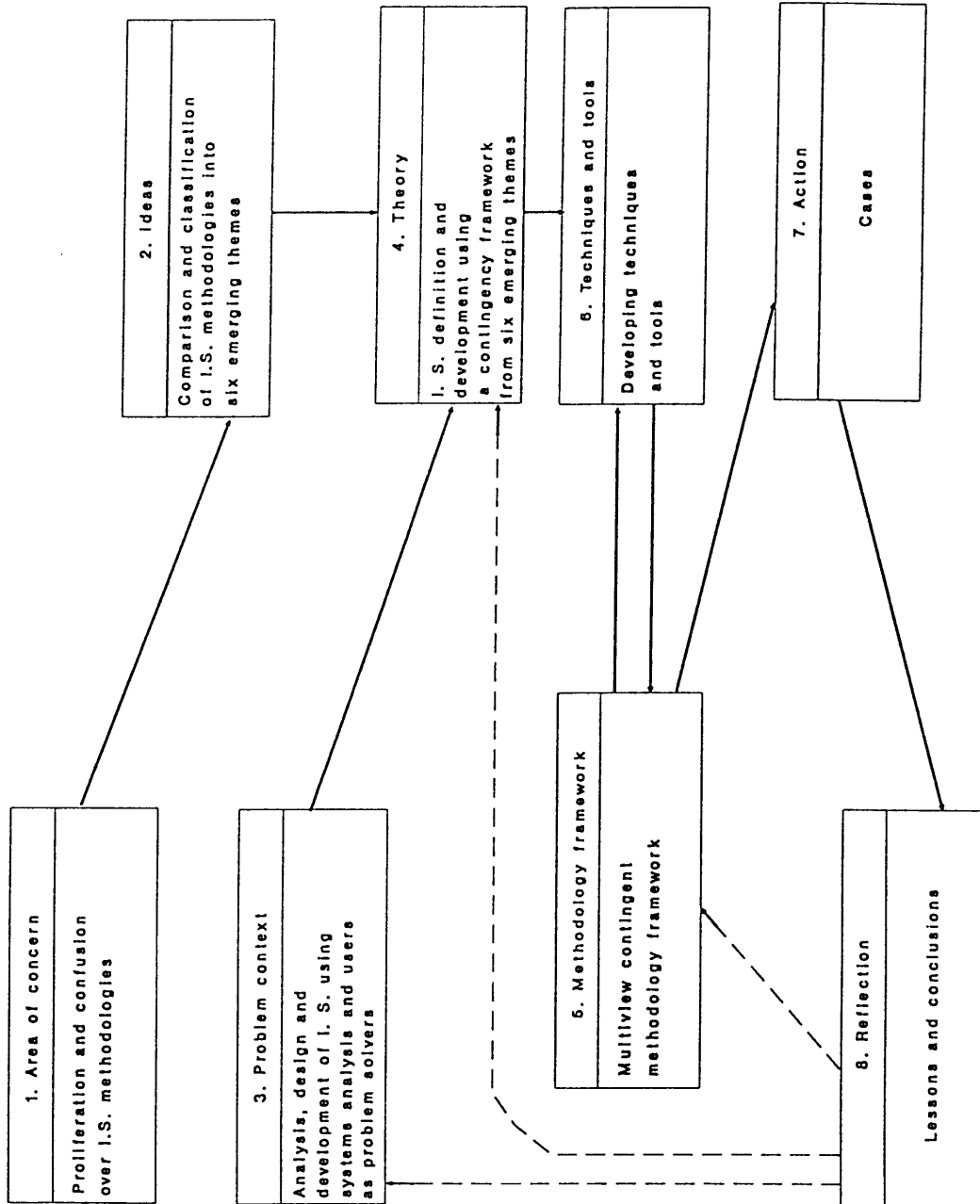


Figure 2.1: Learning cycle of action research (adapted from Avison & Wood-Harper 1991)

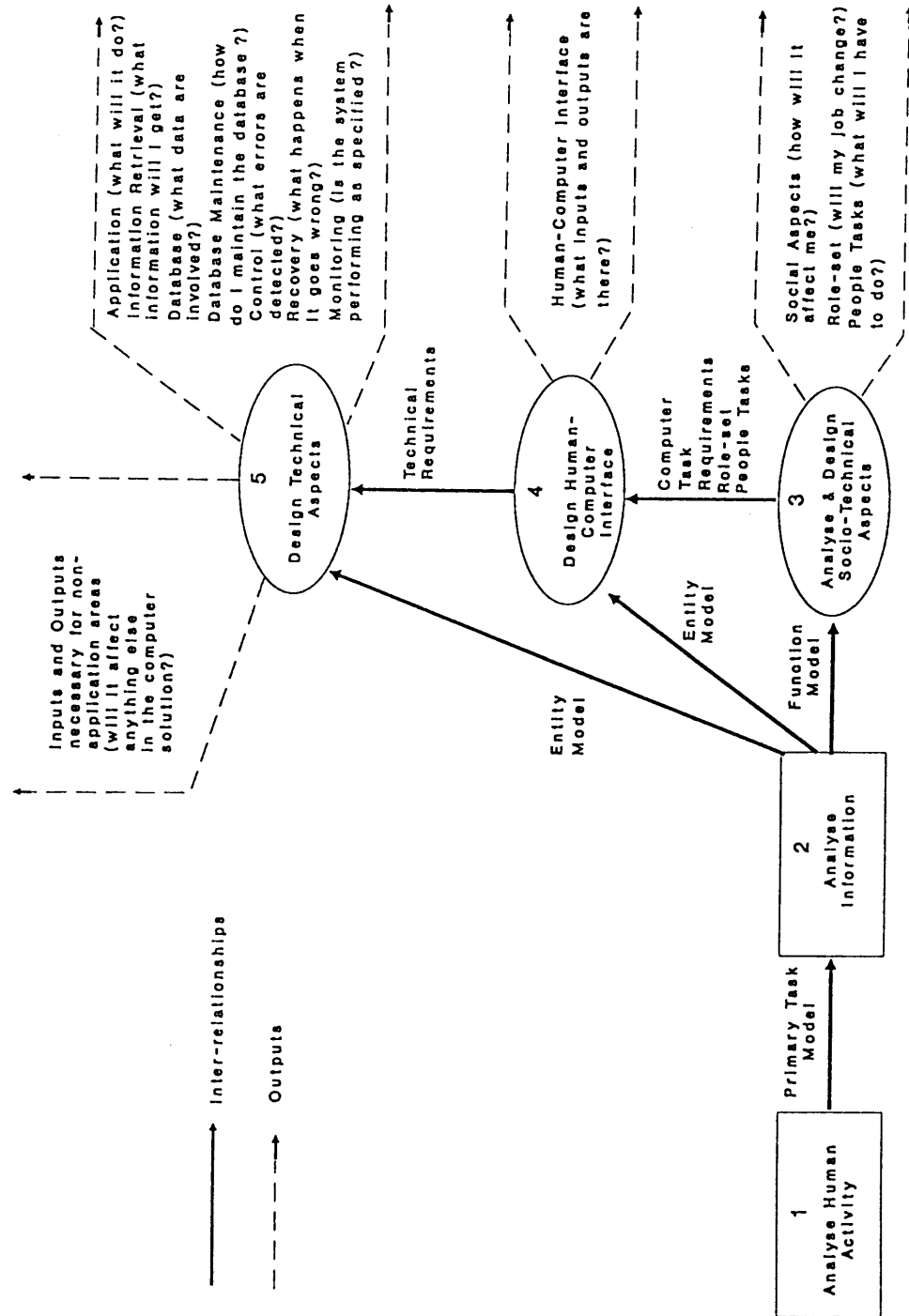


Figure 2.2 The Multiview framework (Avison and Wood-Harper 1990:22)

Outputs	Information
Social Aspects	How will it affect me?
Role-set	Will my job change? In what way?
People Tasks	What will I have to do?
Human-Computer Interface	How will I work with the computer? What inputs and outputs are there?
Database	What data are involved?
Database Maintenance	How will I maintain the integrity of data?
Recovery	What happens when it goes wrong?
Monitoring	Is the system performing to specification?
Control	How is security and privacy dealt with? What errors are detected?
Information Retrieval	What information will I get?
Application	What will the system do?
Inputs and Outputs necessary for non-Application Areas	Will it affect anything else on the computer subsystem?

Figure 2.3 Methodology outputs(Avison & Wood-Harper 1990:23).

2.1.2.3.5 Design of the Technical Aspects.

The inputs to this stage are the entity model from stage 2 and the technical requirements from stage 4.

After working through the first stages of Multiview, the technical requirements have been formulated with both social and technical objectives in mind and also after the consideration of an appropriate human-computer interface. A more technical view can be taken by the analyst because human considerations are already both integrated with forthcoming technical considerations. This technical design will include the application subsystems and the 'non-application subsystems'. These are the information retrieval requirements subsystem, the control subsystem, the recovery subsystem and the maintenance subsystem.

The final major outputs of the methodology are shown in Figure 2.8. These are the application, information retrieval, database maintenance, control, recovery and monitoring aspects, and the database. The interaction of the design activities to produce the final major computer processes of the technical specification are shown in Figure 2.9.

Avison and Wood-Harper (1991) argue that the strengths of Multiview are:

1. Multiview is an explorative structure, with a loose framework in which to define and develop IS, a contingent approach, in that alternative techniques and tools are available which may be chosen according to the requirements of each situation.

2. It is a blended, contingency approach to ISD incorporating aspects of six themes introduced earlier of the IS process: systems approach, planning approach, participation, prototyping, structured approach and data analysis. This is an advantage of Multiview as it is unreasonable to rely on any methodology falling into any one of these themes for all IS development, and a rigid approach to ISD can never be the full answer.

3. It has a framework guiding the user and therefore avoids a completely loose 'tool kit' approach.
4. It has been used in small, medium and large departments, for package and tailor-made solutions on micro, mini, and mainframe computers, representing large as well as comparatively small investments, and in situations where the roles of analysts and users varied. In each case, including the six cases outlined earlier, a prototype was developed which proved useful. Sometimes the prototype, once modified to users' satisfaction became the working system, or the prototype was being used as part of an investigation phase in ISD.
5. The adoption of a contingency approach can lead to problems, though Multiview does provide guidance, for example:
 - . There are difficulties associated with the levels of expertise and the breadth of knowledge required from systems analyst in order to use these approaches. The Multiview framework does however help to guide the analyst to choose an appropriate technique and tool for a particular situation at a particular point of time.
 - . There are difficulties relating to the consistency of standards in organisations that adopt a contingency approach.
6. Multiview has been developed in traditional action research, where there is a close interaction between theory and practice. Although the results of the action research are of qualitative nature, they do offer a degree of external validity because the theory developed can be interpreted and refined by others in other real-world situations.

The Weaknesses of Multiview are:

1. The wide range and large number of techniques and tools that are needed to be described in ISD methodology make such description long and complex and therefore difficult to learn and to master. Multiview is perhaps even more difficult because alternative techniques and tools are included. Further, it does not follow the usual step-by-step description with well defined deliverables at each step.

2. In all the applications using Multiview, the people involved took some time to understand the methodology and therefore to use it in the application.
3. The original exposition of Multiview was not thorough and this caused problems for the people when attempting to use it.
4. The descriptions of some techniques, were inadequate and therefore they were difficult to use.
5. Students fully understand the Multiview only after using it in an action learning situation.
6. As with many other methodologies, Multiview is influenced by the manipulation of power (that is, the political dimension). In most of the cases decisions were being made which were influenced by considerations beyond those that are implied by the Multiview methodology.
7. In Multiview, it is assumed that it is always possible to use responsible participation in ISD. This has proved less successful in some of the applications using Multiview.
8. Although the social and human aspects of systems development are stressed in Multiview, sometimes the use of Multiview has exposed difficulties over technical decisions. Either the techniques were not well applied or there were major problems with the hardware and software used.
9. Contingency factors relating to the team of analysts and users, for example, their training, education, culture, and experience are taken into account, but issues relating to when and why these factors are important and how they influence the success of the IS have not been fully explored.

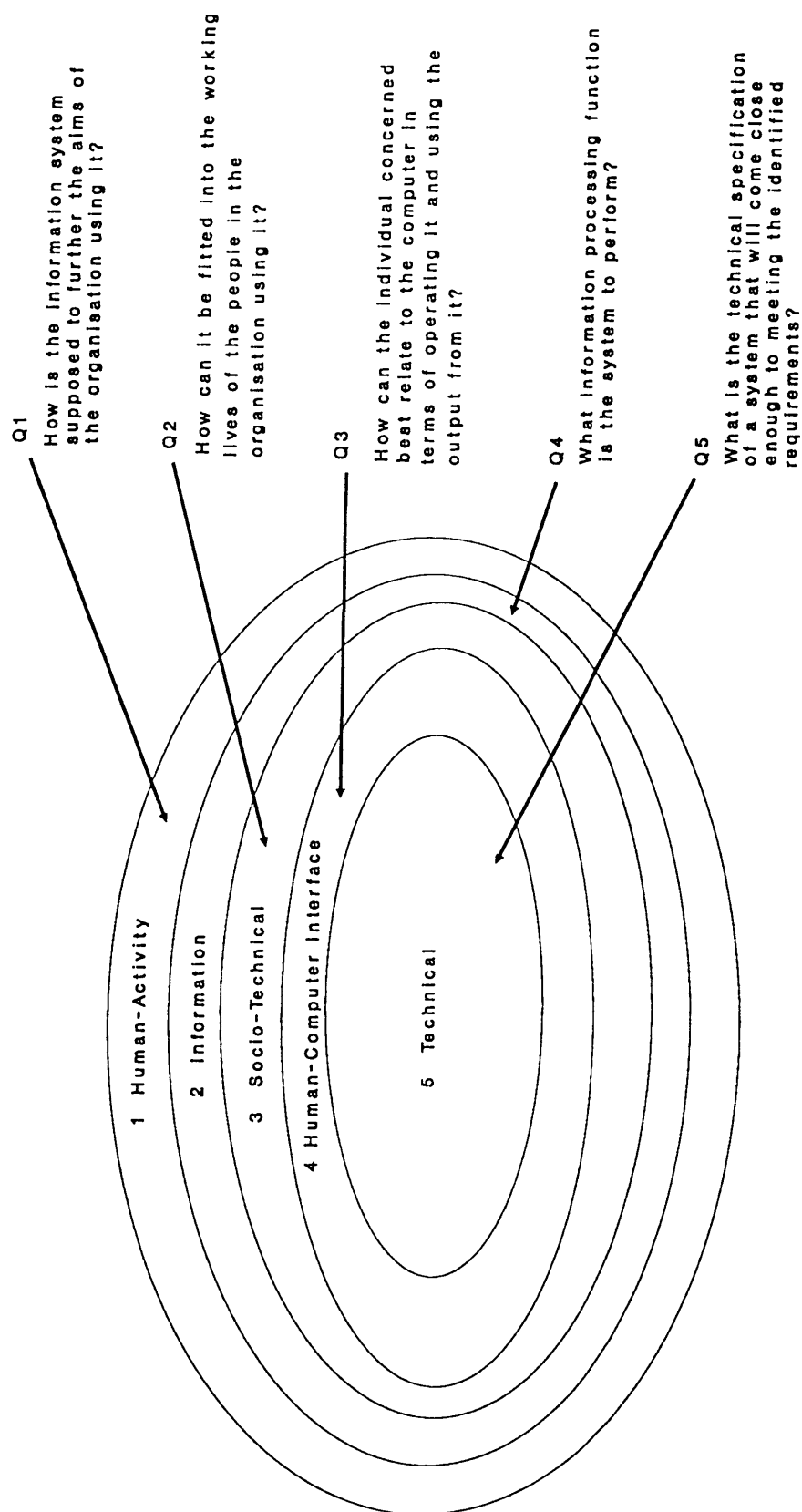


Figure 2.4 The Multiview methodology (Avison and Wood-Harper 1990:25)

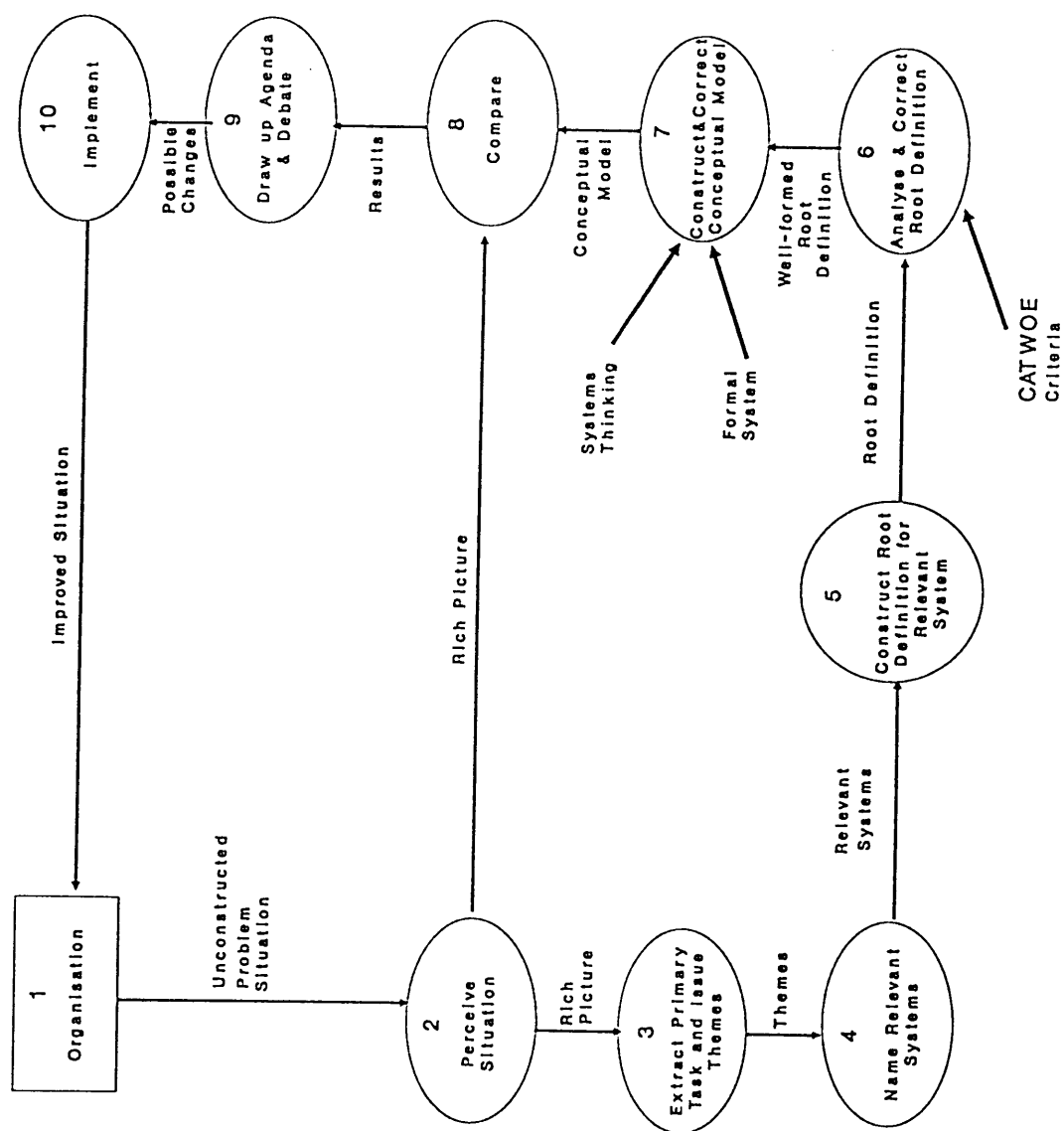


Figure 2.5 Analysis of human activity systems to depict processes and products (Avison and Wood-Harper, 1990:27)

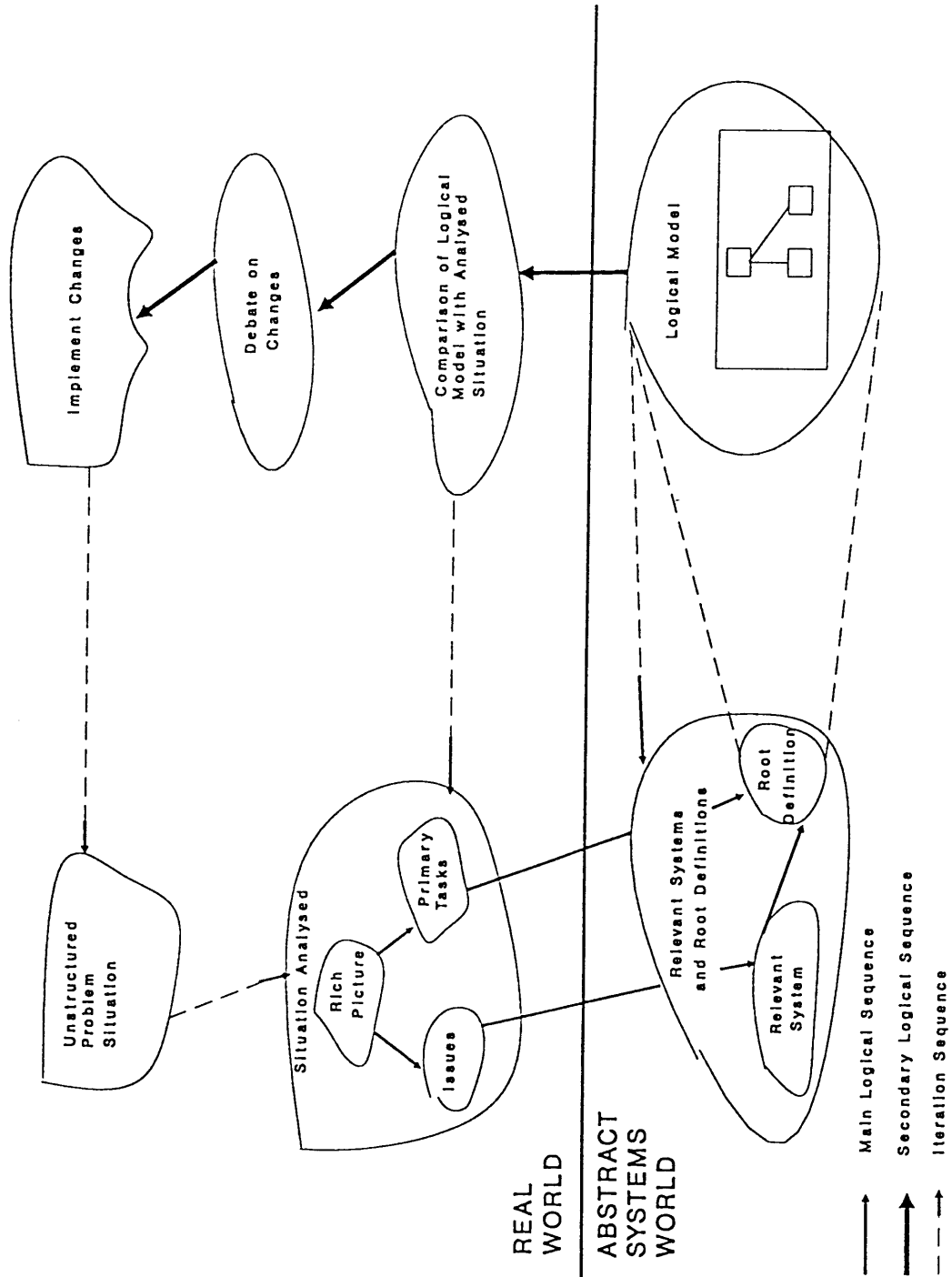


Figure 2.6 Problem situations and abstract systems thinking (Avison & Wood-Harper, 1990:67)

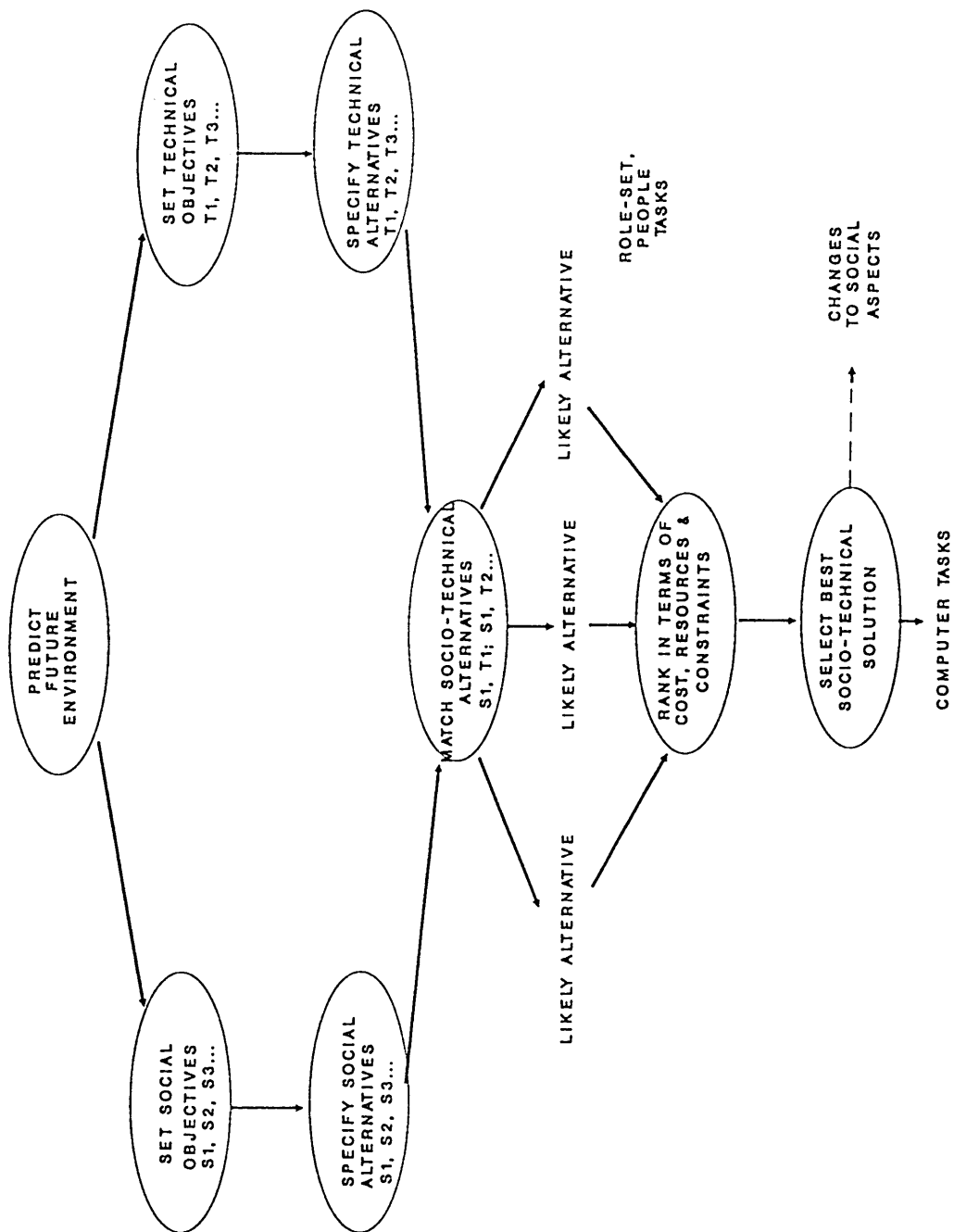


Figure 2.7 Outline of socio-technical analysis and design (Avison and Wood-Harper 1990:31)

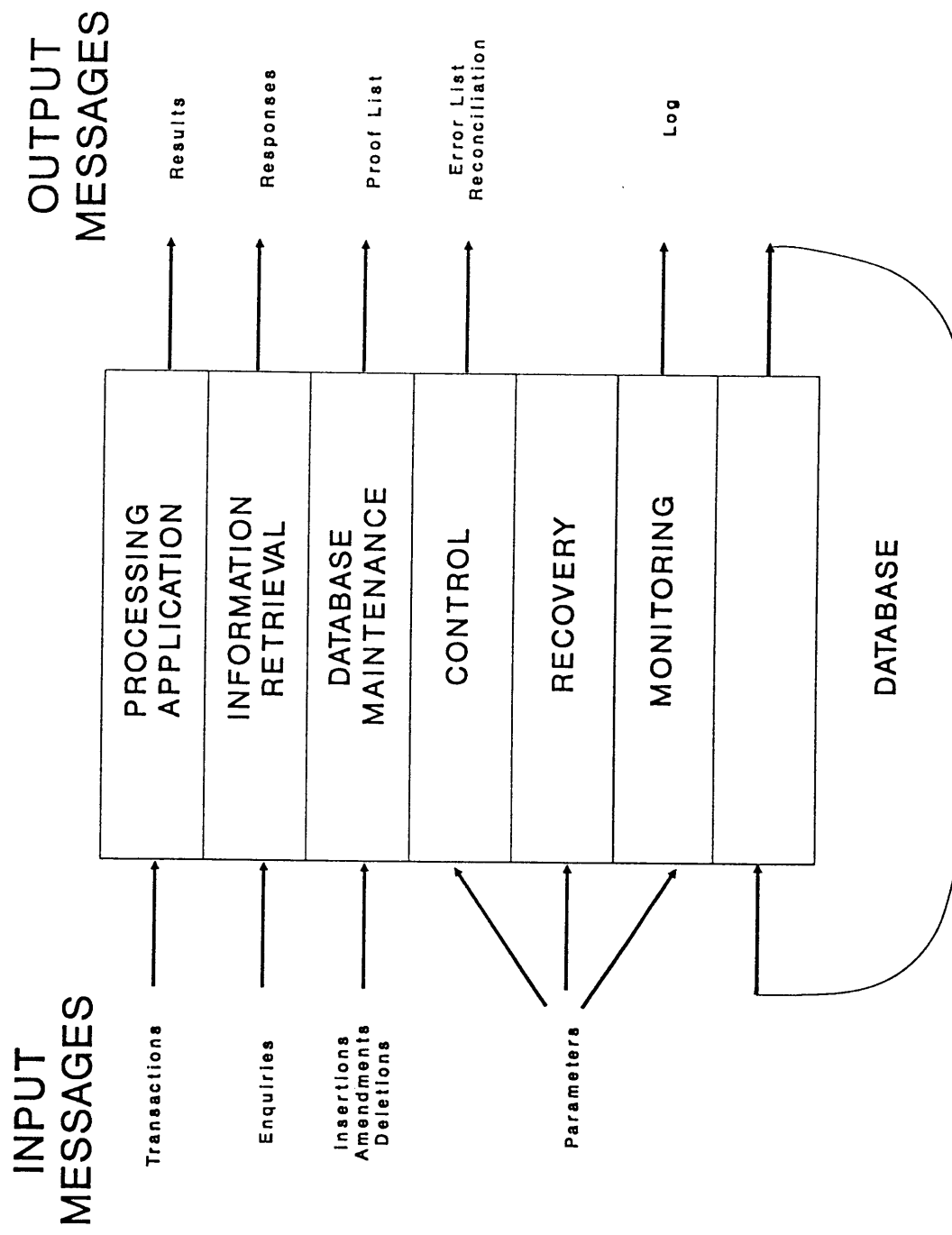


Figure 2.8 Outline of the requirements for the technical specification (Avison & Wood-Harper, 1990:33)

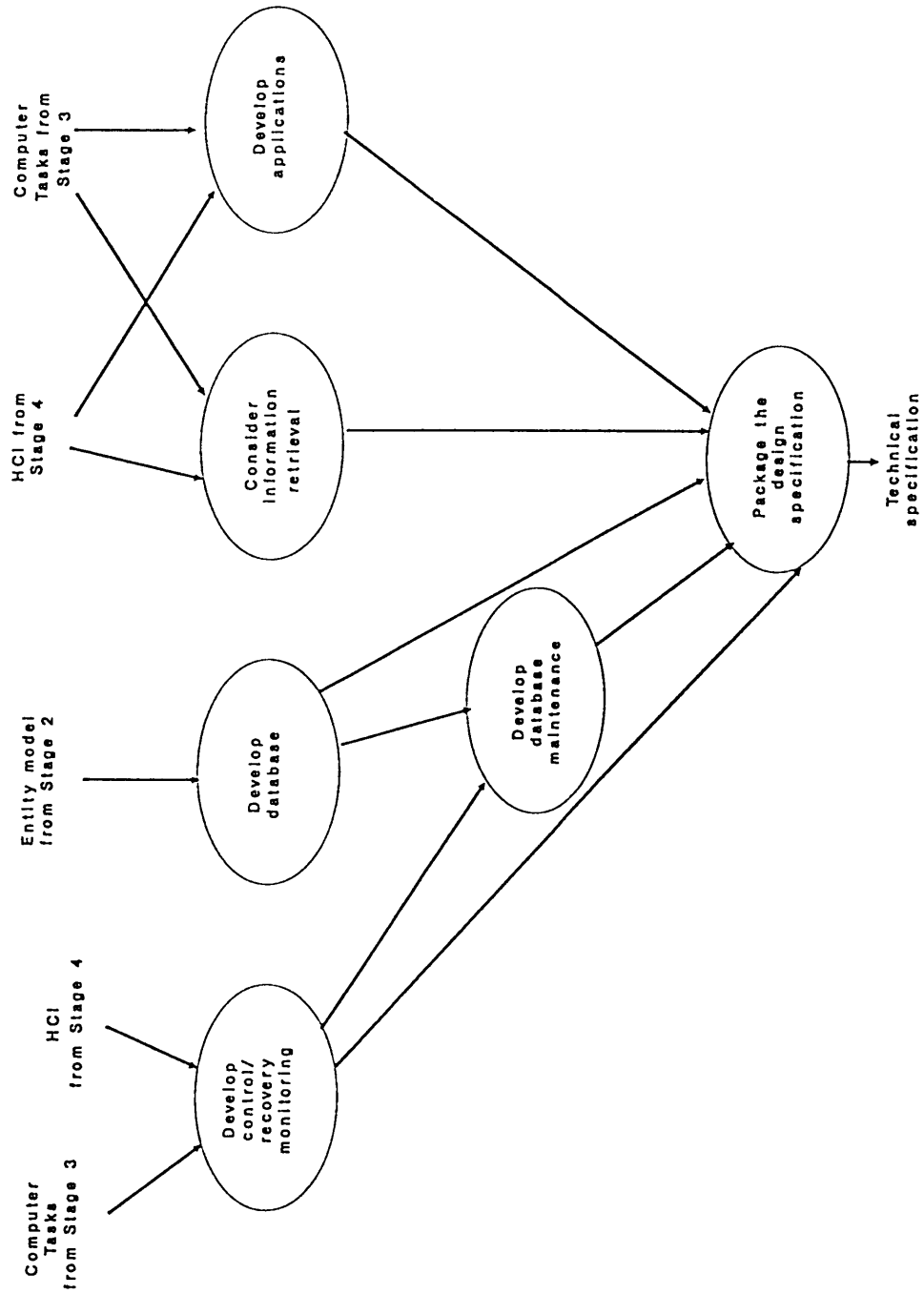


Figure 2.9 The overall process of technical design (Avison and Wood-Harper, 1990:200).

Chapter 3:
Review of Hospital
Information Systems
Already in Place

3.1 Hospital Information Systems

3.1.1 Historical Background

Collecting information about hospitals patient was advocated as long ago as 1732. A national scheme for processing vital statistics was introduced in the U K in 1838, but it was not until 1929 that the interest was awakened of the Local Health Authority. The introduction of the NHS in 1948 provided the opportunity for the introduction of a national scheme for collecting hospital morbidity statistics (Alderson, 1971). By the early 1950s punched cards and accounting machines were used by the NHS for financial applications. In the mid 1950s the use of these facilities was extended into other areas - hospital statistics, works department, catering and even into the clinical areas. In 1956, a Ministry of Health working party was set up to consider the use of automatic data processing as an extension to punch card systems. Jack Rowlandson was the first to write a computer program for health service applications in 1958 - for nursing staff payroll. In 1960/61 the Rowlandson experiment was agreed by the London Teaching Hospital Association and some five hospitals (out of 14). The result was a technical success but an organisational failure with regard to costs and controls. By 1966 a comprehensive finance system was in operation together with a comprehensive patient statistics system. Ten out of fifteen English regions had a computer by 1969. An experimental programme for small computers also began in 1968/69. In 1967 the concept of the Patient Administration System (PAS) had formulated as the primary system leading to a fully integrated hospital information system. A standard programme to be used by all NHS installations was drawn up in 1971, but it was not until 1978/79 that it was accepted. Facilities were upgraded and options improved by the late 1970s. A combination of available systems were chosen by the regional computer services. The real explosion of computer usage began in the 1980s with cheaper computers and more flexible programs (Tallberg, 1992). Today, with powerful micros and following the Korner reports (Taylor et al, 1988; Roger, 1987), many technical and professional staff have been tempted to write their own programmes (Abbott, 1988). Yet, much more than £500-600m was spent on NHS computing between 1983 to 1988 (Fairey, 1988).

3.1.2 The Coding System

The crude outcome measures have been introduced by Florence Nightingale in the 1860s. She introduced a classification of relieved/unrelieved/died. These classification were used in a number of teaching hospitals until 1960s. A renewed interest in this area has occurred due to the increasing availability of computers and the White Paper (which aims to encourage providers to deliver high-quality cost-effective healthcare to patients) (Todd 1990).

There are three types of outcome measures:

- 1) Health profiles, checklists cover a wide range of health items and are mainly suitable for research purposes;
- 2) Diagnosis-specified measures progress for that condition. The disadvantages of such a measure is the inability to compare different conditions, and the misleading measures when patients suffer from multiple problems;
- 3) Global measures of outcome such as Rosser and Watts', which present health status as two major dimensions, disability and distress, relating to external and internal consequences of illness respectively (Benson 1990).

The coding system, such as International Code for Diagnosis (ICD9) (BJHC 1987) and Office of Population Censuses and Survey (OPCS4), implies a systematic collection of symbols to represent item both brevity and to facilitate function and not the primary feature. Somed, is another coding system for medical use. It has a diminishing reputation in the USA, and a limited use in the UK (Weeks 1989).

A User friendly Classification is one which uses English text terms. This classification is the only sensible way to get doctors to record such information. The Read Codes (or Read Clinical Classification) is claimed to facilitate this feature, and accordingly, they became the standard in the primary care (Redford & Wallace 1990). The Read Codes are coded nomenclature of medical terms designed by Dr James Read. They enable a complete medical record to be coded and stored in a computer system. They exist as a medical dictionary in a computer file and are designed to be regularly improved and

updated as clinicians request new terms. The dictionary comprises the main or preferred medical terms and synonyms which are linked to preferred terms. The Read codes can be converted into the codes of other standard systems such as ICD-9, ICD-9-CM & OPCS-4. The codes can be used to support the management of patient care and semi-automatically generate discharge letters etc, as well as for clinical audit and resource management. They contain many more terms and synonyms than other coding systems. The codes are structured into a five-level hierarchy, with up to 58 separate codes (represented by alphanumeric characters) at each level. These codes are being used by 10,000 GPs in routine consultations. They are comprehensive and detailed for diagnosis, procedures and medication. They include all the terms currently contained in ICD-9 and OPCS-4.2 and more. The Read Codes cover: Diseases, Occupations, History/Symptoms, Examinations/Signs, Diagnostic Procedures, Radiology/Diagnostic Imaging, Preventive Procedures, Operative Procedures, Other therapeutic Procedures, Administration and Drugs/Appliances (CAMSL 1991a). They are available in two distinct formats, the later having additional fields to the earlier (CAMSL 1991b).

3.1.3 Hospital Software Packages

NHS ME 1991a and 1991b provide a list of computer software packages used in the NHS. It contains information about applications already in use or being developed in the NHS, and caters for the Admission, Transfer and Discharge activities. The list is divided according to the British regions, and the software are categorised into three categories:

- . custom software - written by or for the NHS;
- . commercial software aimed at healthcare applications but not yet in use in the NHS;
- . general commercial software in use by one or more NHS sites.

This list is provided in the following sections.

3.1.3.1 Northern Region

1. System Name: ACT Stemm Accident and Emergency (Commercial)

ACT Stemm Accident and Emergency system provides departmental clerical support with rapid information capture and recall facilities easing the running of the busy A & E department. Single and multiple incidents are quickly registered in the system, A & E cards and labels are produced for each patient. As patients move around the department or are sent for investigations the system tracks them. All clinical information input into the system is accessible to any authorised personnel immediately. At discharge GP letters are produced. Workload analysis reports allow management to optimise staffing levels and provide improved patient care. The system is very easy to use, being menu-driven with extensive 'help' facilities, full use of function keys and locally defined code files. The system links to Stemm Radiology system and its own Risk Register Management system and can also be linked to the IRC PAS. ICL DRS 300 series microcomputer with Unix or Unix compatible operating system is used to run the system. The system is developed using COBOL and Stemm Generator Languages. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to three NHS computers.

2. System Name: Clips-Clncl In-patient Mngmnt System (Commercial)

A clinical database designed by clinicians around the Korner minimum dataset. The package is useable for maintaining waiting lists, generating routine admission and discharge letters, handling medical and surgical morbidity audit and in-depth research information. Currently being explored is the on-board ICD-9 coding (may use the Read classification) which will have cost implications for other end users. This will link with PAS initially by print-out but possibly by district network. There are facilities

for entering associated information from ward nurse management, theatre and physiotherapy. This will generate letters and management statistics. The database is developed using DataPerfect, the relational database software from WordPerfect Corporation. Files are compatible using these two products which improves ease of use for secretarial staff. The system operational and undergoing clinical trials on medical audit and inpatients. APRICOT/IBM compatible with MSDOS IBM compatible operating system is used to run the system. The system is transferable, fully documented, operational and already transferred to two NHS computers. Development of the system is ongoing.

3. System Name : LETTS (Commercial)

Using the LETTS program, databases of information are built up in the process of producing a clinical letter to send to general practitioners. Data from audio tapes are entered by medical secretaries to produce clinical letters. Data is stored on diagnosis, coded to ICD9.CM, procedures, coded to OPCS4, medications, clinical and referral dates, adverse reactions etc. This data is available for analysis by preprogrammed routines or ad-hoc search systems.

LETTS was developed using CLIPPER language, and runs on any IBM compatible microcomputer with a minimum of 512k RAM and a 20Mbyte hard disk. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to twenty NHS computers.

4. System Name : CODDIS (Commercial)

Information required to produce a discharge summary is entered into the database and can then be printed. Diagnosis are coded to ICD9.CM by the program and procedures to OPCS4. The data is entered by medical secretaries from audio tapes dictated by

medical staff.

The data required to produce the discharge summary is held in databases which are available for analysis by inbuilt procedures or by the ad-hoc search system. Data is stored on admission and discharge details, drugs, diagnosis, procedures.

CODDIS was developed using CLIPPER language and will run on IBM compatible microcomputers with a minimum of 512k RAM and a 20Mbyte hard disk. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to twenty NHS computers.

3.1.3.2 Yorkshire Region

1. System Name : Bradford System (Commercial)

Database system for psychiatric unit (enhanced patient register) covering patient administration and community based units (mental health centres). It includes in-patient, out-patient, day-patient administrative and clinical information. It incorporates: Mental Health Act 1983, Management, Patient Alert, Health Service Indicators, Transcultural Register, Contact File, Diagnosis File, Episode File, Query Database and Ad Hoc Reports. Developments proposed are depot Management and Mental Health Act - Enhancements.

The system was developed using DATAFLEX language, and runs on ICL DRS 300 series microcomputer with CCP/M-CDOS concurrent operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to one NHS computer.

2. System Name : Sonicaid Axis (Commercial)

The Sonicaid Axis is a complete labour and delivery management system providing the users with central review of cardiotocograph (CTG) and all relevant patient notes, labour information and administration details, statistics and archiving. The work-station provides access to all the Axis applications which are modular and can be added as requested. It can accept data from up to 36 monitors. Hospitals requiring more than one work-station can link them together via a local area network (LAN). An important feature of the system is the open architecture allowing interfacing to patient administration systems (PAS) and resource management systems. Statistics such as the Korner data set are collected by the labour information and administration module (LABDEL). The system was developed using Windows 3, and can be run on various microcomputers using MSDOS IBM compatible operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to three NHS computers.

3. System Name : The ACT Stemm Maternity System (Commercial)

ACT Stemm Maternity system is a complete comprehensive system for administration and clinical use in a maternity unit. It includes: a full clinical appointments system; ante-natal history record including investigations and complications; delivery and birth events; discharge reports and interface to child health, follow-up actions and ICD coding details. The system produces a large amount of the statutory documentation, required in a maternity unit, thus leading to a reduction of clerical effort required to administer the unit. All patient medical information is easily accessible to authorised personnel to aid clinical decision making. The system is very easy to use being fully menu-driven with extensive online 'help' facilities. It is linked to the ACT Stemm Colposcopy Clinical and Stemm Radiology systems. The system was developed using COBOL and Stemm generator languages, and runs on ICL DRS 300 series using UNIX or UNIX compatible operating systems. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the

owner, operational and already transferred to one NHS computer.

4. System Name : Psychiatric Case Register (Own)

This system keeps a case register of all psychiatric patients, episodes of care, key workers and is able to track at-risk cases. The system was developed using OMNIS 3 language, and runs on an Apple Macintosh microcomputer using APPLE-DOS operating system. The system is transferable and operational.

3.1.3.3 Trent Region

1. System Name : Waiting List (Own)

The waiting list is a sub-module of the Trent PAS. Other modules, already operational, are Patient Master Index (PMI), Outpatient Management and Inpatient (bedstate). The system offers the full range of waiting list management functions, including letters to patients and GPs, review and selection procedures, links with other hospital waiting lists and cross reference with main PAS. The system will be capable of operating in a stand-alone mode on a micro or mini, or as part of a much larger whole hospitals PAS. The system is Korner compatible.

The waiting list system was developed using MUMPS language, and runs on DEC PDP-11 minicomputer using MUMPS DSM-11 operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to twenty four NHS computers.

2. System Name : Hawley Neonatal System (Own)

The Neonatal Records System is used to keep detailed clinical records of all babies admitted to the special care baby unit at Barnsley DGH. These records contribute to the development of a comprehensive neonatal database which is used for research and neonatal audit. The system fulfills three major functions: 1) Research - comprehensive enquiry facilities; 2) Clinical - ready access to clinical details of all patients in special or intensive care plus facilities for charting of clinical observations and laboratory results at the cotside; 3) Administrative - production of discharge summaries and ward round reports, patient enquiry facilities, monthly and annual reports on SCBU activity. Hawley Neonatal System was developed using MUMPS language, and runs on SWTP S-09 microcomputer using MUMPS other operating system. The system is transferable, fully documented, and operational.

3. System Name : Accident & Emergency Module (Own)

The Trent Accident & Emergency System has been designed to operate as an independent system within the A & E department, or as an integrated module with the standard Trent Patient Administration System. The system is widely parameterised to facilitate different working practices in A & E department. It provides the complete administrative functions required for A & E attendace and collects a considerable amount of patient/clinical data for future detailed analysis. When used as part of the main PAS it can admit patients directly to a ward via the Regional Standard Inpatient System. The system was developed using MUMPS language, and runs on DEC PDP-11 minicomputer using MUMPS DSM-11 operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to seventeen NHS computers.

3.1.3.4 North West Thames Region

1. System Name: Micromed Medical & Surgical Audit S (Commercial)

Clinical Information systems provide consultant surgeons with a fast, accurate and comprehensive means of recording and recalling hospital patients clinical and demographic information. Micromed records diagnosis and treatments provide:

- . Instant access to accurate clinical and personal information on every patient at all times.
- . Automatic generation of booking and waiting lists and GP discharge letters.
- . Patient follow-up and recall details.
- . Audit of out-patient clinic details and time saving production of all clinic letters.
- . Accurate clinical information for medical audit, resource planning.
- . Korner statistics, ICD and OPCS codes.
- . Waiting list management, clinical management.
- . Case Mix and activity analysis.
- . Quality assurance - outcome information.

The system was developed using Compiled BASIC language, and runs on any IBM compatible microcomputer using CCP/MM-DOS Concurrent operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to two hundred and fifty NHS computers.

2. System Name: St Mary's Maternity Information Sys (Commercial)

The St Mary's Maternity Information system was designed through collaboration between the North West Thames RHA and St Mary's Hospital to provide the information required for clinical audit and to relieve the midwife of the need to fill in the forms and letters required for effective communication in pregnancy, by producing them automatically. Information is collated from all relevant sources, from the booking

visit until the 28th day after delivery when the record is closed. All data input is validated at the end of each screen with references to normal ranges and previously entered data, and inconsistent entries are queried. The system produces a daily labour report, a record of all deliveries during the preceeding 24 hours, monthly and annual statistical reports, and an annual hospital report. An ad hoc enquiry system allows information relating to any data item to be retrieved. All information to fulfil Korner is transferred to the district information system and onto the regional information system. Links to the child health system and PAS are being developed. A neo-natal & anaesthetics module are also under development. The system was developed using COBOL language, and runs on ICL DRS 300 series microcomputer using CCP/M-CDOS operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to thirty three NHS computers.

3. System Name : Psymon (Own)

Psymon is a mental health unit computer system that collects patient demographic and clinical data. It can link to most other computer systems available. Data transfer is quick and easy. The system has extensive reporting facilities that enable the user to analyse large amounts of information quickly and efficiently. The system was developed using C tree and Smartware languages, and runs on IBM PC-AT microcomputer using PCDOS operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to sixty NHS computers.

3.1.3.5 North East Thames Region

1. System Name : Bedstate (Own)

Bedstate system provides the following:

- . Enables entry of admission, transfer, discharge details from details made available via a bed return form by nurses.
- . Collects details of lodgers.
- . Collects delivery and baby episode details.
- . Provides a printed bed return.
- . Provides an on-line enquiry system.
- . Produces lists of patients who have been discharged or have died.
- . Facilitates administration of patient notes after discharge and monitoring GP letters and discharge summaries.
- . Provides history episodal information for master index and diagnosis coding systems.
- . All details entered fulfill Korner requirements.

Bedstate was developed using MUMPS DSM-11 language, and runs on DEC VAX minicomputer using MPS DSM-11 operating system. The system is fully transferable, fully documented, supported when transferred to another site and operational.

2. System Name : Diagnostic Coding (Inpatients) (Own)

Input of inpatient history including admission, transfer and discharge details required by Korner. This enables the coding of admission and diagnostic details and entry of Korner obstetric minimum data set. It has facilities to monitor progress of coding task and print lists of outstanding uncoded episodes, and controls transfer of data to N E T RHA. it can be installed without bedstate system but must have Master Index System. Diagnostic Coding (Inpatients) was developed using MUMPS DSM-11 language, and runs on DEC VAX minicomputer using MPS DSM-11 operating system. The system is fully transferable, fully documented, supported when transferred to another site and operational.

3.1.3.6 South East Thames Region

1. System Name : Euroking (Commercial)

System for maternity services covering Ante-Natal bookings, Clinic visits, Labour and discharge wards and Post-Natal follow-up. Main data input is by light pen using Bar-coded questionnaires. Hand-held devices are used for domicilliary visits by community midwives. The system can be run on a variety of mainframes and minicomputers including PDP, VAX, UNIX, also Apricot, PC386 and IBM compatible microcomputers. Links to ICL PAS & pathology are available. Links are being developed to Child Health and Community systems (eg Comcare). It produces birth notifications and all standard documentation, including Korner. The system was developed using MUMPS and 4GL (for users own development) languages. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to three NHS computers.

3.1.3.7 Oxford Region

1. System Name : Panacea (Commercial)

A microcomputer-based system for surgical patient management and research. It encompasses waiting list management, admission and discharge correspondence/summaries and inpatient stay tables for pre-existing medical problems, post operative complications, modes of admission, injury & discharge etc. The ICD9 and OPCS4 international codes are supported, and conversion to Read Codes is projected. Full surgical audit and Korner statistics are produced, whilst individual data interrogation may be used for research purposes. Despite its power and sophistication, it remains easy to use, flexible and adaptable. Its hierarchical structure, drop-down menus, etc. mean that overall the secretarial workload should be significantly increased. Word processing facilities, links to PAS and networking will be available in addition to other modules including outpatients, theatre-usage and correspondence. A special

version of Panacea is available for orthopaedic units, incorporating The Windsor Orthopaedic Coding System, if required. The system was developed using CLIPPER language, and runs on any IBM PC-AT microcomputer using MSDOS/IBM compatible operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to three NHS computers.

3.1.3.8 South Western Region

1. System Name : Patient Discharge (Commercial)

Patient Discharge is a simple to use system for generating consultants' notes to General Practitioners. The relevant data fields for any patient are extracted from the Mumps PAS and placed in the correct position in the 'Word Manager' word processor. These may be name, address, admission date, GP etc; The operator then completes the consultant's notes for that patient and the form may be run off complete for signature. The note may be held in the Ward Managers library or deleted. Patient Discharge was developed using ANSI STANDARD and MUMPS languages, and runs on various minicomputers using MPS DSM-11 operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to one NHS computer.

3.1.3.9 West Midlands Region

1. System Name : .C-Care (Commercial)

.C-Care is used for patient registration and location, nursing notes, ward-based administration, care planning and assessment of workload calculation. It was developed using Sea Change and C languages, and runs on any UNIX based system using UNIX/UNIX compatibles operating system. The system is fully transferable, fully

documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to two NHS computers.

2. System Name : Clinical Care (Commercial)

The system handles the management of patient clinical episodes from referral to discharge, and provides the following:

- . Integral patient demographic database.
- . inpatient and outpatient episodes with clinical diaries, admission and theatre schedules.
- . Records full details of each episode including treatments and diagnosis notes, as well as operation notes.
- . Integral word processing to allow for automatic generation of appointment letters which are to user specified formats.
- . Extensive reporting and enquiry facilities.
- . Handles multiple patient episodes and tracks including all the events within the episodes - appointments, treatment dates and so on.
- . Linkage to waiting list management system.

Clinical Care was developed using DATABASIC language, and runs on IBM RS6000 minicomputer using PICK operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to one NHS computer.

3.1.3.10 North Western Region

1. System Name : Lithotripsy (Commercial)

The system handles management of patients from referral to discharge. It has an integral patient demographic database. Patients may be treated directly from referral

or placed onto a waiting list. It has also an integral word processing facility which allows for the automatic generation of appointment letters, the format of which are user defined. The system allows for the formation of treatment plans, including the size and position of stone(s) and the number of recommended shocks (lithotripsy). Patients can be set for automatic recall if treatment is not completed. The system provides extensive reporting and enquiry facilities. Lithotripsy was developed using DATABASIC language, and runs on IBM RS6000 minicomputer using PICK operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational and already transferred to two NHS computers.

2. System Name : Pride - Patient Reporting (Own)

The system provides users with on-line access and interrogation facilities to a relational database containing Korner episode and aggregated information. The system is accessed from a remote IBM PC, or compatible, which provides users with the capability of printing reports locally and the ability for downloading information for inclusion in PC based software, eg. Lotus 123. The system has been developed to meet the growing information needs of users. The system has been designed to provide maximum flexibility in the way data can be extracted and reported by placing the emphasis on training and supporting users in the use of the INGRES tool set. Pride - Patient Reporting was developed using INGRES language, and runs on any UNIX based system using UNIX operating system. The system is fully transferable, application maintained by the owner and operational.

3.1.3.11 Wales Region

1. System Name : In-patient Administration (PAS 2) (Own)

The DRS based in-patient system is a stand alone system providing the following:

- . Waiting list management.
- . Patient administration for TCI admissions.
- . Transfers, discharges and deaths.
- . Bed state information in the SH3 format welsh version of HAA data for input to regional HAA.
- . Nursing dependency system.
- . Listings available include: bed state occupancy by ward, admissions, discharges, transfers, deaths, enquiry file, scheduled admissions for specified period, admissions expected today, ID labels on demand, waiting list in urgency order, nursing dependency information and SH3 analysis.

The In-patient Administration (PAS 2) was developed using CIS COBOL and BTL languages, and runs on ICL DRS 20/50 using DRX operating system. The system is fully transferable, fully documented, and operational, and already transferred to 3 NHS computers.

2. System Name : MHA Medical Records (Own)

The system maintains administrative records of patients in mental hospitals including admissions and discharges, sectioning under MHA, leave, and special treatments. It also produces monthly statistics for the Welsh Office and some correspondence.

MHA Medical Records was developed using DBASEIII+ and CLIPPER languages, and runs on APRICOT/IBM compatible using MSDOS/IBM compatible operating system. The system is transferable, fully documented and operational.

3. System Name : Urology Inpatient Register (Own)

The system inputs are:

- . administrative details and diagnosis operations for all inpatients in urology unit.

The systems outputs are:

- . individual patient records for all admissions,
- . selection of patients and any criterion entered,
- . analysis of all admissions by consultant, year of admissions by consultant, year of admission, diagnosis and operation etc., and discharge summaries.

Urology Inpatient Register was developed using DBASEIII language, and runs on IBM PC using PCDOS operating system. The system is transferable and operational.

4. System Name : Micropas (Own)

This is a Medical Records system for clinical secretaries. It Maintains a register of out-patients, waiting lists and in-patients. It produces correspondence to patients and bed-state and waiting list statistics.

Micropas was developed using DBASEIII+ language, and runs on APRICOT/IBM compatible using MSDOS/IBM compatible operating system. The system is fully transferable, fully documented and operational.

5. System Name : Discharge Summaries rel 3.X (Commercial)

This system prepares a patient related summary from an integrated H.S.I. including diagnostic coding, lab results, medication history, observed events and recommended nursing care. It is based on installed systems user selection of output. The system also feeds therapeutic and audit needs. Discharge Summaries rel 3.X was developed using SQL WINDOWS language, and runs on various minicomputers using DOS operating system. The system is fully transferable, fully documented, application maintained by the owner, operational, and already transferred to one NHS computer.

3.1.3.12 Scotland Region

1. System Name : Lothian Psychiatric Case Register (Own)

This is an on-line TP system which holds the details of each visit, to a number of psychiatric hospitals in the Lothian area, by a patient. Data is entered by VDU operators for each admission, discharge, ward transfer, review, outpatient contact, day-patient contact and follow-up. The data is held on a master file which produces an analysis file. This file produces statistics and is used for research purposes when ad-hoc requests are made. The master file also produces SMR4 figures on a monthly basis and annual tables. Ad-hoc requests use SPSSX to produce tables and lists from the analysis file. A small SPSSX program is written for each ad-hoc request that is processed. Lothian Pscychiatric Case Register was developed using COBOL and SPSS languages, and runs on ICL 2900 series mainframe computer using VME operating system. The system is fully transferable, supported when transferred to another site, and operational.

2. System Name : Inpatient Management (Commercial)

The Inpatient Management system is designed to collect and record patient demographic details including all data about the movement of patients during their stay in hospital. The system runs on various minicomputers using PICK operating system. The system is fully transferable, fully documented, supported when transferred to another site, application maintained by the owner, operational, and already transferred to twenty NHS computers.

3. System Name : SMR4 Recording (Own)

This system allows local recording of the SMR4 on admission and then on discharge. The hospital population and previous discharges is available for various reports and ad-

hoc enquiries. Extensive statistical reports have recently been added to this system. SMR4 Recording was developed using DATA BASIC language, and runs on Reality (CMC) minicomputers using PICK operating system. The system is transferable, fully documented and operational.

4. System Name : Hospital Episode Summary (Commercial)

Using magnetic tape, the system can generate a preselected report of hospital episode, to meet statutory requirements and the requirements of purchaser authorities. Hospital Episode Summary runs on various minicomputers using PICK operating system. The system is fully transferable, fully documented, application maintained by the owner, supported when transferred to another site, operational, and already transferred to two NHS computers.

5. System Name : Patient Master Index rel 3.0 (Commercial)

This system holds a complete record of all patients registered referenced by several numbers and by names in the central reference database. It may be accessed by appropriate authorised users and linked to other hospital modules. there are any different methods of patient search, by 'SOUNDX', surname, age etc. It has open interface for third party use in evolving integration. The system may be extended to eg medical record tracking, ATD, O/P & A&E. Patient Master Index rel 3.0 runs on various minicomputers using PICK operating system. The system is fully transferable, fully documented, application maintained by the owner, supported when transferred to another site, operational, and already transferred to twenty NHS computers.

6. System Name : Maternity Management System (Own)

This is a system for antenatal care - recording medical/social history. It can hold obstetric history, admission/discharge details, labour and delivery details and data pertaining to monitoring tests performed at Day Assessment Unit for each patient. It can also provides automatic production of SMR2 records (at pre-diagnostic coding stage). A labour delivery module is currently being enhanced to automatically produce postnatal cards and the notification of birth form. Maternity Management System was developed using DATABASIC and ENGLISH languages, and runs on Mentor minicomputer using PICK operating system. The system is transferable and operational.

Although some writers viewed the importance of the 4th Generation Languages (4GL), in particular Structured Query Language (SQL), to develop applications to use in the hospitals (see for example Moore 1990), it can be noticed that some of the applications listed above were developed using the 3rd generation languages such as COBOL. However, none of the above applications has been developed using Oracle software, despite its great flexibility in information management and its ease of use (Myers 1990).

The above applications in general cater for some of the ATD functions I intend to cover in my proposed information system, but none of them caters for all the functions.

Chapter 4: Application Analysis

4.1. Stage 1: Analysis of Human Activity System.

4.1.1 Drawing the Boundaries of the system.

The proposed information system is to operate at the hospitals in the Ministry of Health which is headed by the Minister of Health. He is a member of the Cabinet Ministers headed by the Prime Minister. The Minister of Health is assisted by the Undersecretary and four Assistant Undersecretaries. The Assistant Undersecretaries are administratively responsible for hospitals, management and finance, medical services and primary and public health. The Ministry of Health functions in coordination with agencies like the Ministry of Finance and National Economy, Civil Service Bureau etc.

Primary Health Care is provided by the Health Centres. There are 18 Health centres. Each health centre is staffed by the family physicians to provide health care to all the members of the family.

The Secondary Health Care is provided by the Salmaniya Medical Centre (SMC), four Maternity Hospitals, Psychiatric Hospital and Geriatric Hospital. The total number of beds available in these hospitals is about 1300.

The environment and the occupational health care needs of Bahrain is the responsibility of the Public Health Directorate which include general sanitation, water sanitation, insect and rodent control, food hygiene, communicable disease control, health education, occupational health etc.

The total number of personnel employed by the Ministry of Health is about 5000 of which there are about 450 physicians and about 1000 nurses in the various hospitals and the health centres.

The Health Care System consists of the following activities:

- . Admission, Transfer and Discharge.

- . Medical Record.
- . Order Communication.
- . Laboratory.
- . Radiology.
- . Blood Bank and Donor.
- . Pharmacy and Drug Information.
- . Non-operative and Special Procedure.
- . Nursing Service.
- . Appointments and Resource Scheduling.
- . Catering and Dietetics.
- . Patient Billing.
- . Patient Progress Recording.

The Support Systems are as follows:

- . Personnel Information Management.
- . Materials Management.
- . Engineering Management Information.
- . Financial Management.
- . Training Information.
- . Public Health Information.
- . Linen and laundry Supply.
- . Security and safety.
- . Housing.
- . Licensing and registration.
- . Medical Commission.

The proposed information system is to operate for patient's Admission, Transfer and Discharge (ATD) activities such as management of patient registration, admissions, bed control, discharge, and outpatient encounters at the various hospitals of the Ministry of Health.

SMC is the main hospital in Bahrain, where the majority of the ATD activities are performed. The proposed system is intended to operate in this hospital as a basis toward future integration of patient care system. The Departments/Sections which are involved in the ATD activities are as follows:

- . Admission Bureau.
- . Filing.
- . Data Quality.
- . Ward (Inpatient Nursing Station).
- . Outpatient (OP) Appointment Desk.
- . O P Clinics.
- . Day Case Unit.
- . Staff Clinic.
- . Ambulance.
- . Accident and Emergency (A&E) - Registration Counter.

(c.f. Appendix : Study of User Requirements, for details of the functions of the above Department/Section).

The users of the ATD system are the following:

- . Admission Bureau.
- . Reception Offices at the various clinics.
- . Medical Records Units.
- . Nursing Stations.
- . Doctors.
- . Administration.
- . Clerks at the various Department/Section.

The objectives of the proposed system are:

- . To deliver an improved patient service by reducing the amount of paperwork.
- . To reduce the interdepartmental communications time.
- . To remove duplication of data storage.
- . To create a unified system for clinical information about individual patients.
- . To assure ready availability of reliable information.

- . To provide a fast data retrieval.
- . To provide immediate access to patient data.
- . To provide the management with information required.
- . To understand the population's health condition and opportunities for improvement.
- . To contain public expenditure within acceptable limits.
- . To function in a multi hospital environment where several hospitals and health centres can be run as individual units with the possibility of data exchange and data sharing.
- . To provide a high security for data and a high controlled access.
- . To provide opportunities for future integration of patient care system.
- . To provide an easy to use system.
- . To improve the patients services by substituting the manual paperwork system.
- . To provide a faster way to produce reports and to answer queries.

4.1.2 The Rich Picture of the Problem Situation.

The first technique used in the Multiview for analysing human activity system is to draw the **rich picture**. It is an invaluable tool for helping to explain what the organisation is about. Figure 4.1 shows a pictorial representation of the problem situation. The elements of the picture include the clients of the system, people taking part in it, the task being performed, the environment, and the owner of the system. The main purpose of the picture is to capture a holistic summary of the situation which will be helpful to extract problem themes, that is, things noticed in the picture that are, or may be, causing problems and/or it is felt worth looking at in more detail. The picture represents the important **hard** facts of the organisation situation and the **soft** or subjective facts. These soft facts include the sort of things that people in the problem are worried about, the social roles which the people within the situation think are important, and the sort of behaviour which is expected of people in these roles.

4.1.3 Constructing The Root Definition.

The rich picture helps to understand the nature of the human activity system that the IS is to solve, it also helps to extract relevant systems, or in other words, make a decision of which systems are to be examined further. Critical aspects of the organisation and its objectives need to be defined in order to prevent any possibility of misunderstandings. These definitions also serve as touchstones against which to test new ideas.

Multiview uses the technique of the **root definition** (Checkland and Scholes 1990) in which IS should grow. The root definition is used to look at the most significant groupings of people, objects and activities and consider how they relate to achieve the outputs.

Root definitions can be used to define two things. These are **problems** and **systems**. The root definition is checked for the presence of six characteristics. These are **who** is doing **what** for **whom**, and to whom are they **answerable**, what **assumptions** are being made, and in what environment is this happening?

There are technical terms for each of the six parts, the first letter of each forming the mnemonic **CATWOE**. The explanation of this mnemonic is:

- . **C**ustomer is the 'whom'
- . **A**ctor is the 'who'
- . **T**ransformation is the 'what'
- . **W**eltanschauung is the 'assumptions'
- . **O**wner is the 'answerable'
- . **E**nvironment (or environmental constraints).

The word Weltanschauung is German has no real English equivalent. It means something like 'world view' or 'all the things that you take for granted'.

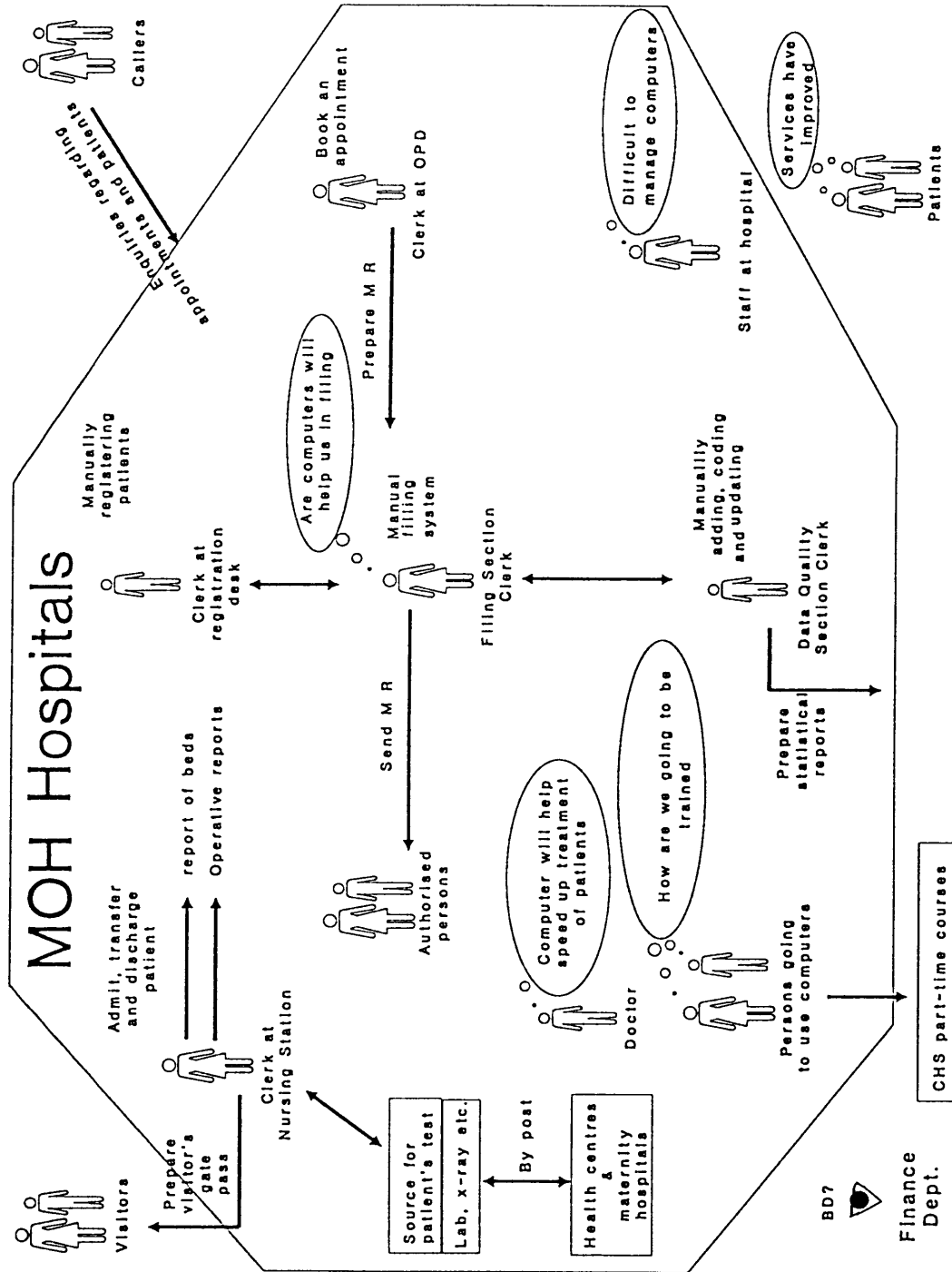


Figure 4.1 The rich picture of the problem situation

In the root definitions of the proposed system, eight systems were identified. These are ATD, Patient Information, Appointment, Administration, Medical Record, File Maintenance, Treatment, and Report and Enquiry. The root definitions of the proposed system are as follows:

1.

CUSTOMERS: All SMC Departments/sections and Health Centres.

ACTORS: A T D System.

TRANSFORMATION: Perform the tasks related to the admission, transfer and discharge of patients.

WELTANSCHAUUNG: Computer system is efficient since it may contribute in performing most of the tasks.

OWNERS: SMC Administration.

ENVIRONMENT: SMC.

2.

CUSTOMERS: Admission Bureau, Data Quality, Ward, Medical Records OPD, Day Case Unit, A&E, Staff Clinic, doctors and nurses.

ACTORS: Patient Information System.

TRANSFORMATION: Patients' A T D information.

WELTANSCHAUUNG: Computer system is efficient since speed of entering, retrieving and updating information required.

OWNERS: SMC Administration.

ENVIRONMENT: SMC.

3.

CUSTOMERS: Doctors, patients, OPD, LPP and Health Centres.

ACTORS: Appointment System.

TRANSFORMATION: Booking the different appointments required in SMC and Maternity Hospitals.

WELTANSCHAUUNG: Computer system may be efficient if appointments bookings are provided to all appointments stations.

OWNERS: LPP, OPD and doctors.

ENVIRONMENT: SMC.

4.

CUSTOMERS: Patients and visitors.

ACTORS: Administration System.

TRANSFORMATION: Performing the different payment tasks, issuing leave certificate and visitor's gate passes.

WELTANSCHAUUNG: These will be performed as quickly as possible with accuracy.

OWNERS: SMC Administration.

ENVIRONMENT: SMC.

5.

CUSTOMERS: Administration Bureau, Data Quality, Ward, OPD, LPP and A&E.

ACTORS: Medical Record System.

TRANSFORMATION: Issuing new MR and requesting old MR.

WELTANSCHAUUNG: Computer system is efficient since speed of entering, retrieving and storing information is required.

OWNERS: MR (SMC).

ENVIRONMENT: SMC.

6.

CUSTOMERS: Data Quality.

ACTORS: File Maintenance System.

TRANSFORMATION: Checking, updating, coding, adding and deleting information.

WELTANSCHAUUNG: Computer system is efficient since the above take time to perform manually.

OWNERS: Data Quality.

ENVIRONMENT: SMC.

and connected. This is called a **conceptual model** or an **activity model**. This technique is an abstract process used in the Multiview. It is constructed in terms of **what** must go into the system and it can therefore be set alongside the real world. The conceptual model serves three purposes:

- . It is an essential element in the architect's design activities.
- . It is a medium of communication between architect and client to enable the right design to be selected.
- . It is a set of instructions to the builder.

The conceptual model is formed from the root definitions as follows:

- . Form an impression of the system to carry out a physical or abstract transformation from the root definition.
- . Assemble a small number of verbs which describe the most fundamental activities in the defined system.
- . Use the idea of a 'formal system model' and decide what the system has to do, how it would accomplish the requirement and how it would be monitored and controlled.
- . Structure similar activities in group together.
- . Use arrows to join the activities which are logically connected to each other by information, energy, material or other dependency.
- . Verify the model against a formal model of Human Activity System.

Figures 4.2 to 4.9 represent the conceptual model of the proposed system.

4.2 Stage 2: Information Analysis.

The conceptual model in the previous stage of Multiview - analysis of human activity system takes us to the second stage of Multiview - information analysis, that is the detailed analysis of information flows.

The purpose of stage 2 is to analyse the entities and functions derived from the **notional system**, that is, the primary task root definition together with its model and its

associated universe of discourse. It also combines the concepts of data modelling and structured analysis with the practical orientation. The concepts utilised are the entity-function models for a database environment (Davenport 1978). The three main phases involved are:

- . Development of the function model.
- . Development of an entity or data model.
- . Interactions of functions and entities, and verification of the model.

4.2.1 The Function Chart.

The first step of the second stage is to create a **function chart** (or **function model**). The process of creating the function model is already started as we build the conceptual model. The conceptual model which is now taken one stage further by removing all the physical things and concentrating on the functions to be performed.

The purpose of the function chart is to detail in a hierarchical manner all the functions that have to be performed within the new IS (not just the functions that are to be computerised).

The function chart breaks the major information processing function into their components. It is formed by taking the major function of the system and putting its name in a box at the top of the paper. The next step is placing the secondary functions in boxes on the second line, and so on.

For the proposed information system the major information processing functions (see Figure 4.10) are:

- . Patient Information.
- . Appointment.
- . Administration.
- . Medical Record.
- . Report & Enquiry.
- . Treatment.

. File Maintenance.

The above major functions (correlate directly to the seven systems identified in the conceptual model) are broken down into their sub-functions (Figure 4.10 to 4.21). The letters in small boxes shows the connections to the diagrams in later pages.

In Figure 4.11 to 4.21 you note that the major functions such as Patient Information (figure 4.11) is broken down into its secondary functions. These are register Patient, Admit Patient, Perform Patient Admission Assignment, Transfer Patient and Discharge Patient. The secondary function Transfer Patient is also broken down into its secondary functions, which are: Transfer to Ward and Transfer to Unit. This process of dividing the functions is applied to all the major functions and most of the sub-functions.

4.2.2 Events and Data Flows.

The next step in information analysis is to identify the **events** (also called transactions), what triggers each of these actions and what information is involved. There are two types of events: internal and external. An internal event occurs inside the model and is a function of completing or starting. An external event occurs outside the domain of the model. These events can be depicted on the function hierarchies (through the use of arrows) and on data flow diagrams (DFD).

The DFDs give precedence to processes of functions and the use of the data. It is constructed to examine how information flows in and around the function hierarchies. It acts as a check on the previous diagrams. Entries missing from the functional chart can be checked using the DFD.

The DFDs have four basic constructions: data flow, process, data store and external entity.

The *data flow*: Data flow is represented by an arrow and depicts the facts that some data is flowing or moving from one process to another.

The *processes*: The processes or tasks performed on the data flows are represented by soft boxes (a box with rounded edges). The process transforms the data flow by either

changing the structure of the data or by generating new information from the data.

The *data store*: If a process cannot terminate a data flow because it must output something, then the data flow stops in a data store, which can be envisaged as a file, although it is not necessarily a computer file or even a manual record in a filing cabinet. A data store symbol is a pair of parallel lines with one end closed and a compartment for a reference code and a compartment for the name of the data store.

The *Source* or *sink* (External Entity): The second way of terminating a data flow in a system is by directing the flow to a sink which are usually entities that are external to the organisation.

Figure 4.22 represents a simplified DFD of the proposed system, Figures 4.23 to 4.35 represent high level DFDs of the proposed system, and Figures 4.36 to 4.43 represent lower levels DFDs of the proposed system.

4.2.3 Analysis of Entities

At this stage looking at the nature of the information prior to the implementation of an information system is very important. A separation of the logical model of information from its implementation considerations should be done.

4.2.3.1 Entities and Relationships.

An entity is something about which records are kept and is any object of interest to the organisation, any part of the system or any object about which data can be stored and collected (Veryard, 1984).

Data modelling is a diagrammatic technique, representing entities as 'soft box' in most conventions. A soft box is a rectangle with rounded corners. The name of the entity type is written in the box. The second step in data modelling is to identify the connections (or relationships) between entities. These connections give a structure to the data model. The degree of a relationship is based on the number of occurrences of

the entity types that can be related to one another. The possible degrees (Barker 1990a) are:

- . One-to-one - represented by a line without a crow's foot
- . One-to-many (or many-to-one) - represented by a line with a crow's foot at the 'many' end
- . Many-to-many - represented by a line with a crow's foot at both ends.

The lines can be drawn to represent three types of relations which are:

- . Solid line - to represent mandatory relations,
- . Dotted line - to represent optional relations, and
- . Part solid and part dotted - to represent mandatory and optional relations respectively.

Figure 4.44 represents the entity relationship for the whole system. The entities of the system are:

- . Patient.
- . Registration.
- . Admission.
- . Employer.
- . Informer.
- . Contact.
- . Admission Assignment.
- . Provisional Diagnosis.
- . Ward Transfer.
- . Unit Transfer.
- . Patient Condition.
- . Discharge.
- . Patient Stay.
- . Accommodation.
- . Change of Accommodation.
- . Patient Leave.
- . Last Leave.
- . Responsible Person.
- . Patient Alias.

- . Diagnosis.
- . Other Diagnosis.
- . Operation.
- . Other Operation.
- . Special Treatment.
- . Non-Operative Procedure.
- . Payment Slip.
- . Maternity Booking.
- . Admission Booking.
- . LPP/OP Booking.
- . Issue MR.
- . Issue MR Against Appointment.
- . Receive MR of Individual Patient.
- . Receive MR of Discharge Patient.
- . Change MRN/CPRN.
- . Delivery Registration
- . Birth Registration.
- . Visitor's Gate Pass.

4.2.3.2 Verifying the Entity Model.

A way of verifying the entity model is by using the normalisation technique (Howe 1989) which is used by a number of methodologies. The process has three steps: *first normal form*, *second normal form* and *third normal form*. This process involves inserting, deleting and updating entity occurrences.

For the proposed system the entities after normalisation are listed above. The attributes of these entities are as follows:

1. Entity name : PATIENT.

Attributes:

1. CPRN

2. MRN

* 3. first name

* 4. middle1 name

* 5. middle2 name

* 6. last name

* 7. sex code

* 8. age

* 9. marital status code

o 10. spouse's name

o 11. father's name

o 12. mother's name

* 13. flat no

* 14. building no

* 15. street type

* 16. street no

* 17. area

* 18. telephone no

* 19. nationality code

* 20. occupation code

* 21. religion code

* 22. language code

* 23. health centre code

o 24. health centre file no.

2. Entity name : REGISTRATION.

Attributes:

1. date

* 2. patient's CPRN

* 3. patient's MRN

- * 4. source of referral code

- * 5. clerk's CPRN.

3. Entity name : ADMISSION

Attributes:

- ** 1. date

- ** 2. time

- * 3. patient's * 4. patient's MRN

- * 5. source of referral code

- o 6. no of previous

- o 7. last date

- * 8. episode no

- * 9. hospital code

- o 10. hospital name

- * 11. clerk's CPRN.

4. Entity name : EMPLOYER

Attributes:

- ** 1. name

- o 2. phone

- * 3. patient's CPRN.

5. Entity name : INFORMER.

Attributes:

- ** 1. name

- * 2. relation

- * 3. flat no

- * 4. building no

- * 5. street type

- * 6. street no

- * 7. area

- o 8. phone
- * 9. patient's CPRN.

6. Entity name : CONTACT.

Attributes:

- ** 1. name
- * 2. flat no
- * 3. building no
- * 4. street type
- * 5. street no
- * 6. area code
- o 7. phone no
- * 8. patient's CPRN.

7. Entity name : ADMISSION ASSIGNMENT.

Attributes:

- ** 1. admission unit
- ** 2. admission ward no
- ** 3. admission bed no
- * 4. admitting consultant CPRN
- * 5. admitting resident CPRN
- * 6. current ward
- * 7. admission date
- * 8. patient's CPRN
- * 9. patient's MRN
- * 10. reasons for admission
- * 11. department code
- * 10. service code
- * 12. specialty code
- * 13. clerk's CPRN.

8. Entity name : PROVISIONAL DIAGNOSIS.

Attributes:

- ** 1. code
- o 2. description
- * 3. patient's CPRN.

9. Entity name : WARD TRANSFER.

Attributes:

- ** 1. date
- ** 2. time
- ** 3. ward code
- ** 4. bed code
- * 5. patient's CPRN
- * 6. patient MRN.

10. Entity name : UNIT TRANSFER.

Attributes:

- ** 1. date
- ** 2. time
- ** 3. unit code
- ** 4. clinic code
- * 5. patient's CPRN
- * 6. patient's MRN.

11. Entity name : PATIENT CONDITION.

Attributes:

- ** 1. code (SAT-satisfactory, FAIR-fair, SI-seriously ill,
(DI-dangerously ill, D-deceased)
- * 2. conscious (Y=yes, N=no, S-semi conscious)
- * 3. progress code
- * 4. mobility code
- o 5. operation date

- * 6. IV. drip (Y=yes, N=no)
- * 7. visitor's (P-permitted, R-restricted)
- o 8. expected discharge date
- * 9. allergies (Y=yes, N=no)
- * 10. ventilation code
- * 11. respirator code
- * 12. barrier nurse (Y=yes, N=no)
- * 13. diet (if patient has to follow a special diet)
- * 14. diagnosis
- * 15. patient's CPRN
- o 16. remarks.

12. Entity name : DISCHARGE.

Attributes:

- ** 1. date
- ** 2. time
- * 3. patient's CPRN
- * 4. patient's MRN
- * 5. unit code
- * 6. ward code
- * 7. bed code
- * 8. disposition code
- * 9. destination code
- * 10. consultant's CPRN
- * 11. resident's CPRN.

13. Entity name : PATIENT STAY.

Attributes:

- ** 1. length
- * 2. discharge date
- * 3. date of admission
- * 4. patient's CPRN.

14. Entity name : ACCOMMODATION.

Attributes:

** 1. date

** 2. time

** 3. type code

* 4. source of payment code

* 5. admission date

* 6. patient's CPRN

* 7. patient's MRN

* 8. category (C-charge, MG-medical ground & SS-space shortage).

15. Entity name : CHANGE OF ACCOMMODATION.

Attributes:

** 1. date

** 2. time

** 3. type

* 4. source of payment code

* 5. admission date

* 6. patient's CPRN

* 7. patient's MRN

* 8. category.

16. Entity name : PATIENT LEAVE.

Attributes:

** 1. date

** 2. time

* 3. return date

* 4. return time

* 5. no of days

* 6. admission date

* 7. admission time

* 8. patient's CPRN

- * 9. patient's MRN
- * 10. granted leave CPRN
- o 11. remarks

17. Entity name : LAST LEAVE.

Attributes:

- ** 1. date
- * 2. return date
- o 3. admission date
- o 4. admission time
- * 5. patient's CPR
- * 6. patient's MRN.

18. Entity name : RESPONSIBLE PERSON.

Attributes:

- ** 1. CPRN
- o 2. phone
- * 3. relation
- * 4. leave date
- * 5. patient's CPRN.

19. Entity name : PATIENT ALIAS.

Attributes:

- ** 1. patient's CPRN
- ** 2. patient's MRN
- * 3. first name
- * 4. middle1 name
- * 5. middle2 name
- * 6. last name.

20. Entity name : DIAGNOSIS.

Attributes:

- ## 1. code
- * 2. patient's CPRN
- * 3. patient's MRN
- o 4. date of admission.

21. Entity name : OTHER DIAGNOSIS.

Attributes:

- ## 1. code
- * 2. patient's CPRN
- * 3. patient's MRN
- o 4. date of admission.

22. Entity name : OPERATION.

Attributes:

- ## 1. code
- ## 2. date
- ## 3. provider's CPRN
- * 4. patient's CPRN
- * 5. patient's MRN
- o 6. admission date.

23. Entity name : OTHER OPERATION.

Attributes:

- ## 1. code
- ## 2. date
- ## 3. provider's CPRN
- * 4. patient's CPRN
- * 5. patient's MRN
- o 6. admission date.

24. Entity name : SPECIAL TREATMENT.

Attributes:

- ** 1. code
- ** 2. date
- ** 3. provider's CPRN
- * 4. patient's CPRN
- * 5. patient's MRN.

25. Entity name : NON-OPERATIVE PROCEDURE.

Attributes:

- ** 1. code
- ** 2. date
- ** 3. provider's CPRN
- * 4. patient's CPRN
- * 5. patient's MRN.

26. Entity name : PAYMENT SLIP.

Attributes:

- ** 1. no
- * 2. date
- * 3. patient's CPRN
- * 4. patient's MRN
- * 5. patient name
- * 6. patient's nationality
- * 7. department code
- * 8. new/follow-up
- * 9. date of admission
- * 10. date of discharge
- * 11. type of accommodation
- * 12. ward no
- * 13. room no
- * 14. source of payment

- * 15. amount
- * 16. clerk's CPRN.

27. Entity name : MATERNITY BOOKING.

Attributes:

- ** 1. date
- * 2. patient's CPRN
- * 3. patient name
- * 4. source of referral code
- o 5. expected delivery date
- o 6. hospital code.

28. Entity name : ADMISSION BOOKING.

Attributes:

- ** 1. date
- ** 2. time
- * 3. patient's CPRN
- * 4. patient's MRN
- * 5. patient name
- * 6. consultant CPRN
- * 7. specialty code
- * 8. diagnosis
- o 9. operation date.

29. Entity name : LPP/OP BOOKING.

Attributes:

- ** 1. date
- ** 2. time
- * 3. patient's CPRN
- * 4. patient name
- * 5. consultant code
- * 6. department code

- * 7. clinic code
- * 8. new/follow-up
- * 9. extra (Y=yes, N=no).

30. Entity name : ISSUE MR.

Attributes:

1. MRN

- * 2. date
- * 3. time
- * 4. patient's CPRN
- * 5. patient name
- * 6. source code
- * 7. unit code
- * 8. ward code
- * 9. requester name
- * 10. date of request
- * 11. time of request
- o 12. requester's phone.

31. Entity name : ISSUE MR AGAINST AN APPOINTMENT.

Attributes:

1. MRN

- * 2. date
- * 3. time
- * 4. patient's name
- * 5. issued (Y=yes, N=no)
- * 6. appointment date
- * 7. appointment unit
- * 8. appointment clinic
- * 9. requested doctor
- * 10. receiver's name.

32. Entity name : RECEIVE MR OF INDIVIDUAL PATIENT.

Attributes:

- ** 1. date
- ** 2. time
- ** 3. patient's MRN
- * 4. patient's CPR
- o 5. date of issue
- * 6. source code.

33. Entity name : RECEIVE MR OF DISCHARGE PATIENT.

Attributes:

- ** 1. date
- ** 2. time
- ** 3. patient's MRN
- * 4. patient's CPRN
- * 5. patient name
- * 6. received (Y=yes, N=no)
- * 7. discharge date
- * 8. discharge unit
- * 9. discharge source code.

34. Entity name : CHANGE MRN/CPRN.

Attributes:

- ** 1. old patient's MRN
- ** 2. old patient's CPRN
- * 3. new patient's MRN
- * 4. old patient's CPRN
- * 5. patient's name
- * 6. patient's age

35. Entity name : DELIVERY REGISTRATION.

Attributes:

- ** 1. date
- ** 2. mother's MRN
- ** 3. mother's CPRN
- * 4. duration of marriage
- * 5. interval since last delivery
- * 6. no of children before delivery
- * 7. no of dead children
- * 8. gestation (in weeks)
- * 9. delivery type code
- * 10. multiple birth type - set
- * 11. multiple birth type - sex.

36. Entity name : BIRTH REGISTRATION.

Attributes:

- ** 1. date
- ** 2. time
- ** 3. mother's CPRN
- * 4. baby's condition (L-live, S-still born, N-neonatal death)
- * 5. sex code
- * 6. weight at birth
- * 7. gestation age (F-full term, P-premature)
- * 8. child no
- * 9. no of brothers/sisters
- * 10. baby's first name
- * 11. baby's middle1 name
- * 12. baby's middle2 name
- * 13. baby's last name.

37. Entity name : VISITOR'S GATE PASS.

Attributes:

- ** 1. date
- ** 2. visit date
- ** 3. visit time
- * 4. patient's CPRN
- * 5. patient's name
- * 6. ward of admission
- * 7. room of admission
- * 8. visitor's name
- * 9. responsible person.

The meaning of the marks preceding the attributes are as the following:

- . # - Unique identifier.
- . * - Mandatory attribute.
- . o - Optional attribute.

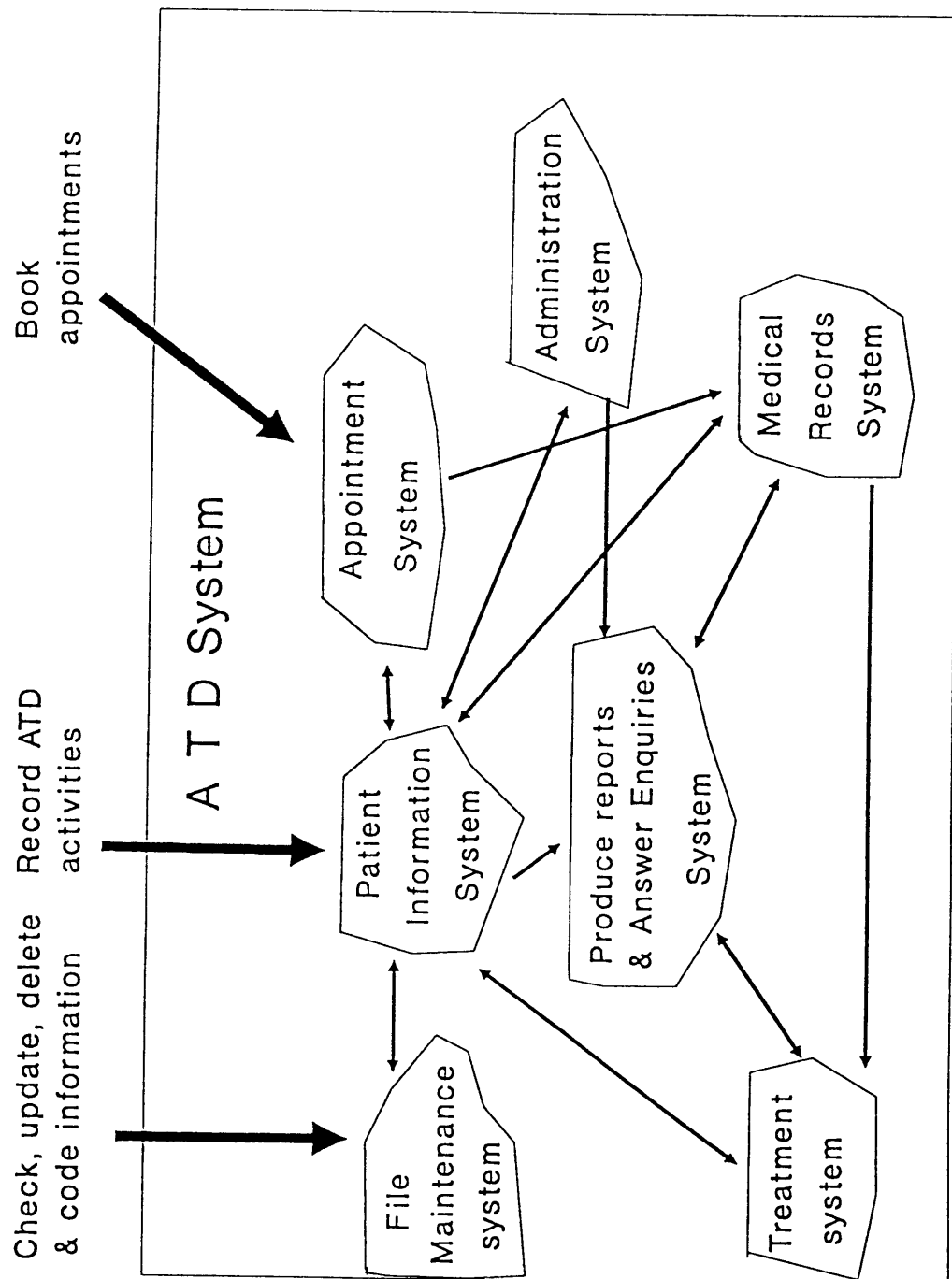


Figure 4.2 Conceptual model level 1

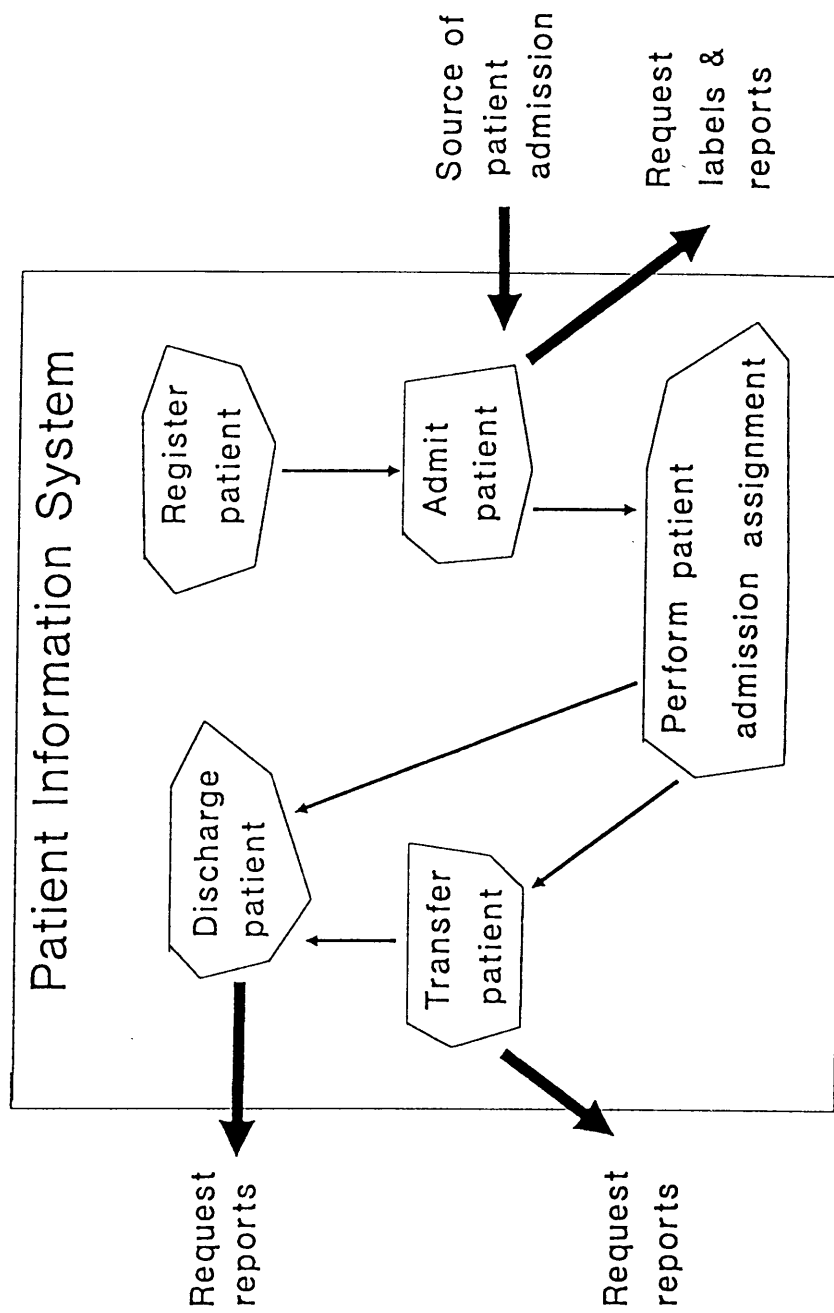


Figure 4.3 Conceptual model level 2 - patient information system

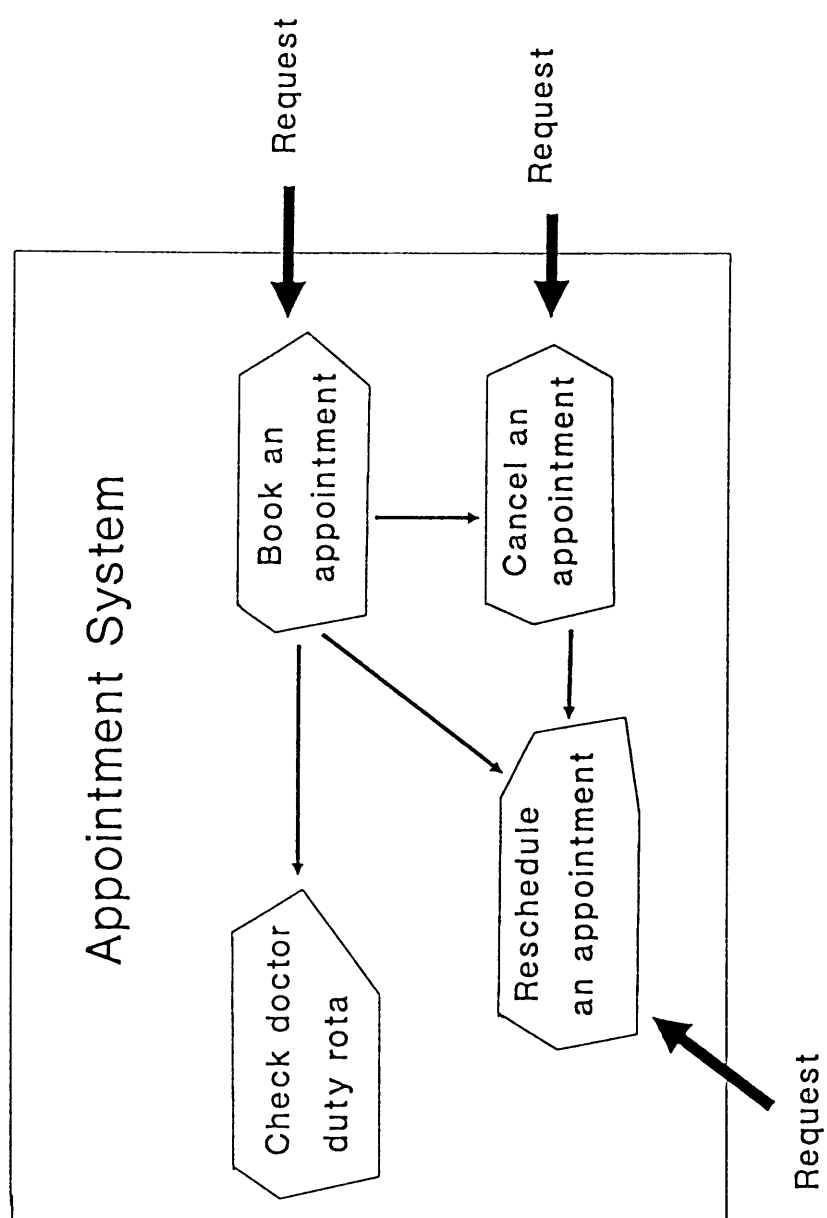


Figure 4.4 Conceptual model level 2 - appointment system

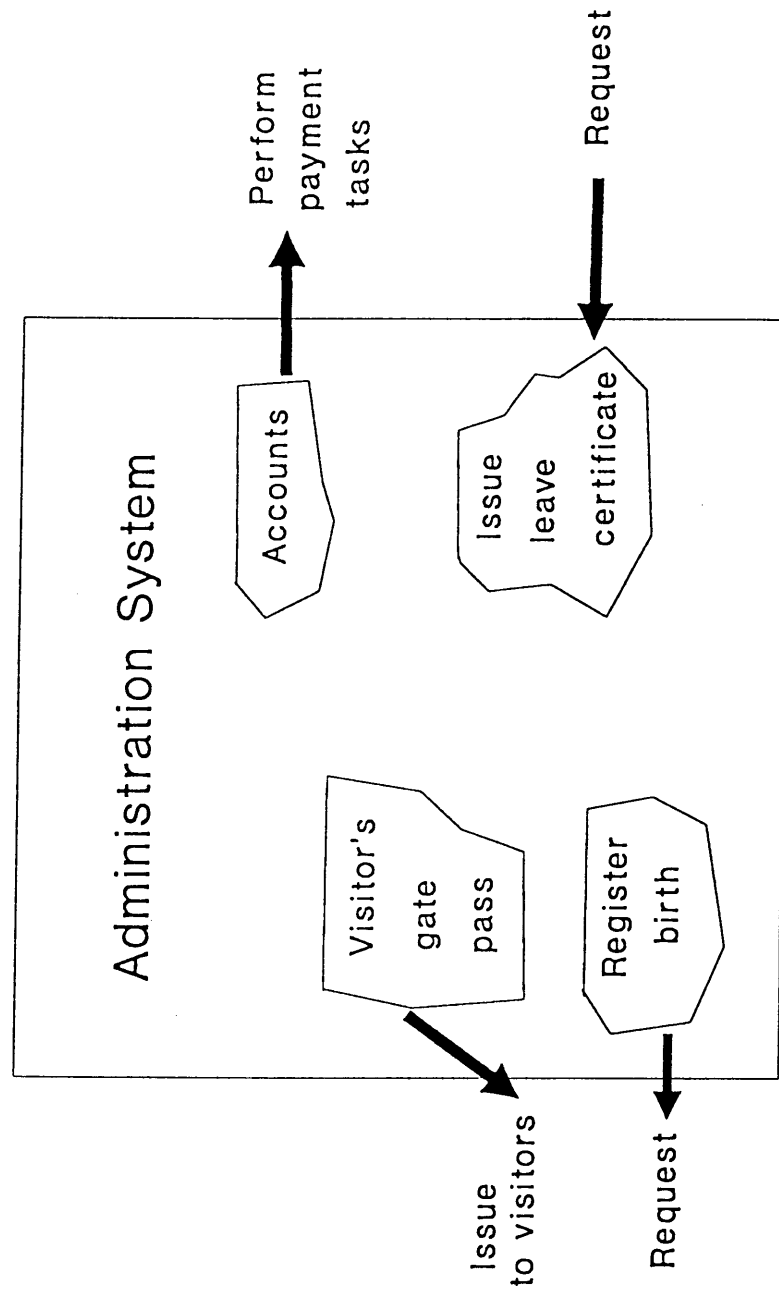


Figure 4.5 Conceptual model level 2 - administration system

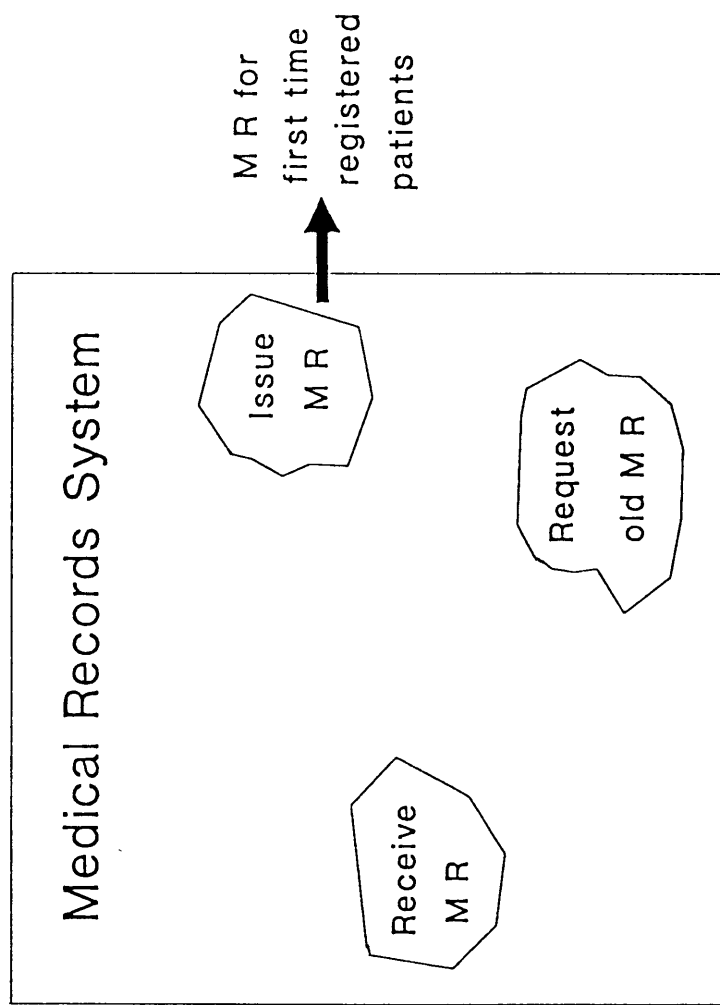


Figure 4.6 Conceptual model level 2 - medical record system

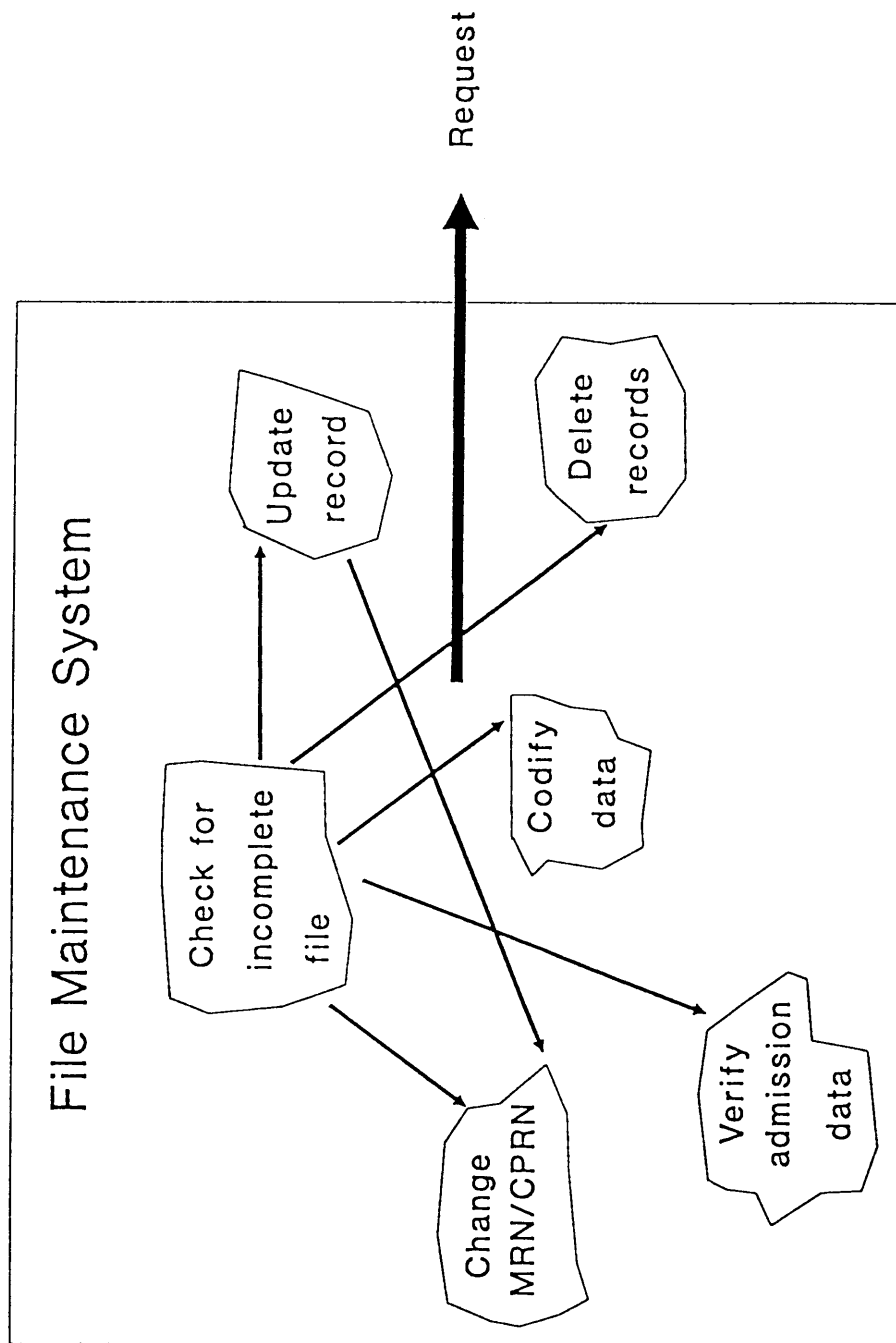


Figure 4.7 Conceptual model level 2 - file maintenance system

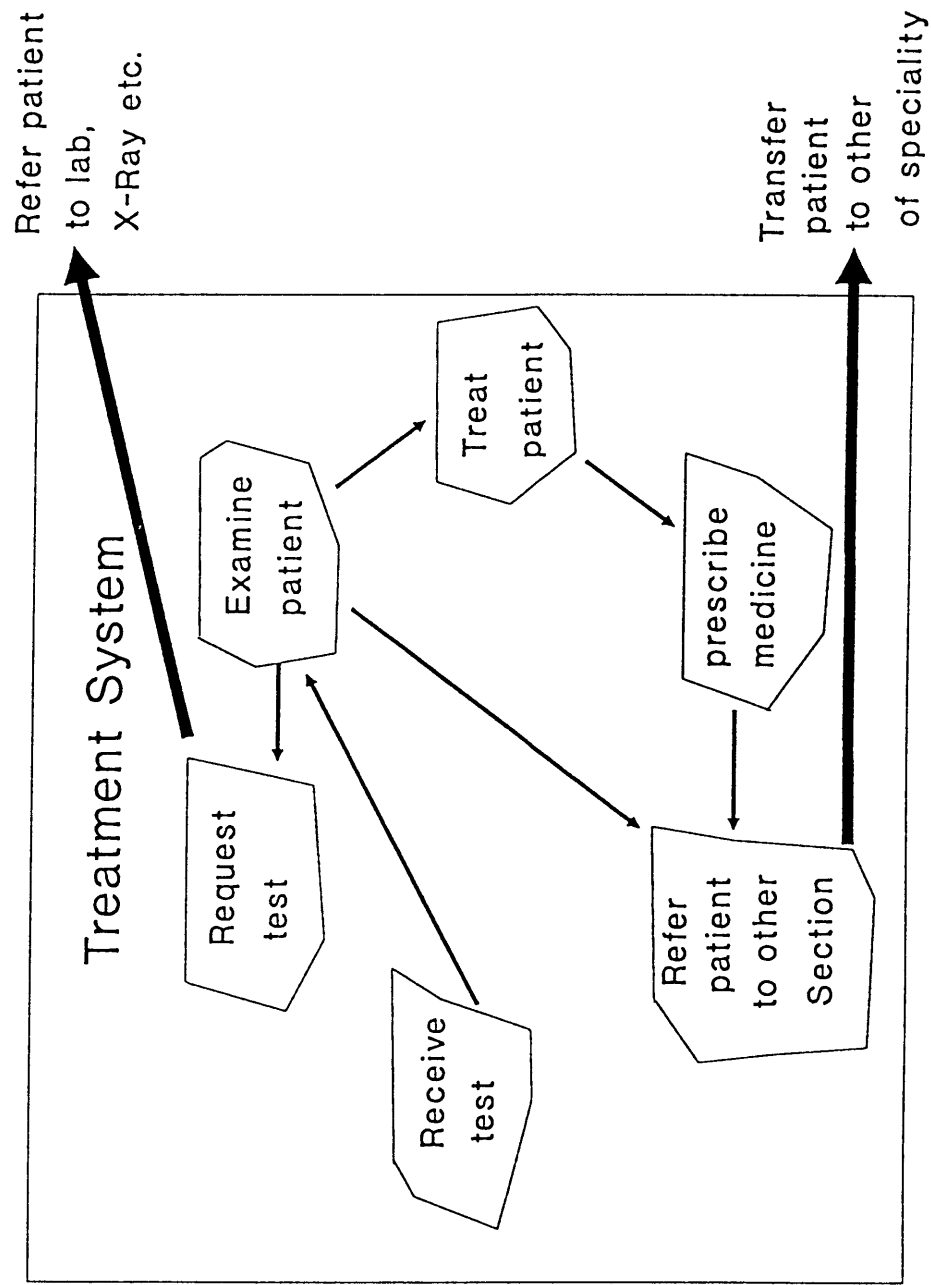


Figure 4.8 Conceptual model level 2 - treatment system

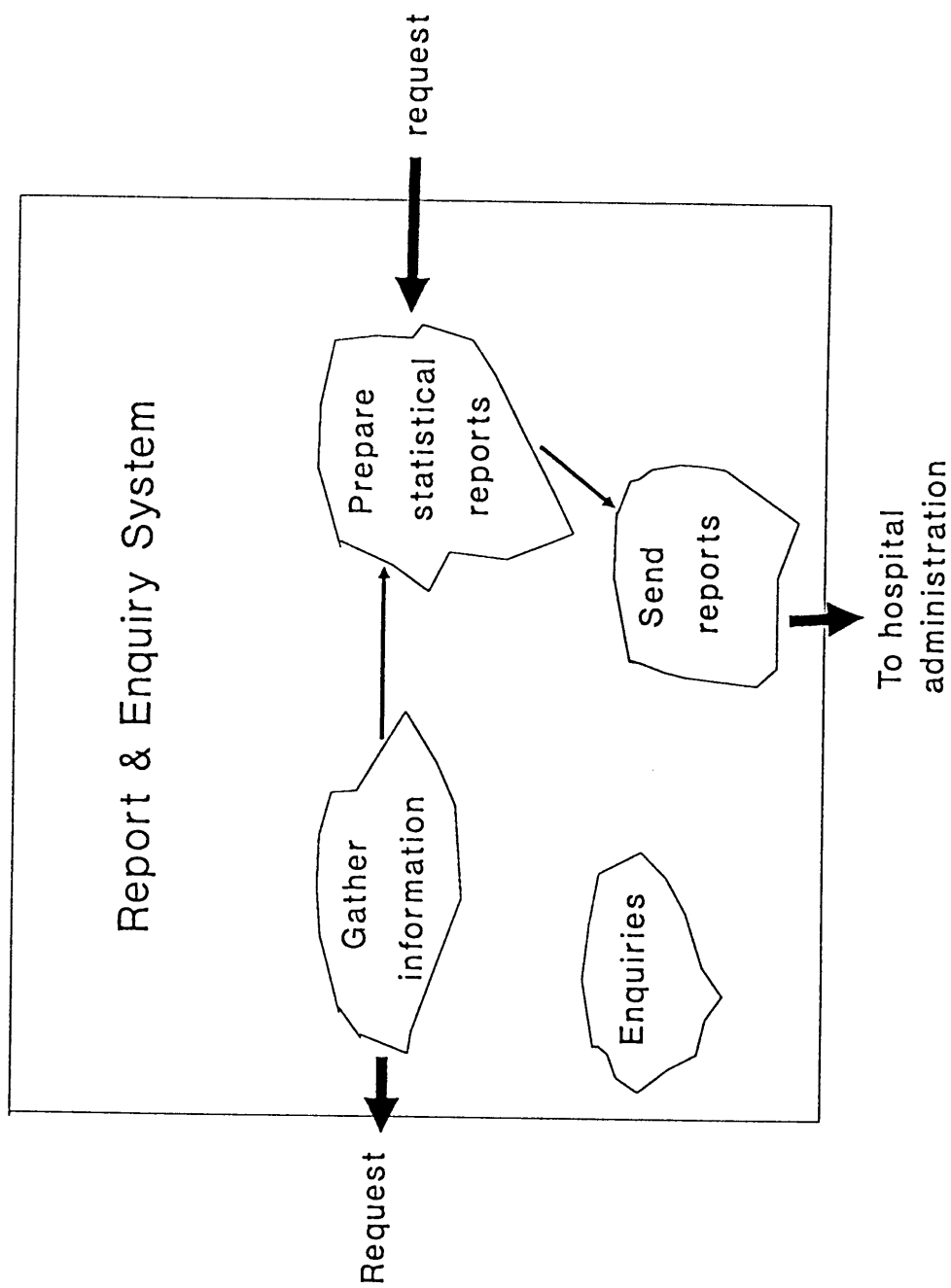


Figure 4.9 Conceptual model level 2 - report & enquiry system

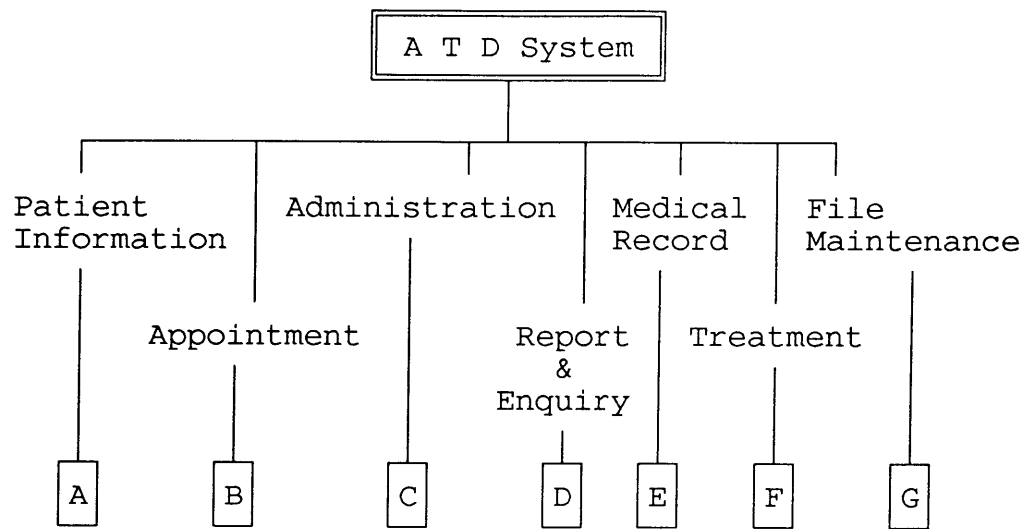


Figure 4.10. Function model.

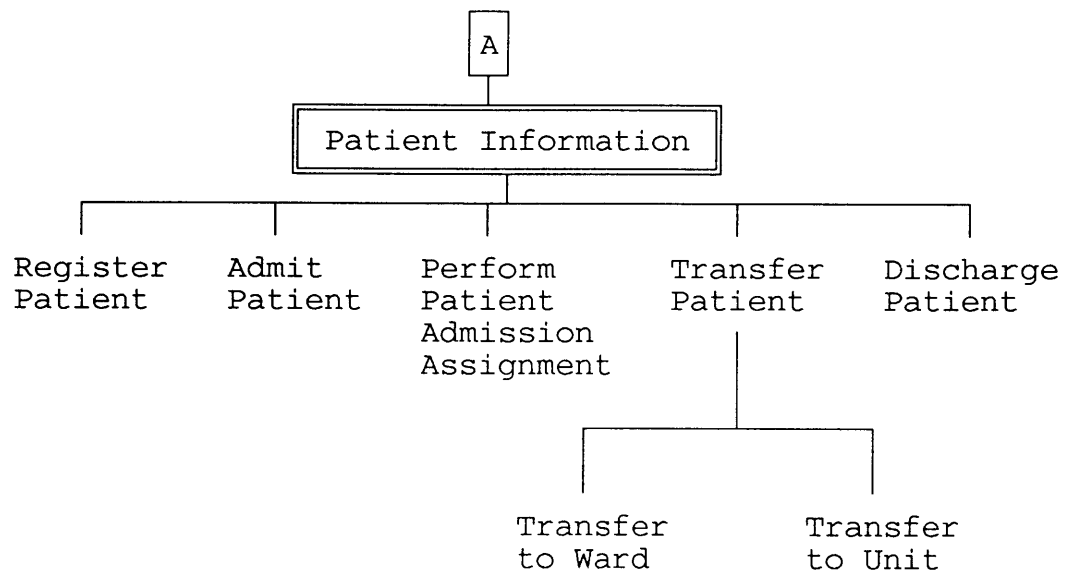


Figure 4.11. Functional model : patient information.

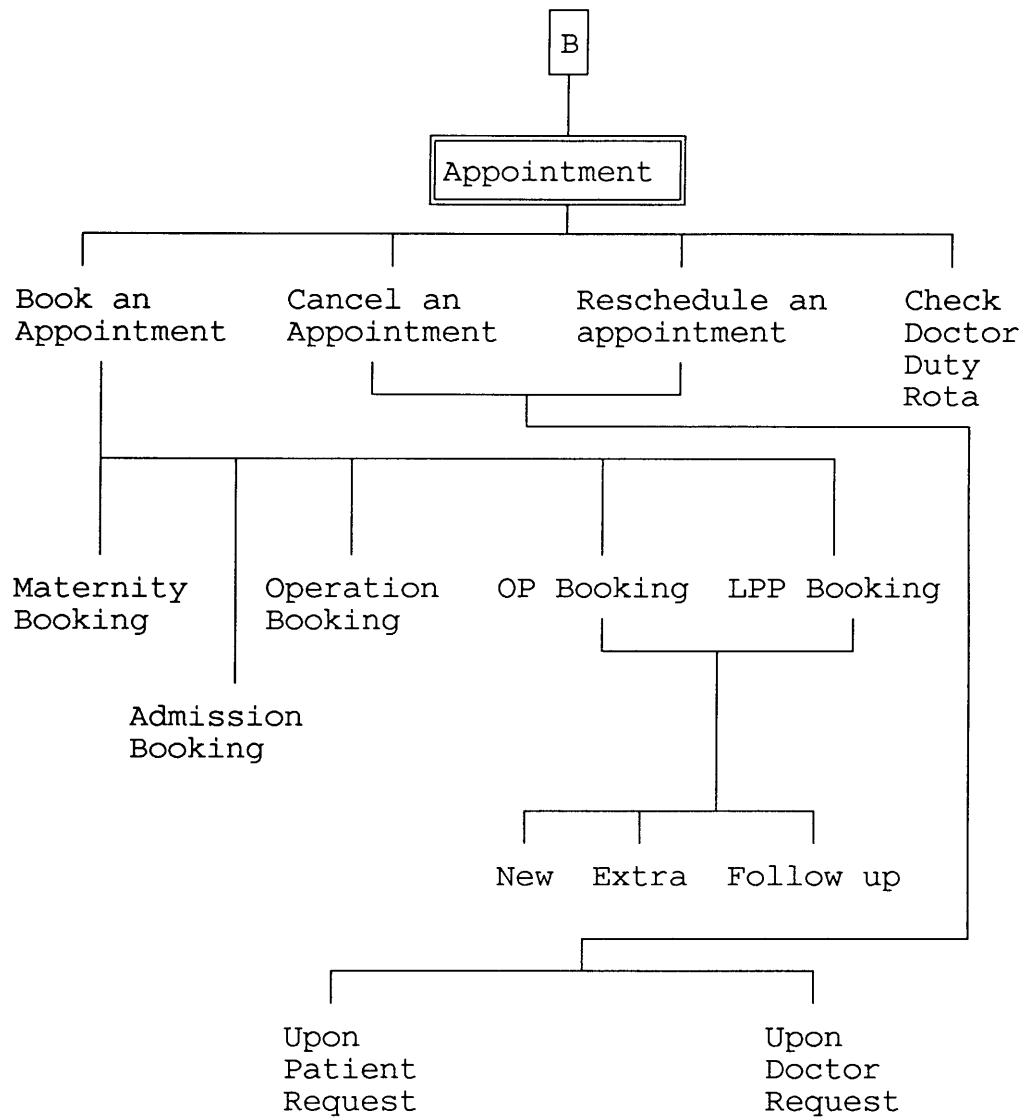


Figure 4.12. Functional model : appointment.

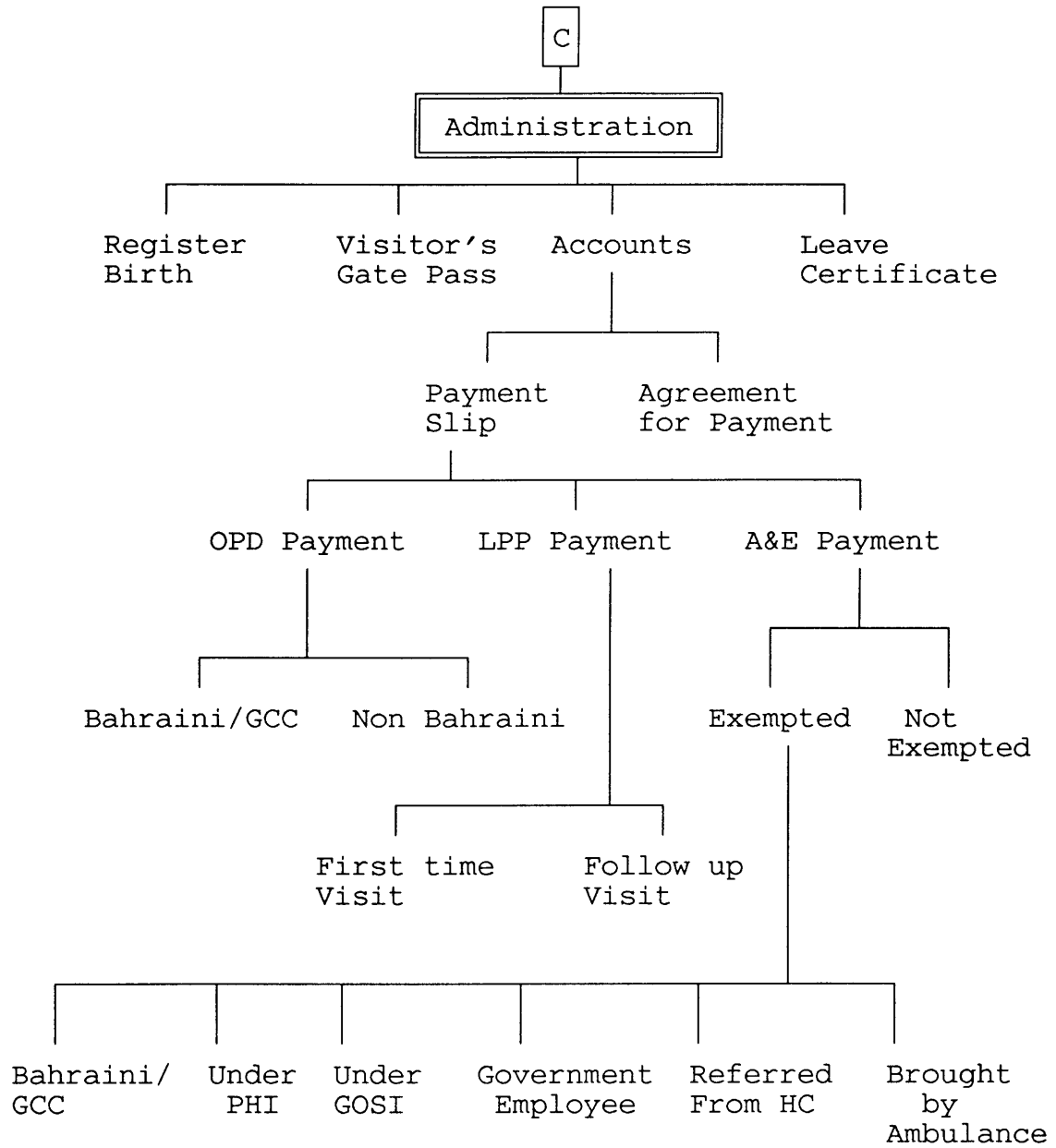


Figure 4.13. Functional model : administration.

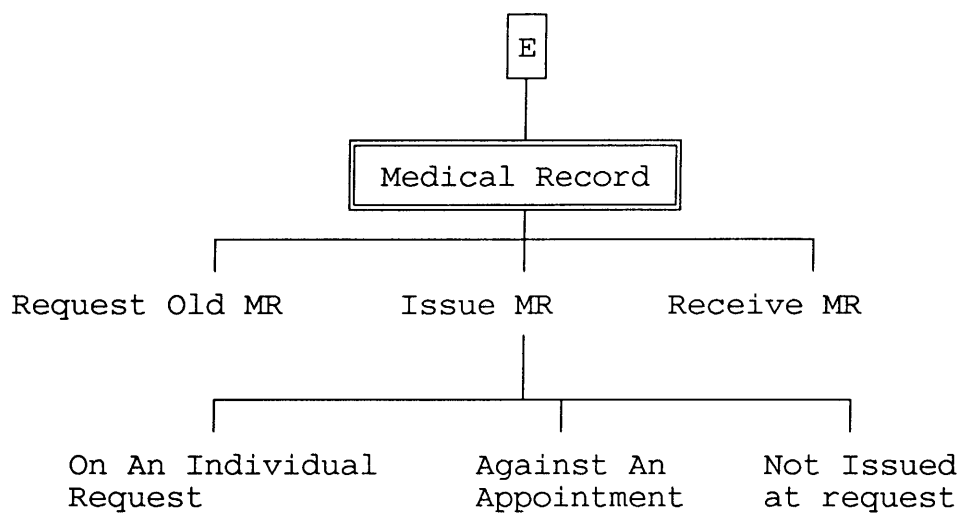
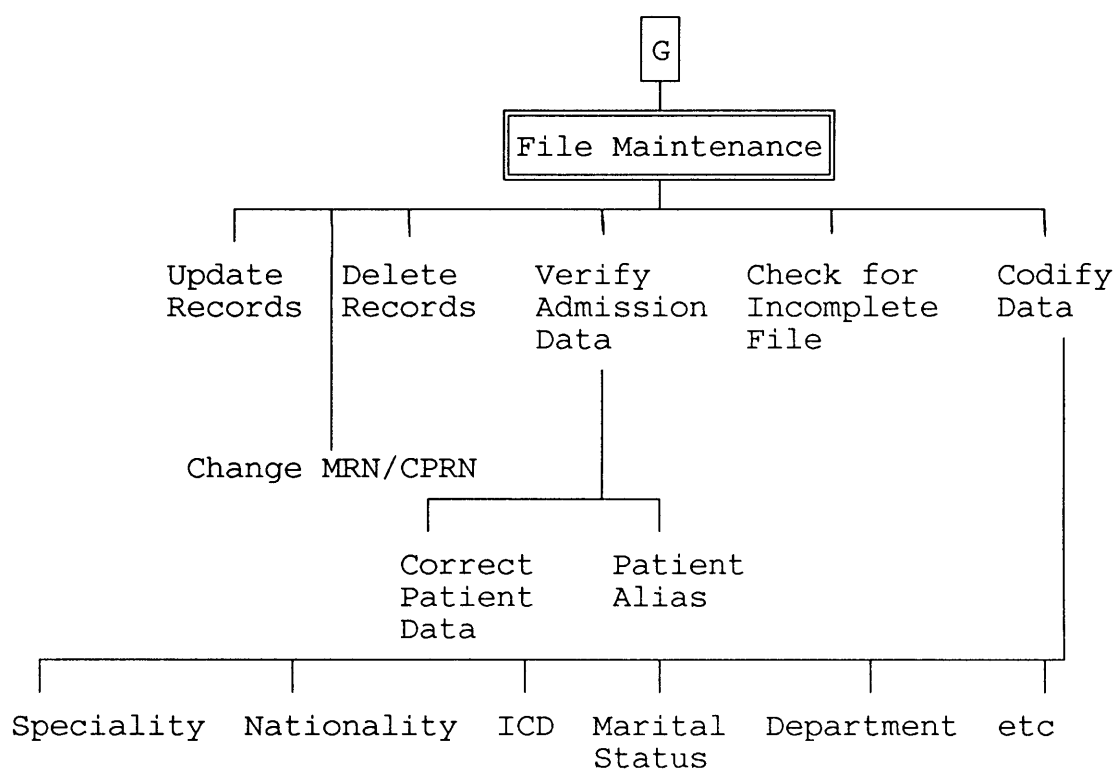


Figure 4.14. Functional model : medical record.



4.15. Functional model : file maintenance.

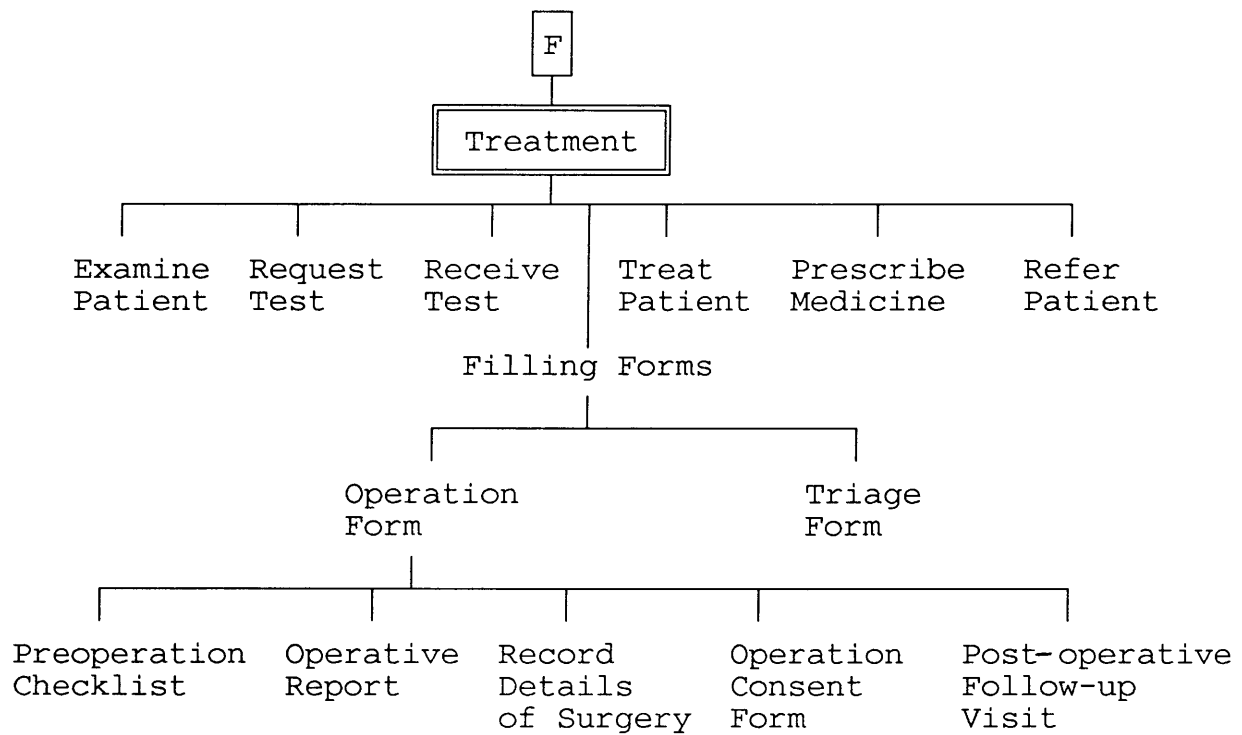


Figure 4.16. Functional model : treatment.

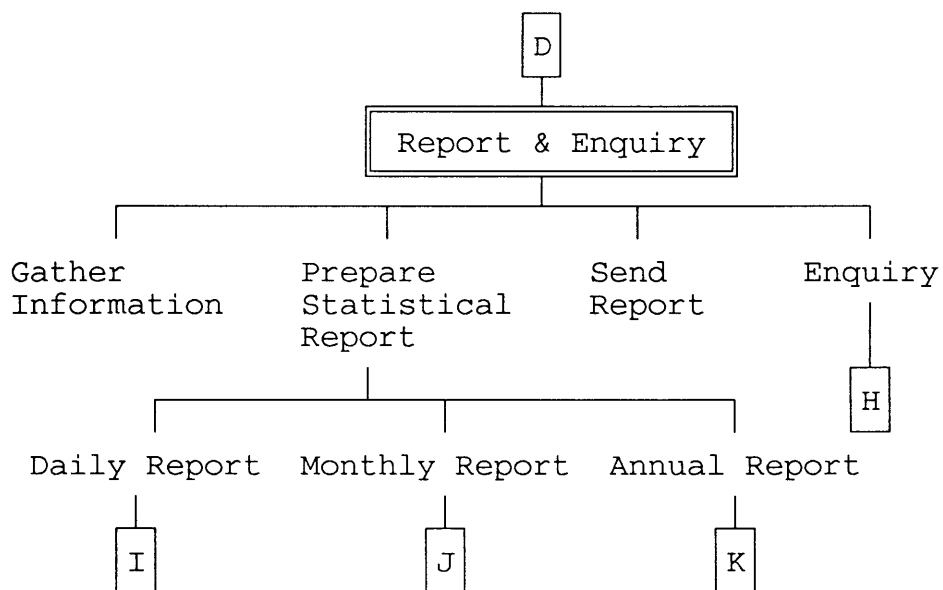


Figure 4.17. Functional model : report & enquiry.

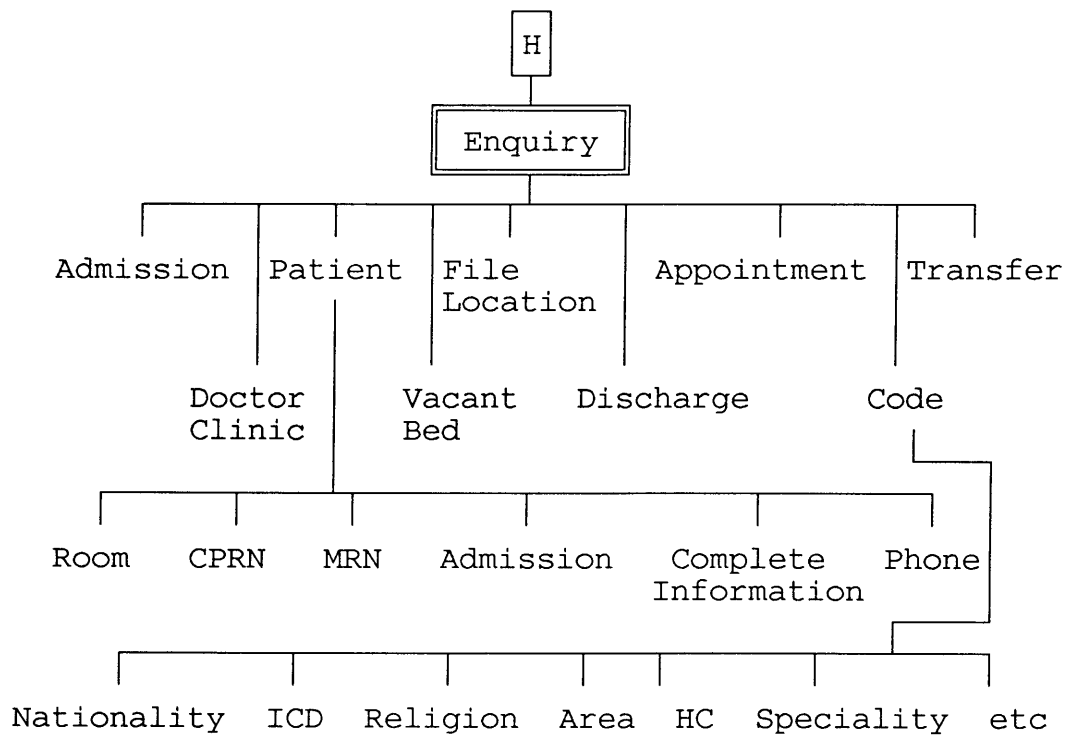


Figure 4.18. Functional mode : enquiry.

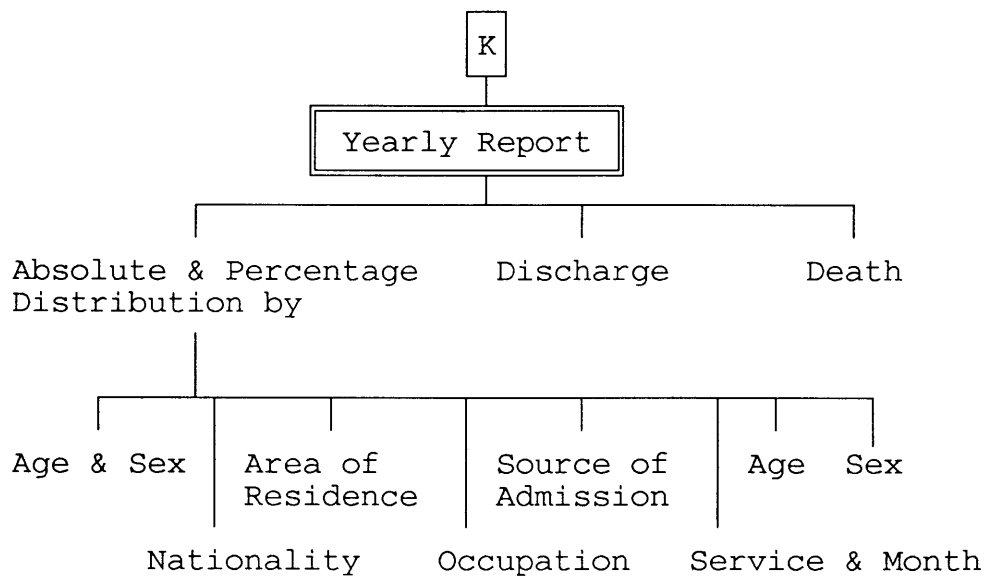


Figure 4.19. Functional model: yearly report.

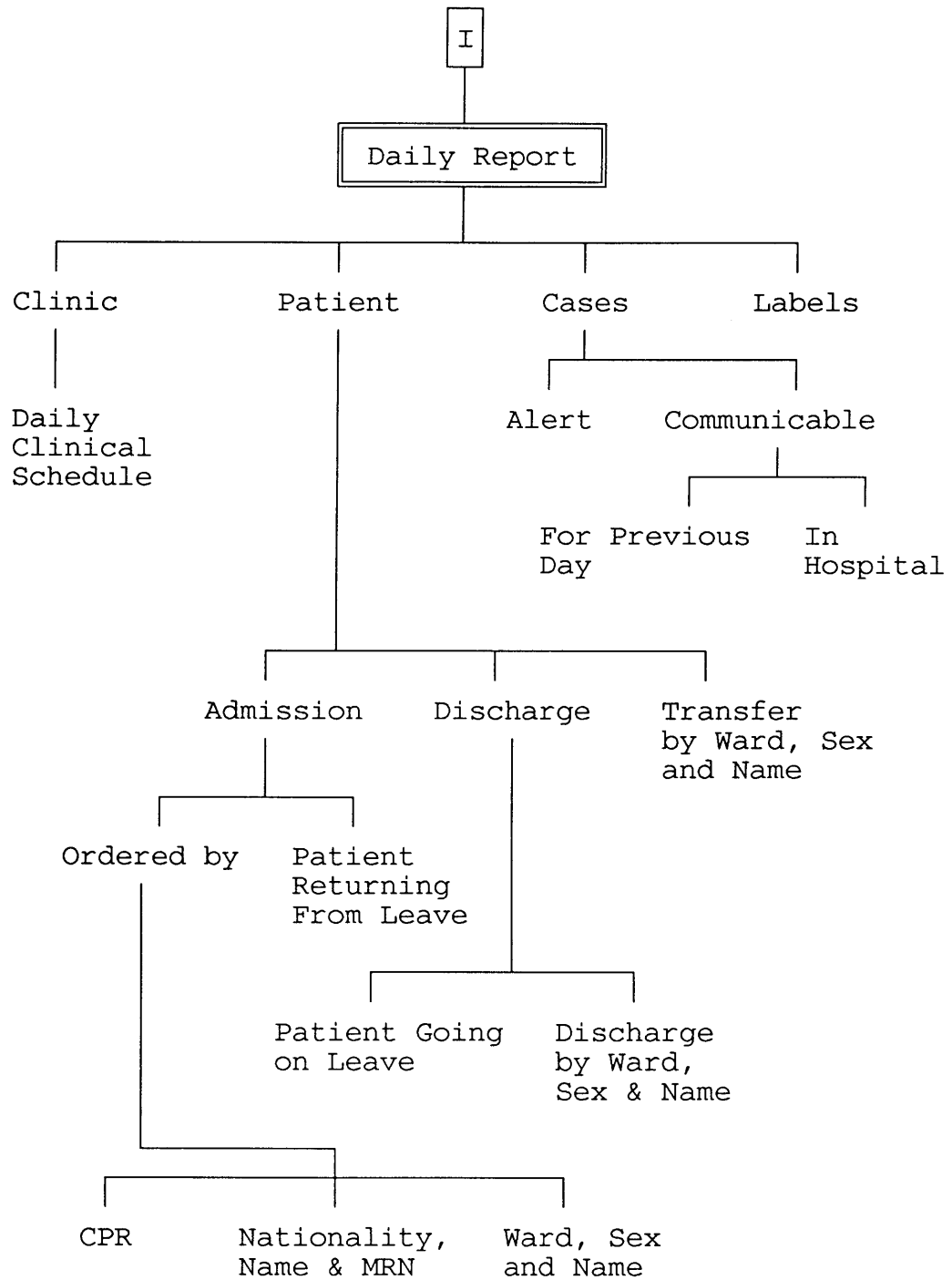


Figure 4.20. Functional model : daily report.

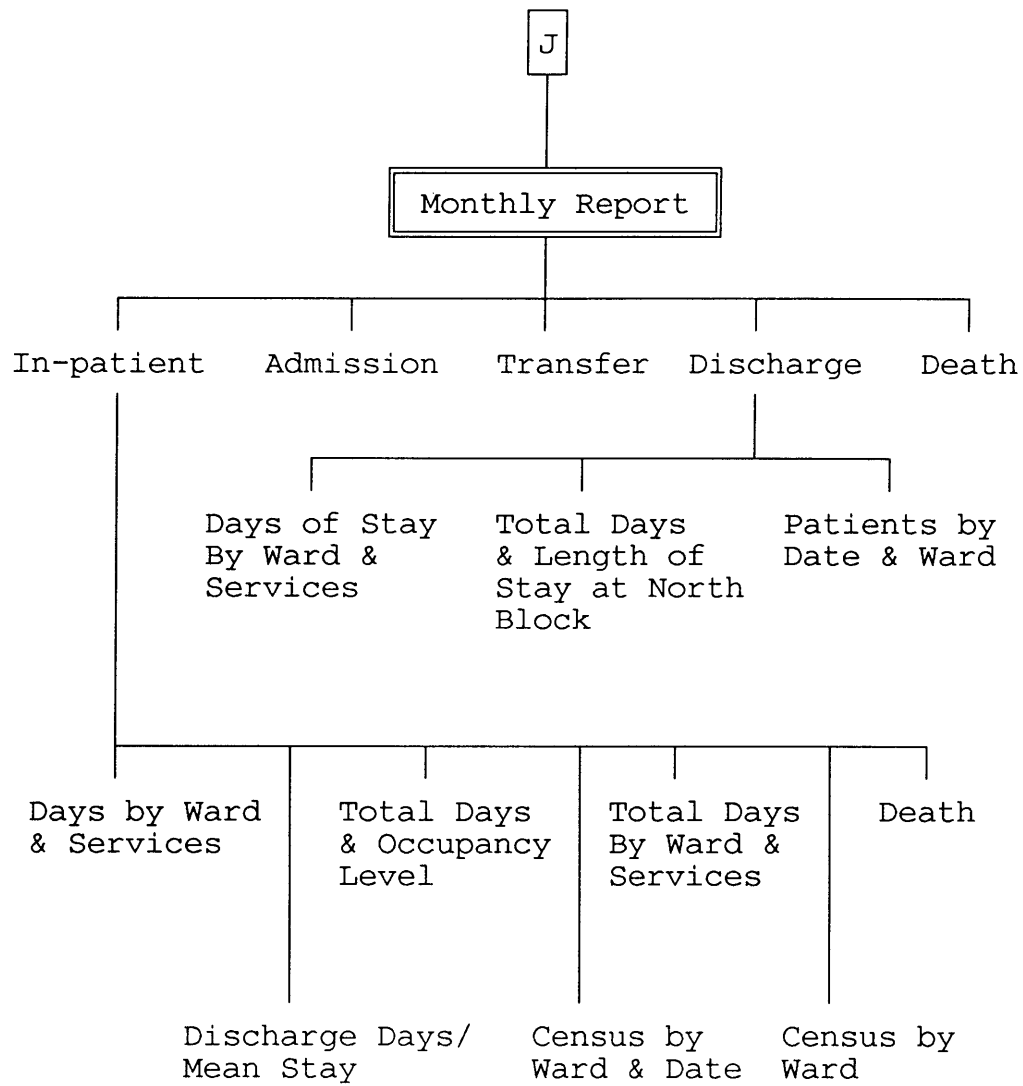


Figure 4.21. functional model : monthly report.

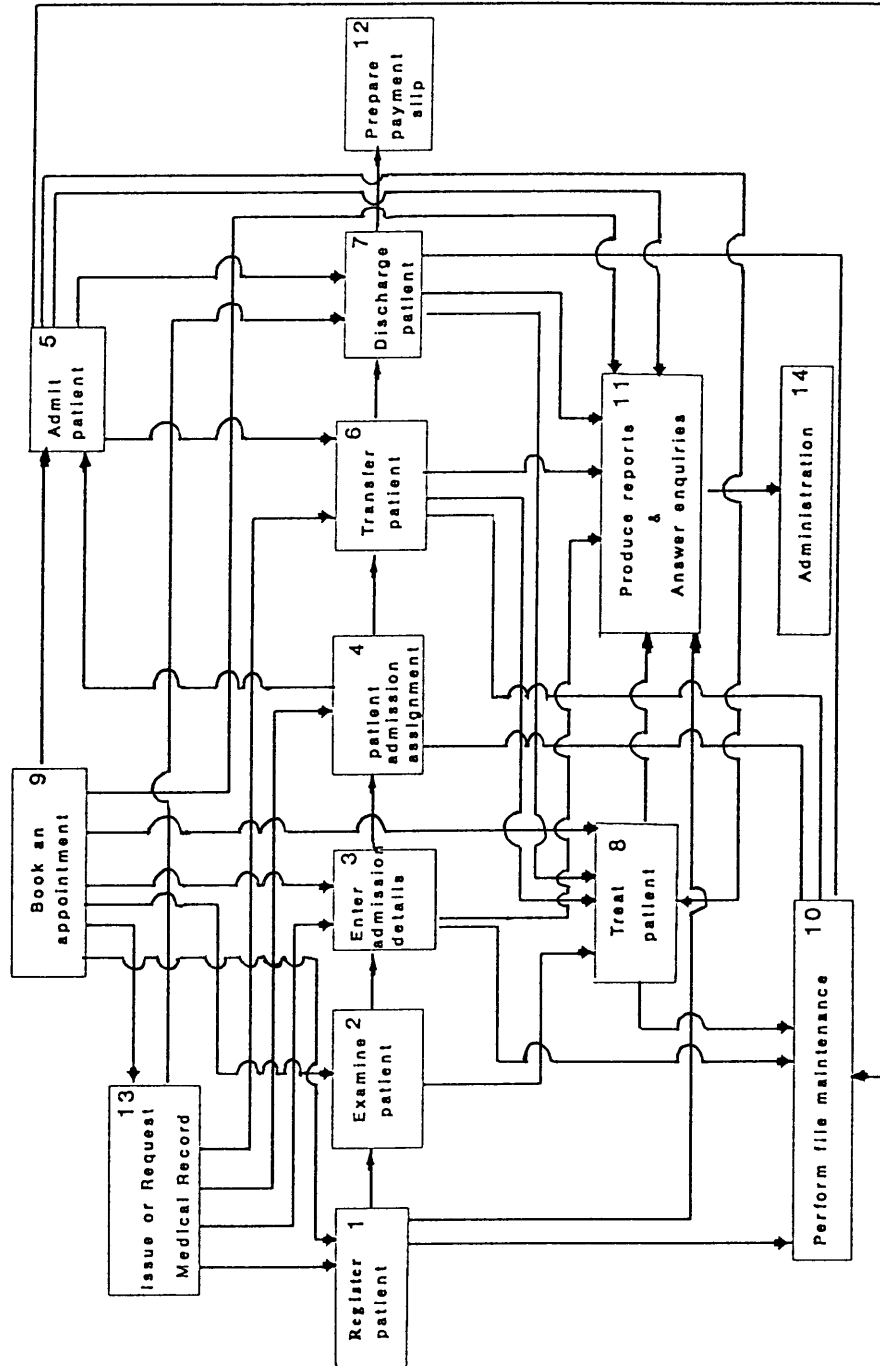


Figure 4.22 The system data flow diagram

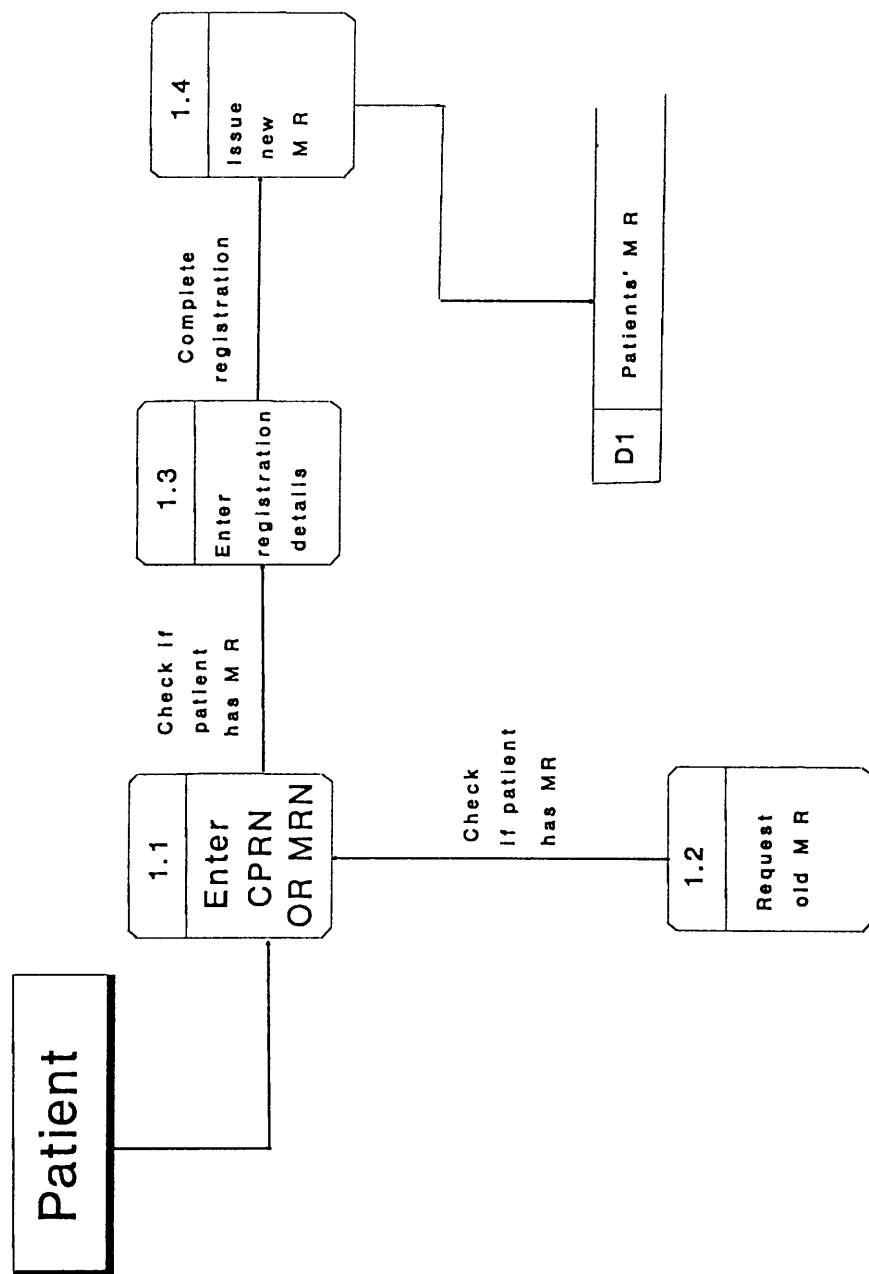


Figure 4.23 Data flow diagram for registration

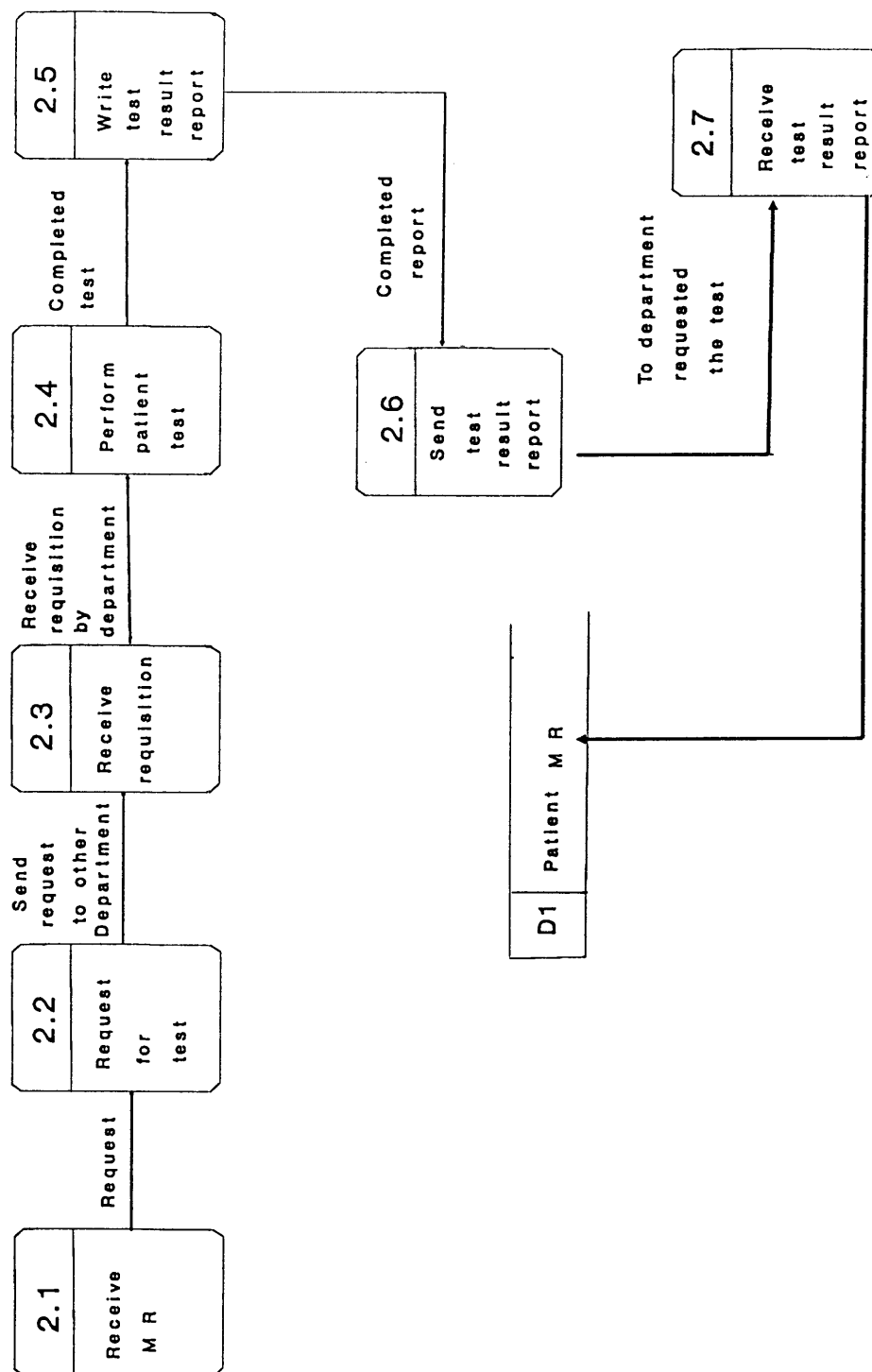


Figure 4.24 Data flow diagram for patient examination

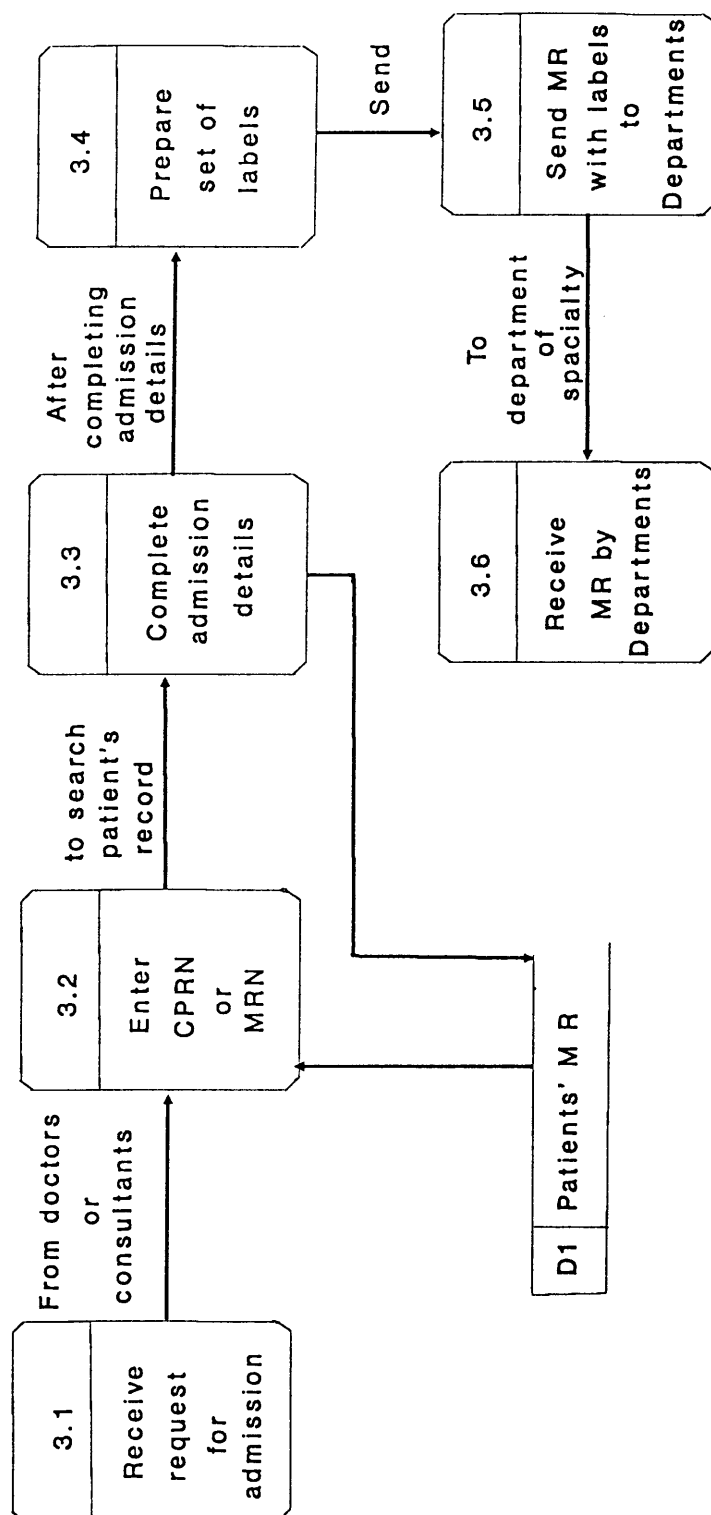


Figure 4.25 Data flow diagram for admission details

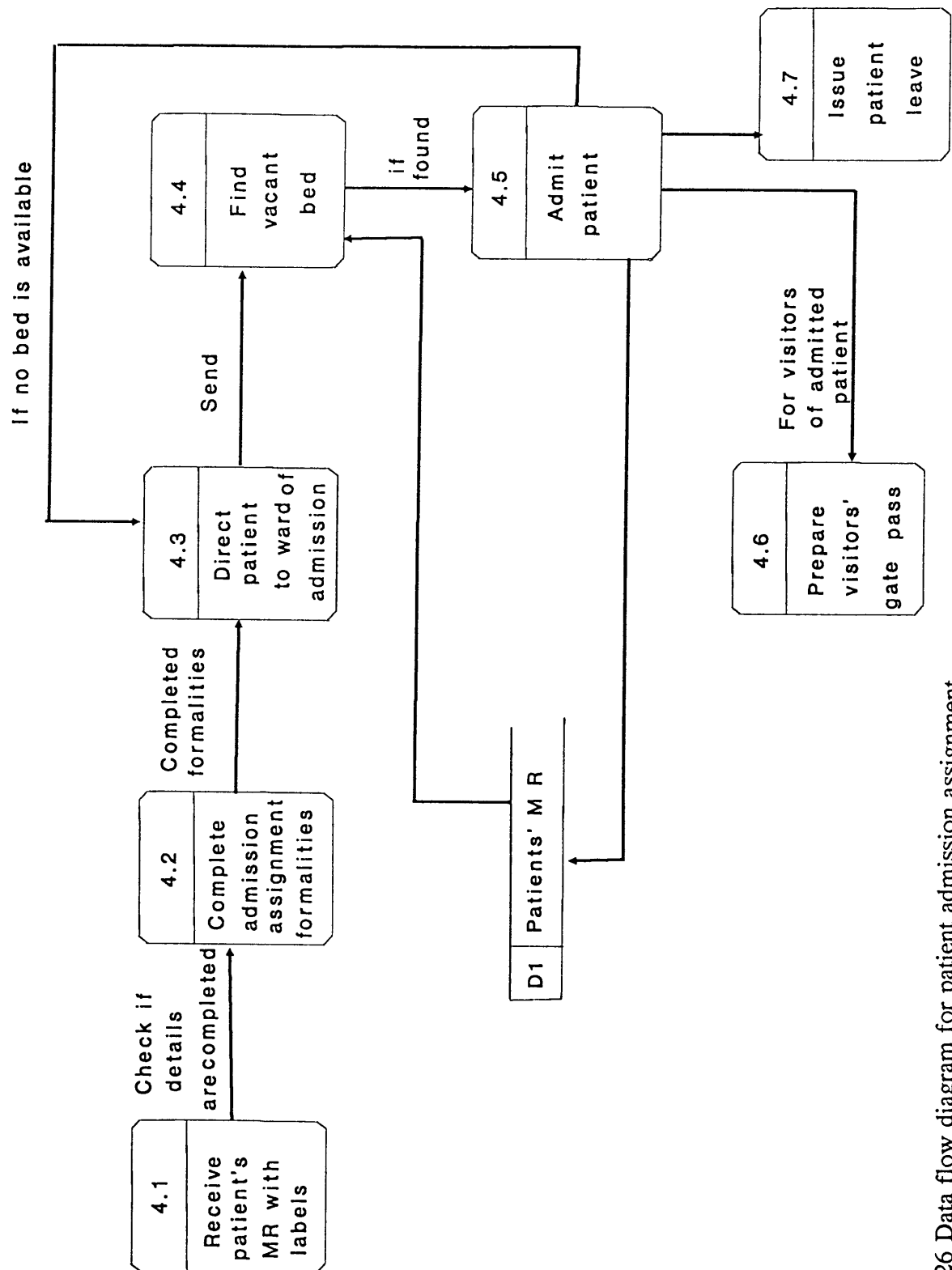


Figure 4.26 Data flow diagram for patient admission assignment

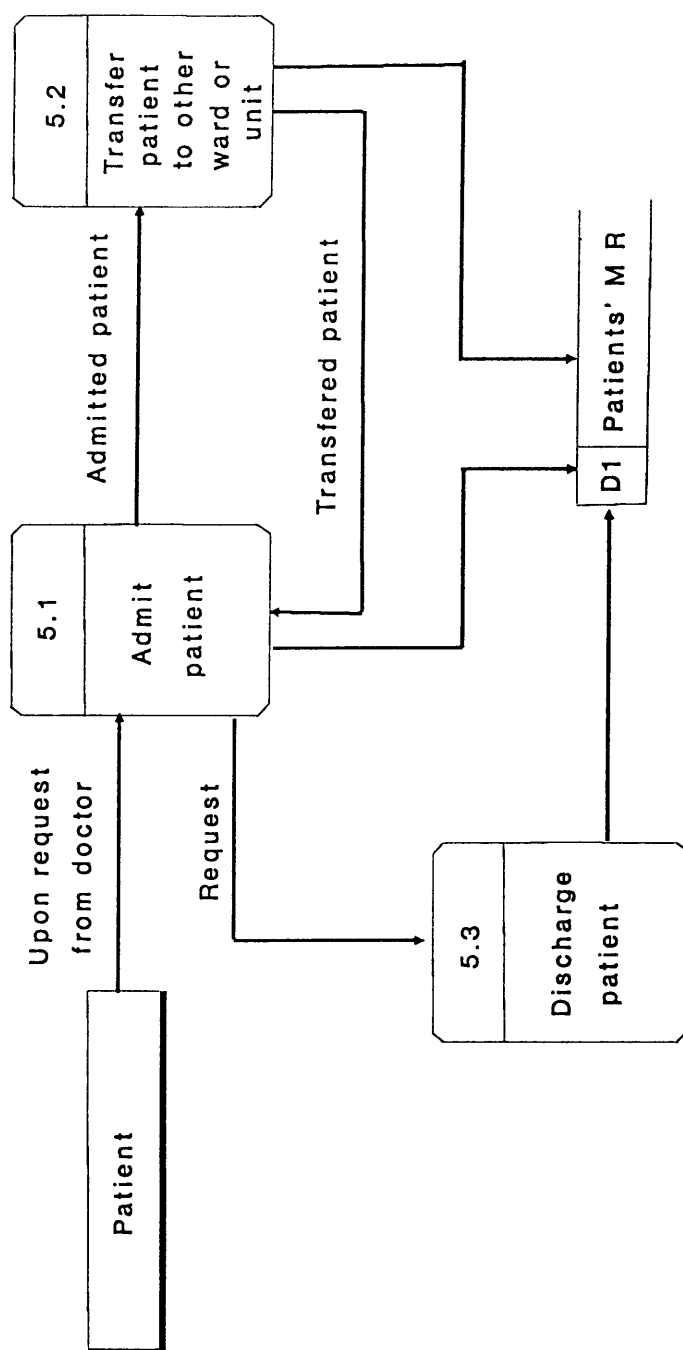


Figure 4.27 Data flow diagram for patient admission

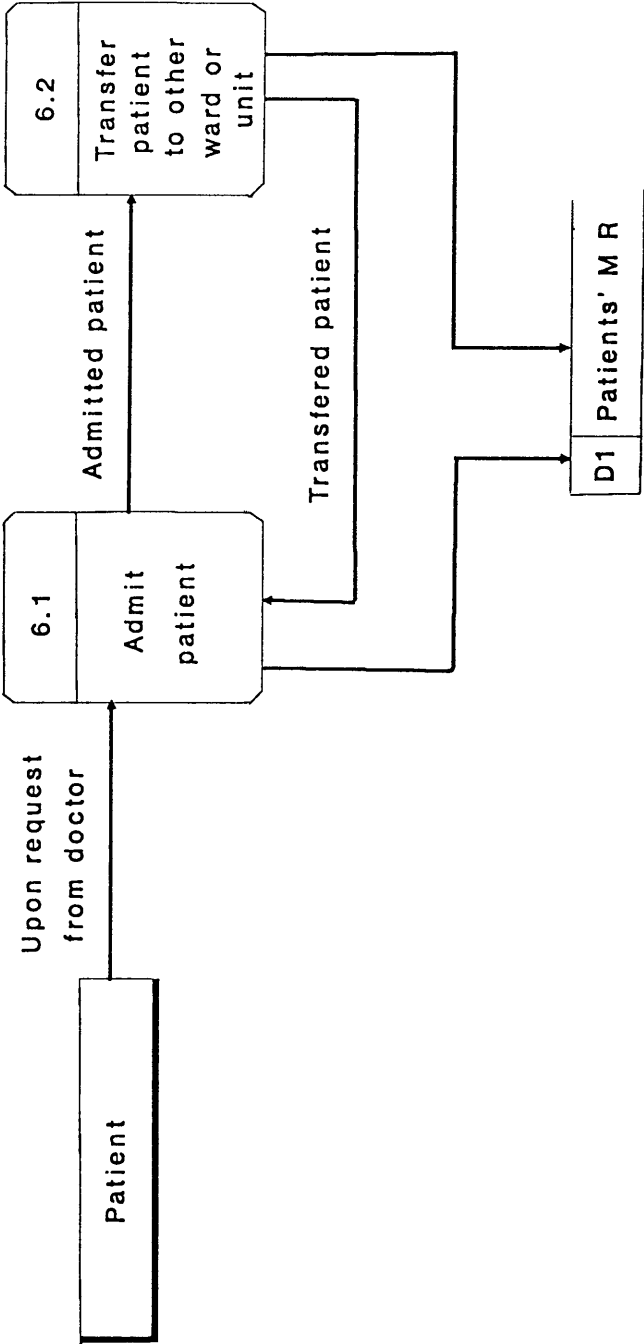


Figure 4.28 Data flow diagram for patient transfer

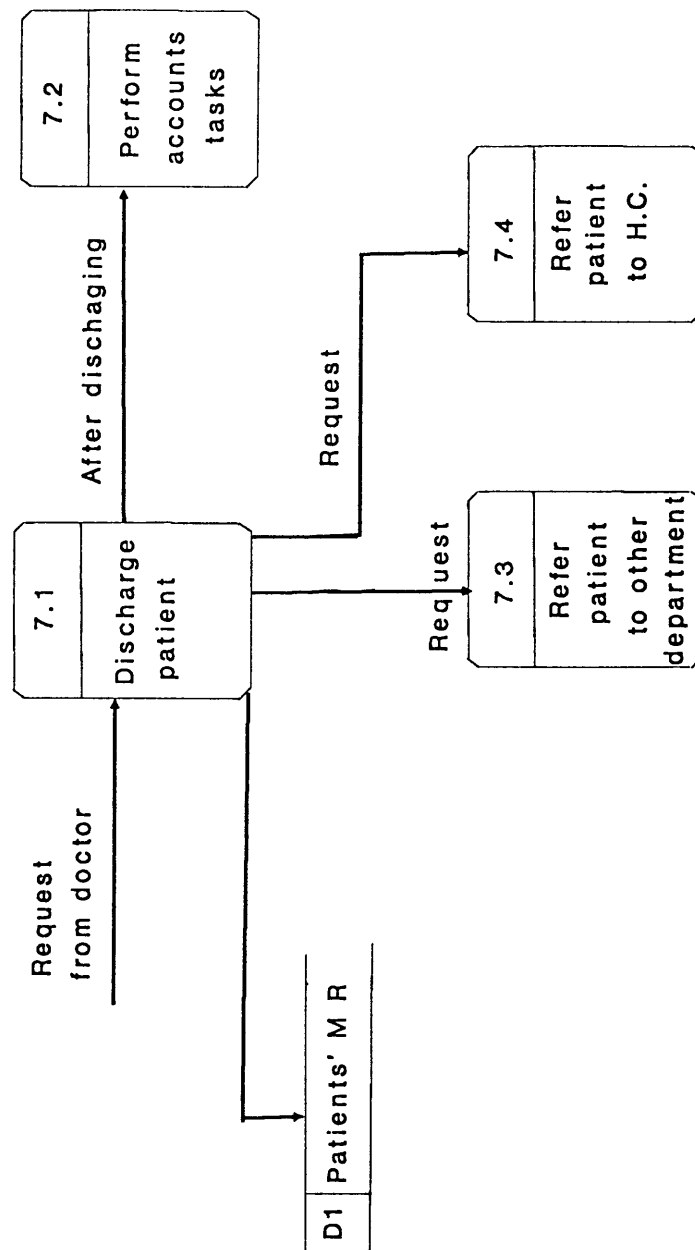


Figure 4.29 Data flow diagram for patient discharge

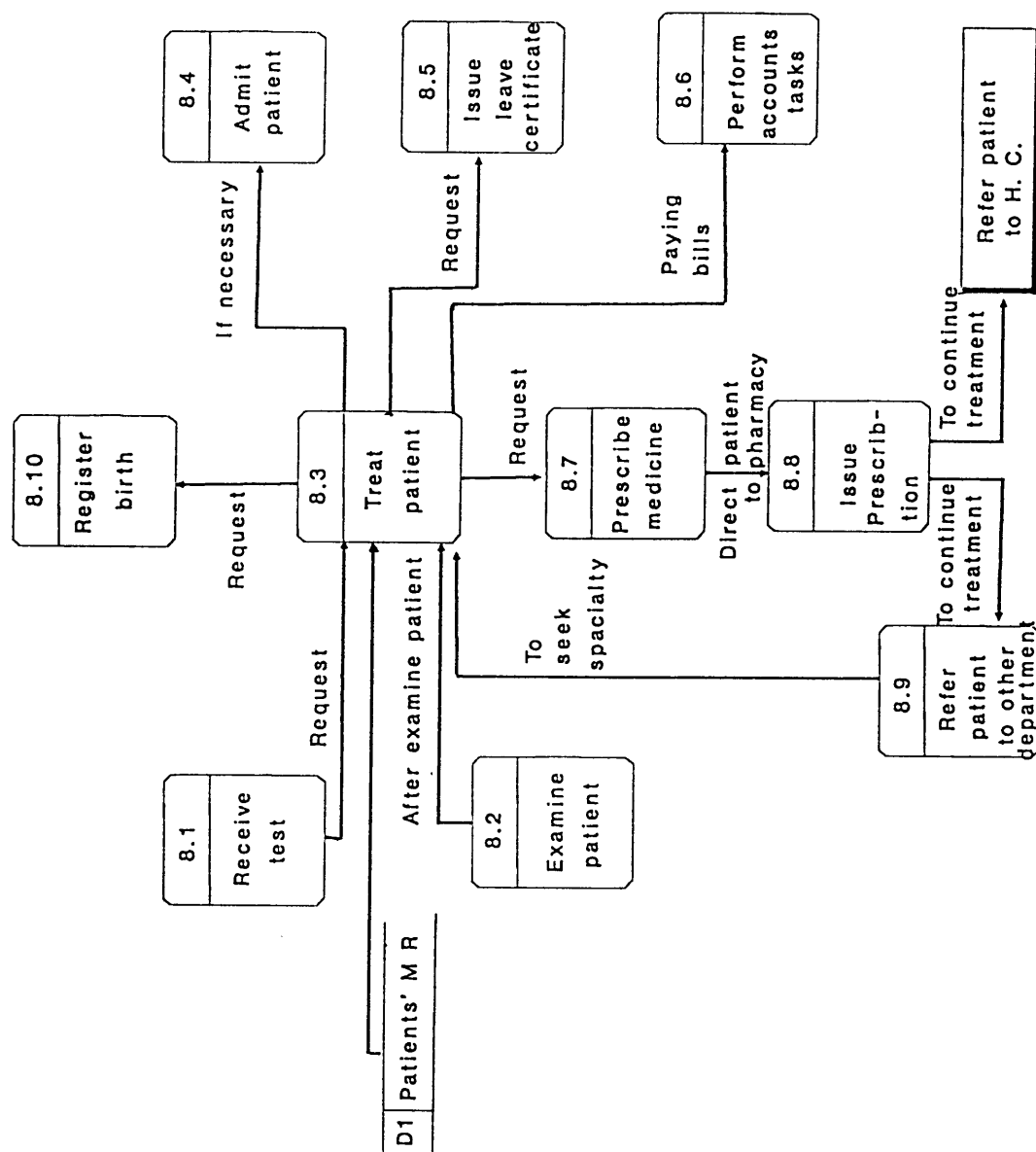


Figure 4.30 Data flow diagram for patient treatment

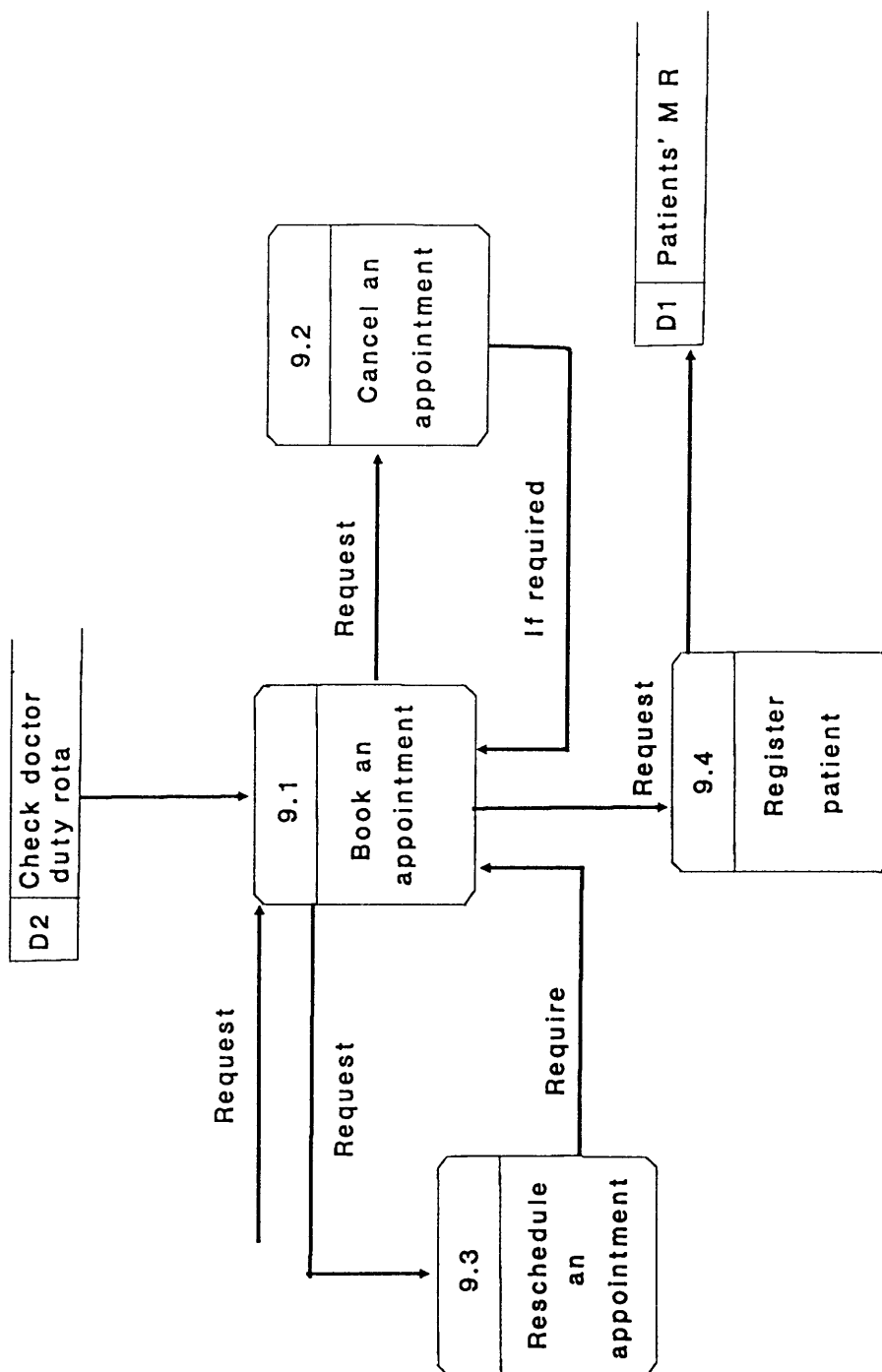


Figure 4.31 Data flow diagram for appointment booking

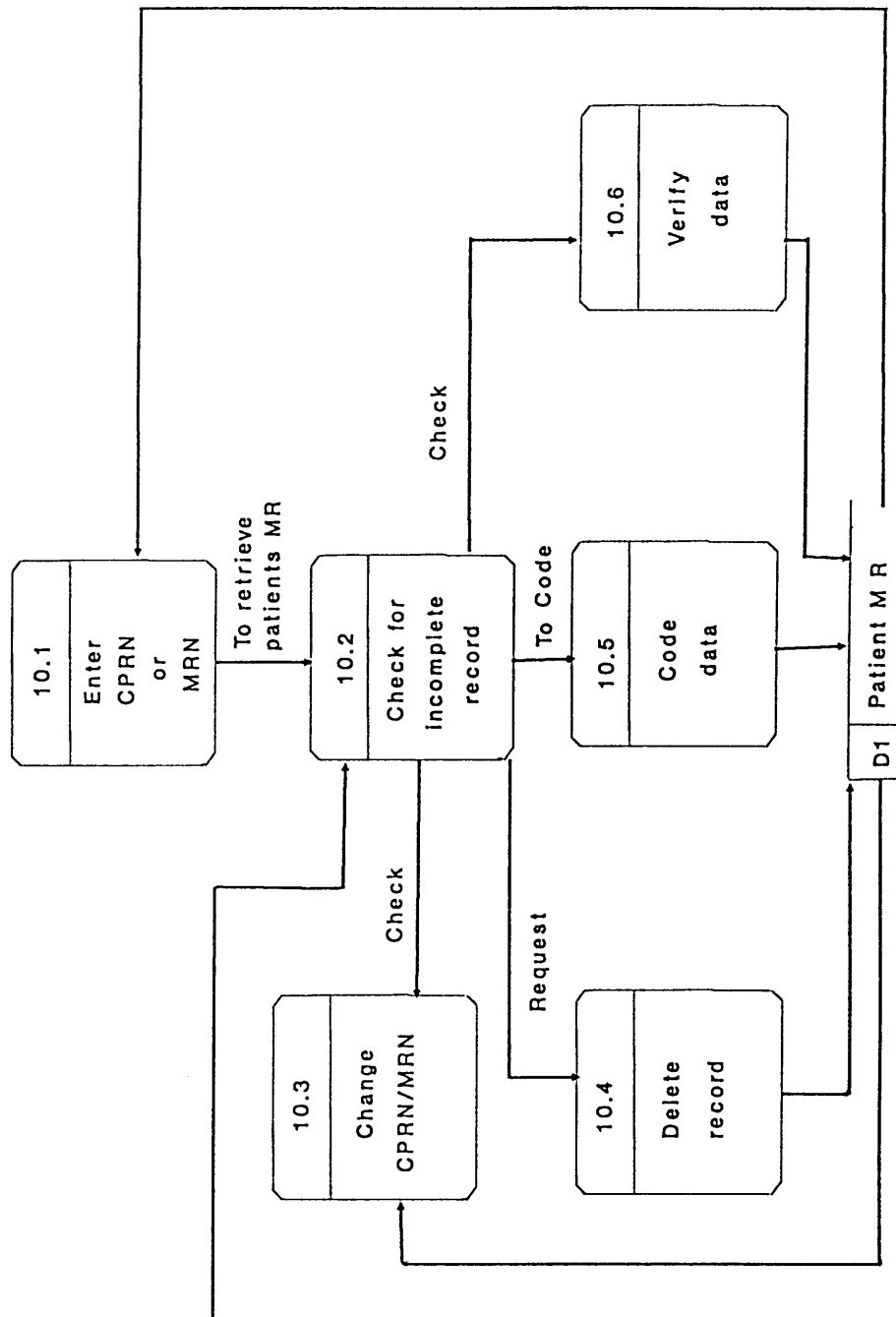


Figure 4.32 Data flow diagram for file maintenance

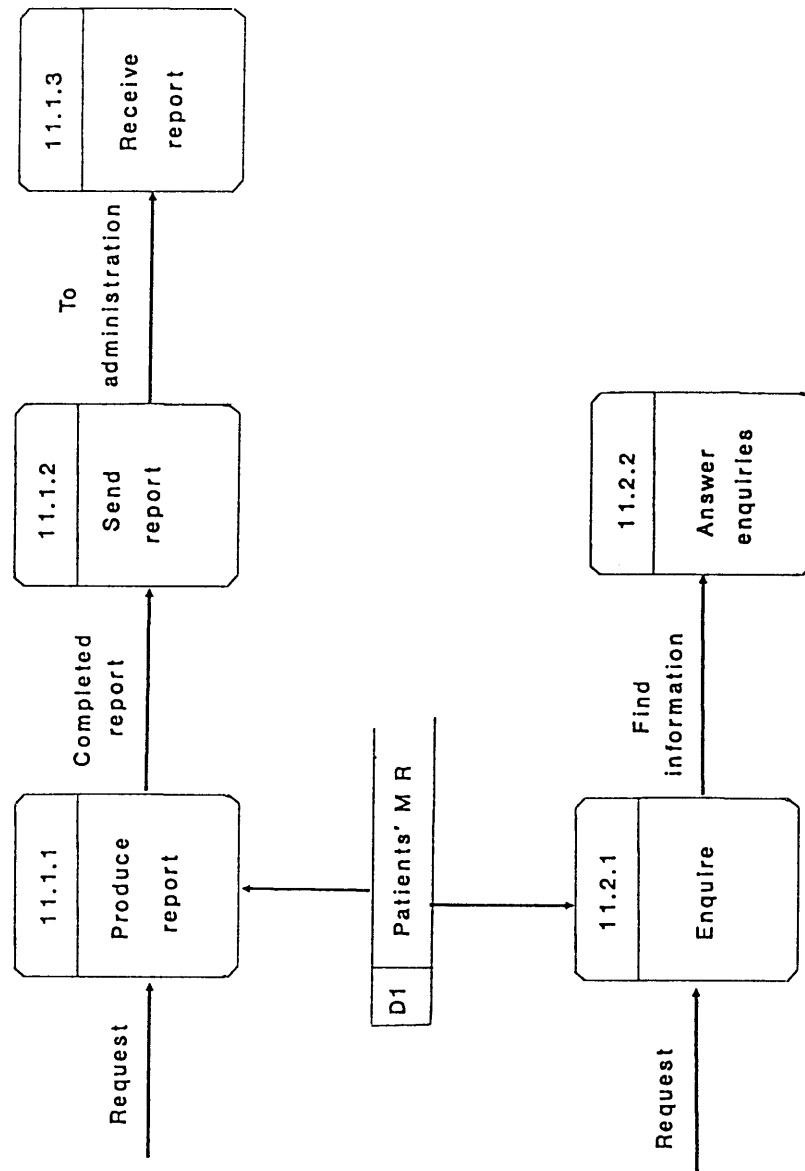


Figure 4.33 Data flow diagram for report & enquiry

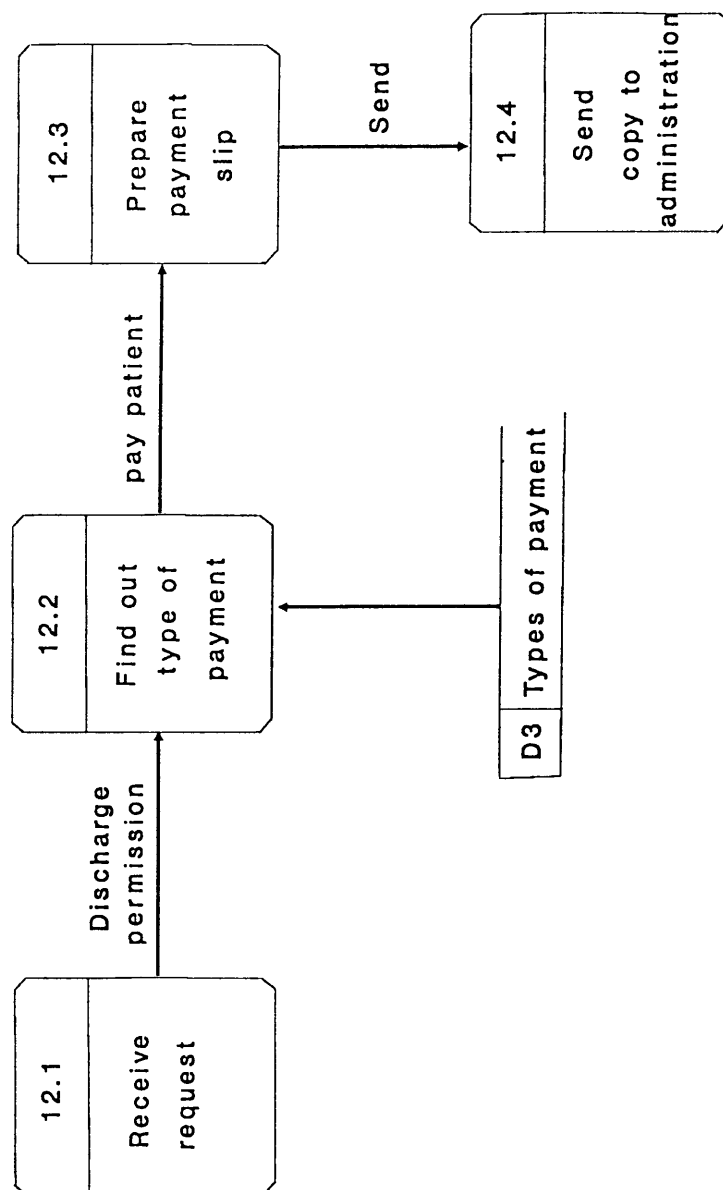


Figure 4.34 Data flow diagram for payment slip

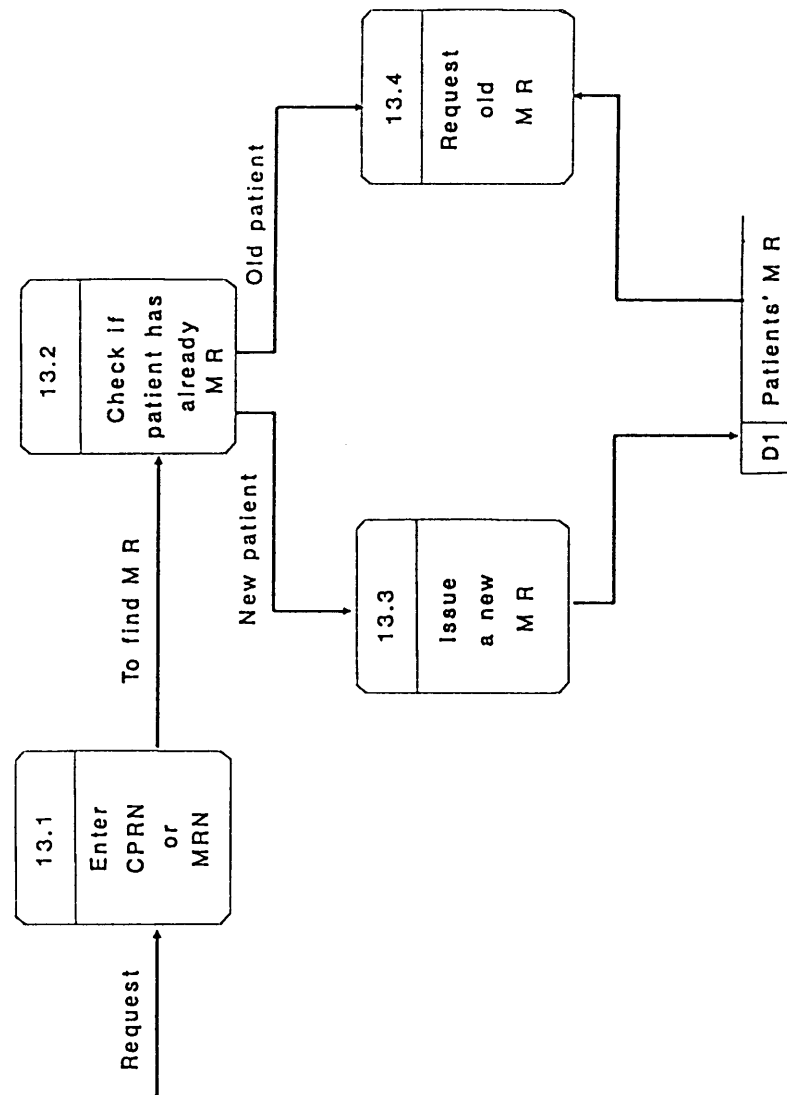


Figure 4.35 Data flow diagram for medical record

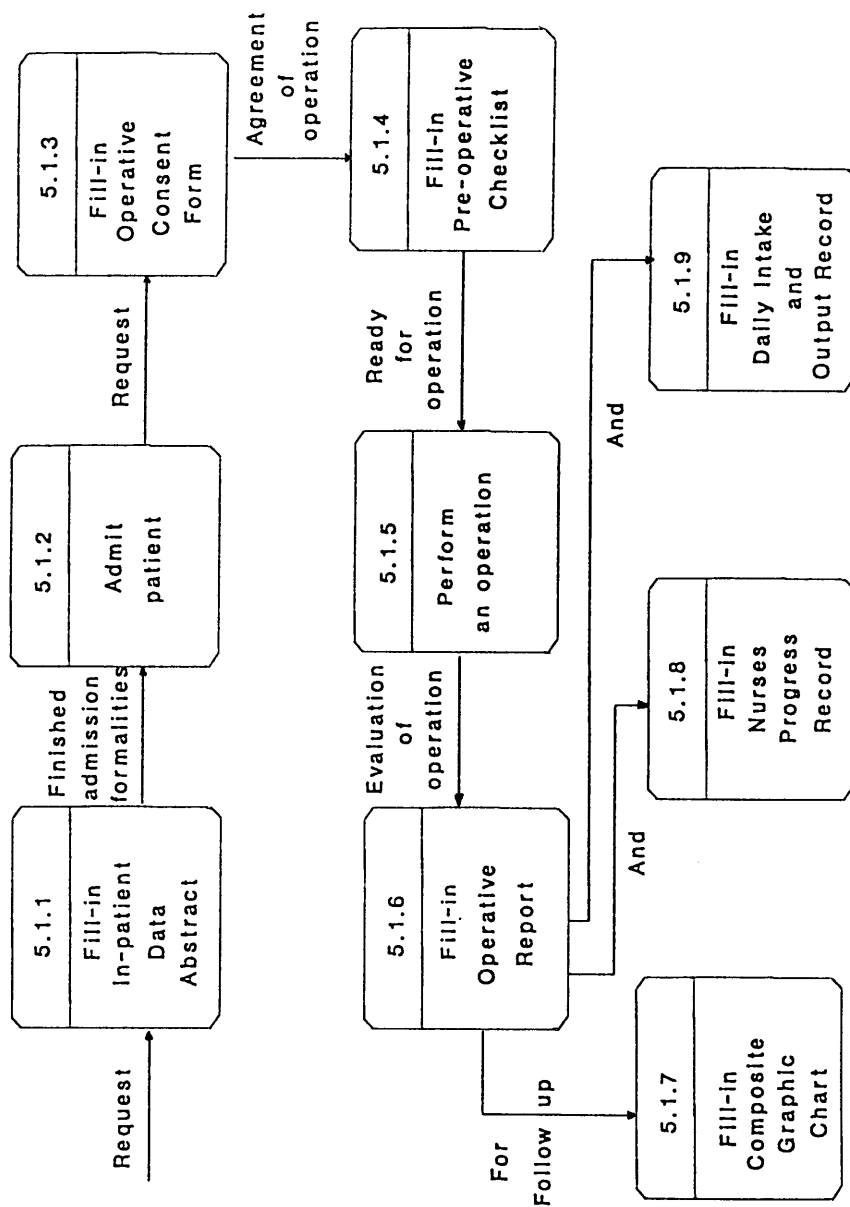


Figure 4.36 Lower level data flow diagram for patient admission

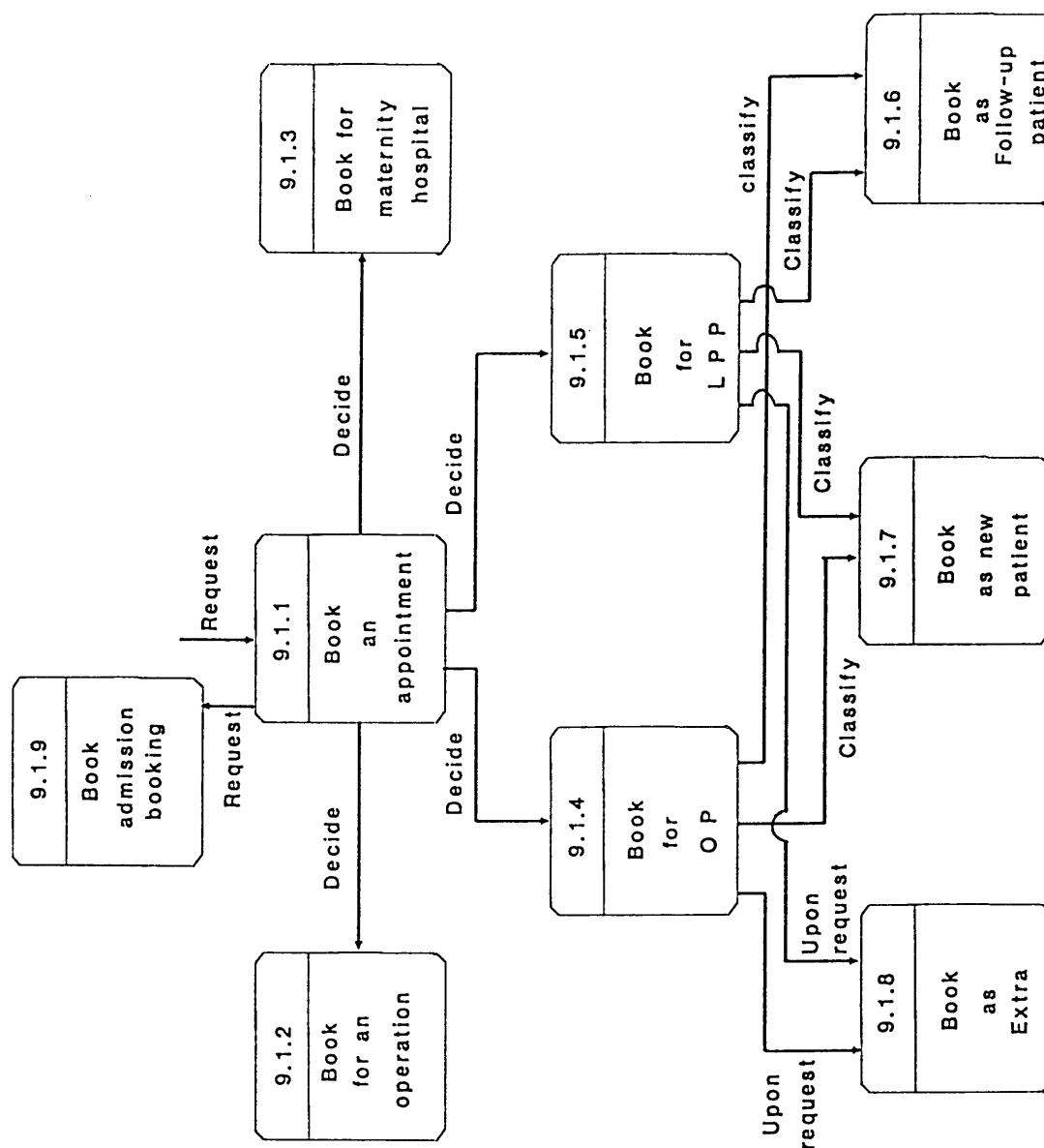


Figure 4.37 Lower level data flow diagram for appointment booking

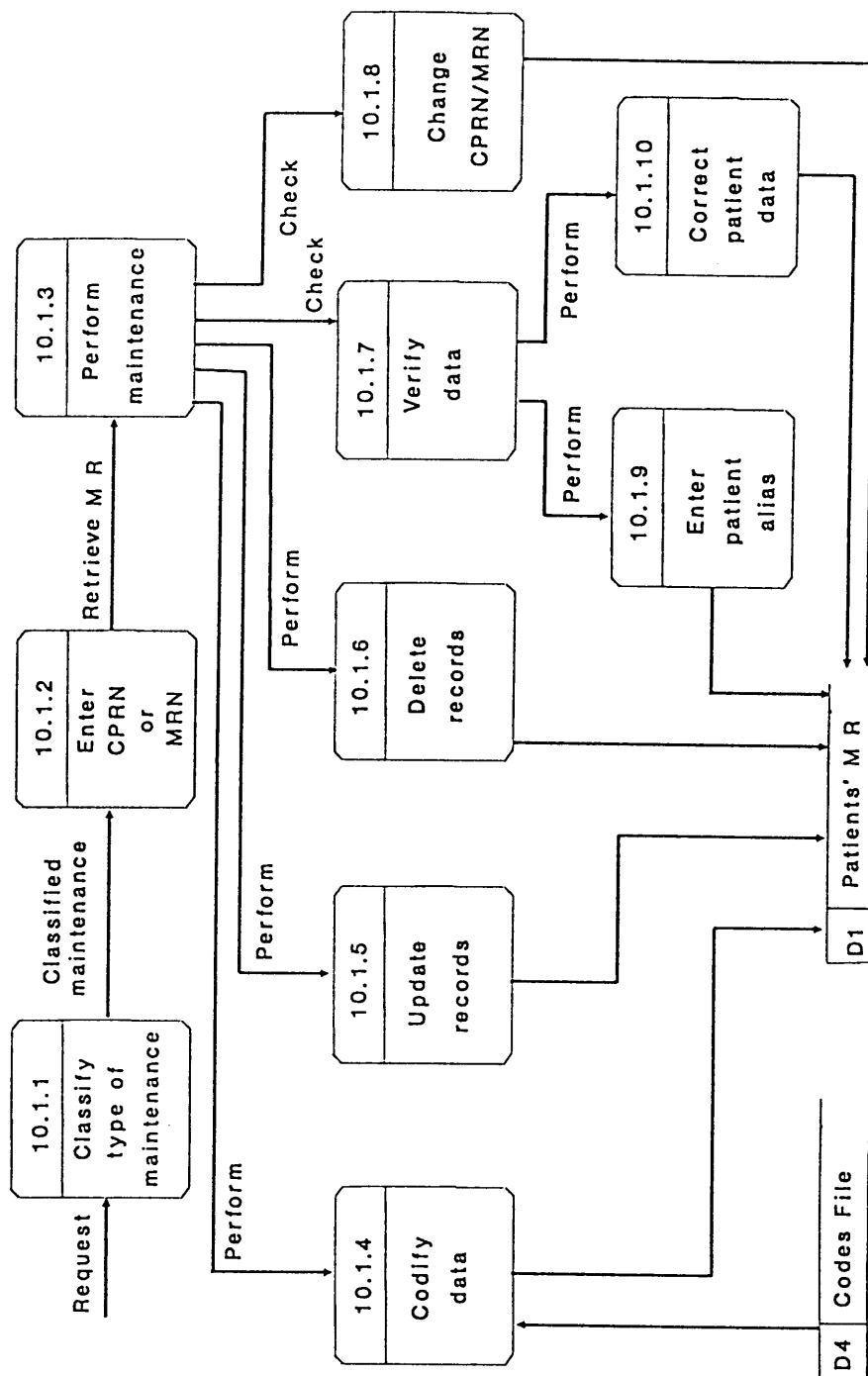


Figure 4.38 Lower level data flow diagram for file maintenance

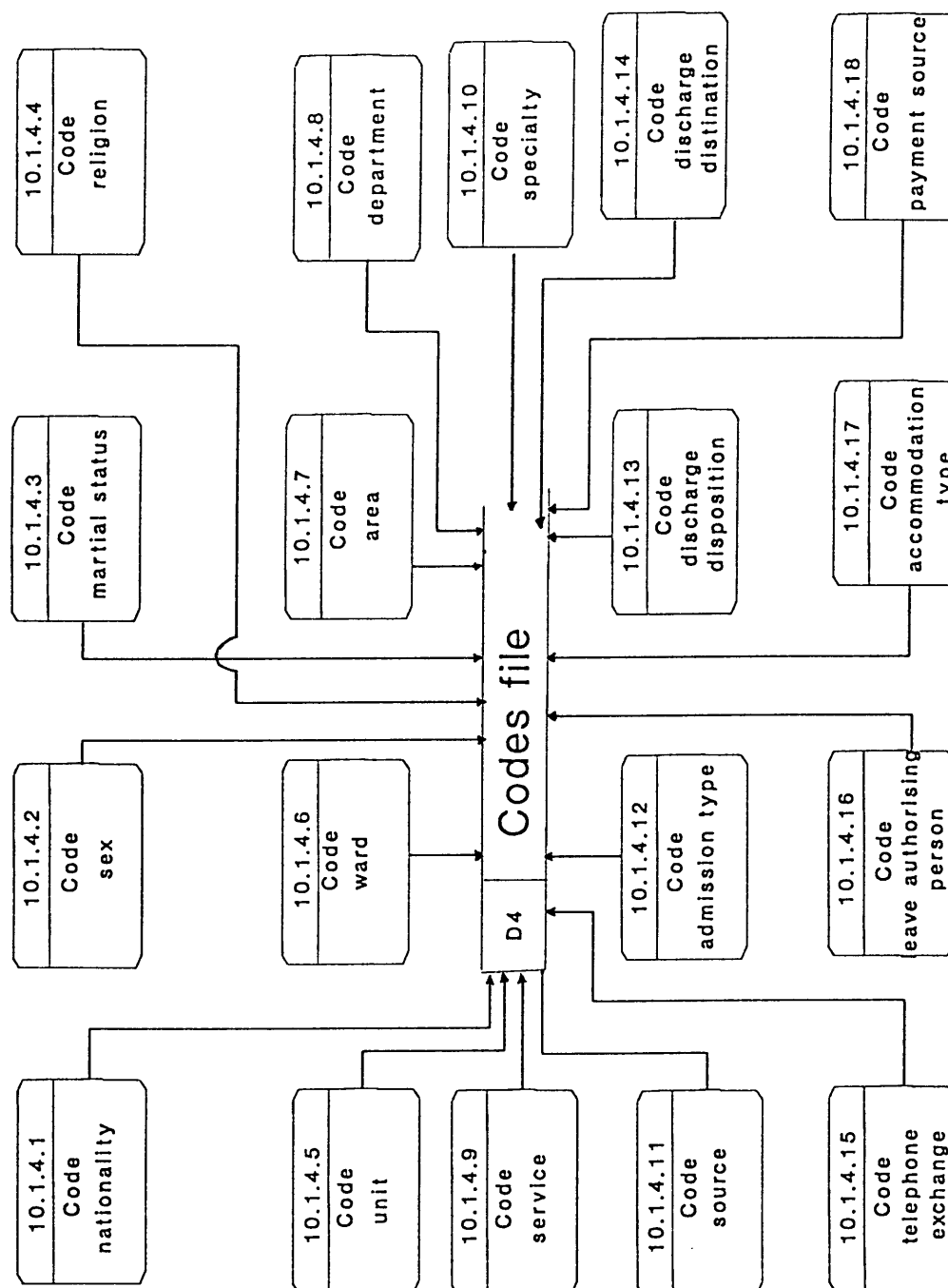


Figure 4.39 Lower level data flow diagram for coding data (cont.)

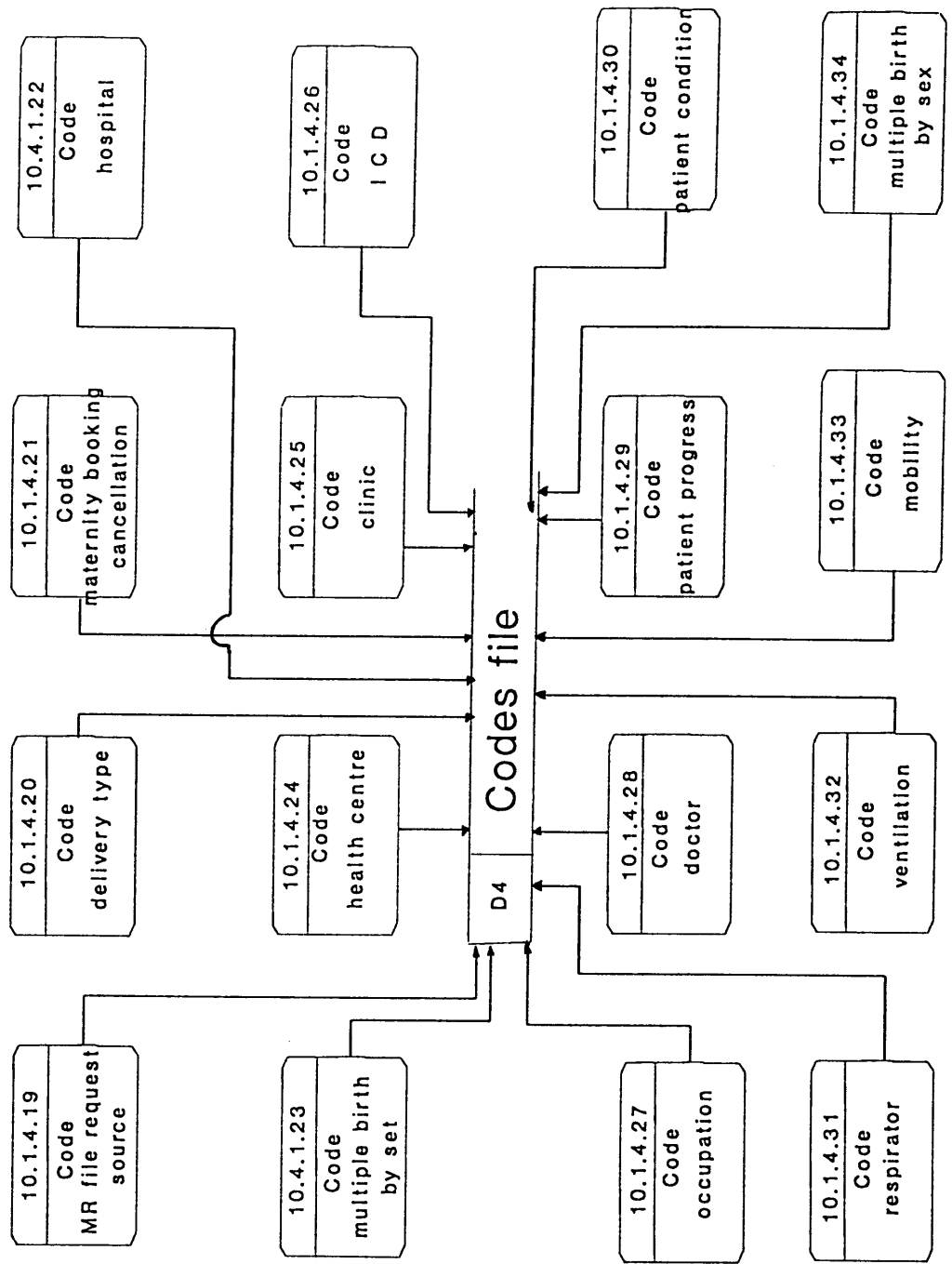


Figure 4.39 Lower level data flow diagram for coding data

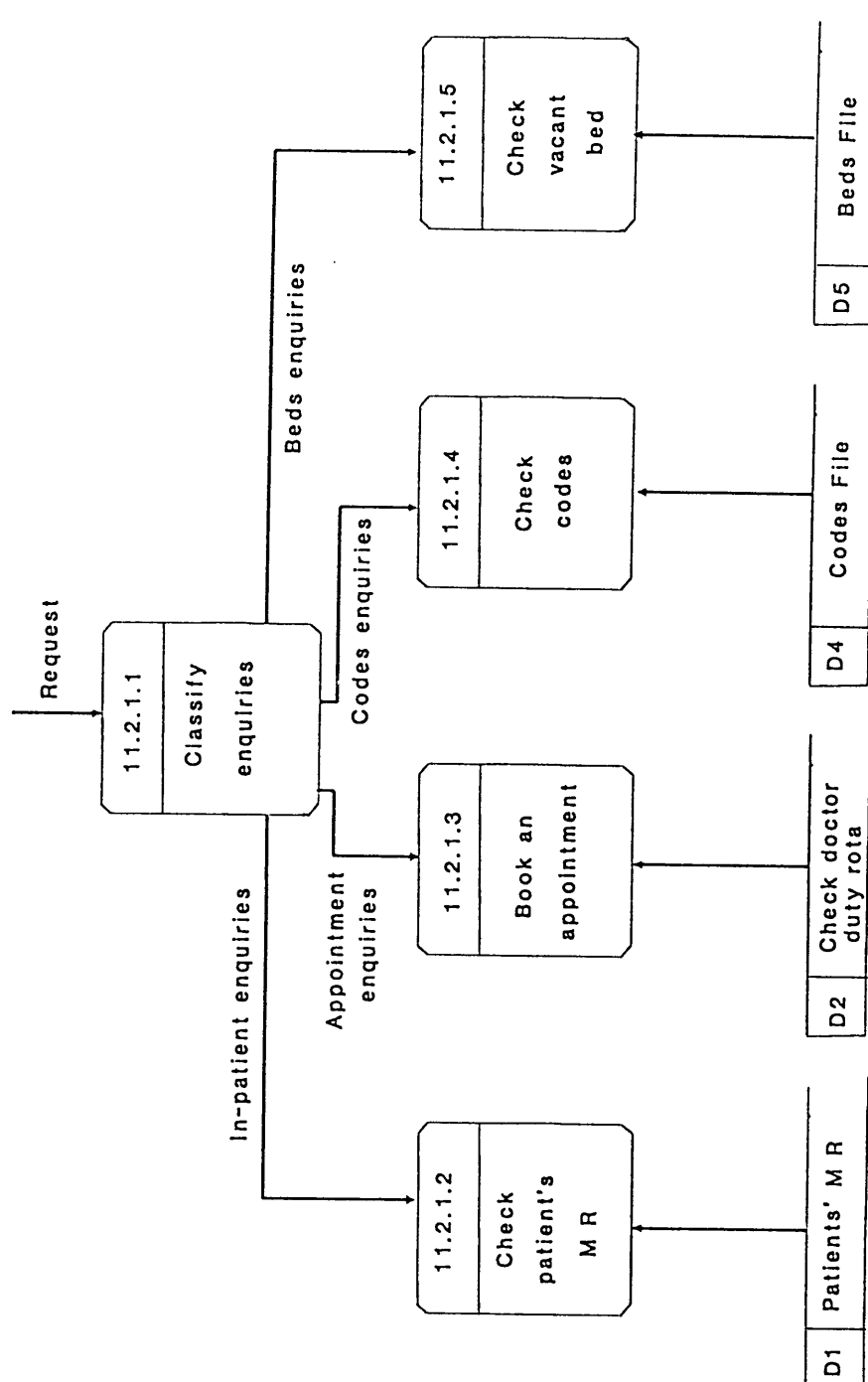


Figure 4.40 Lower level data flow diagram for enquiry

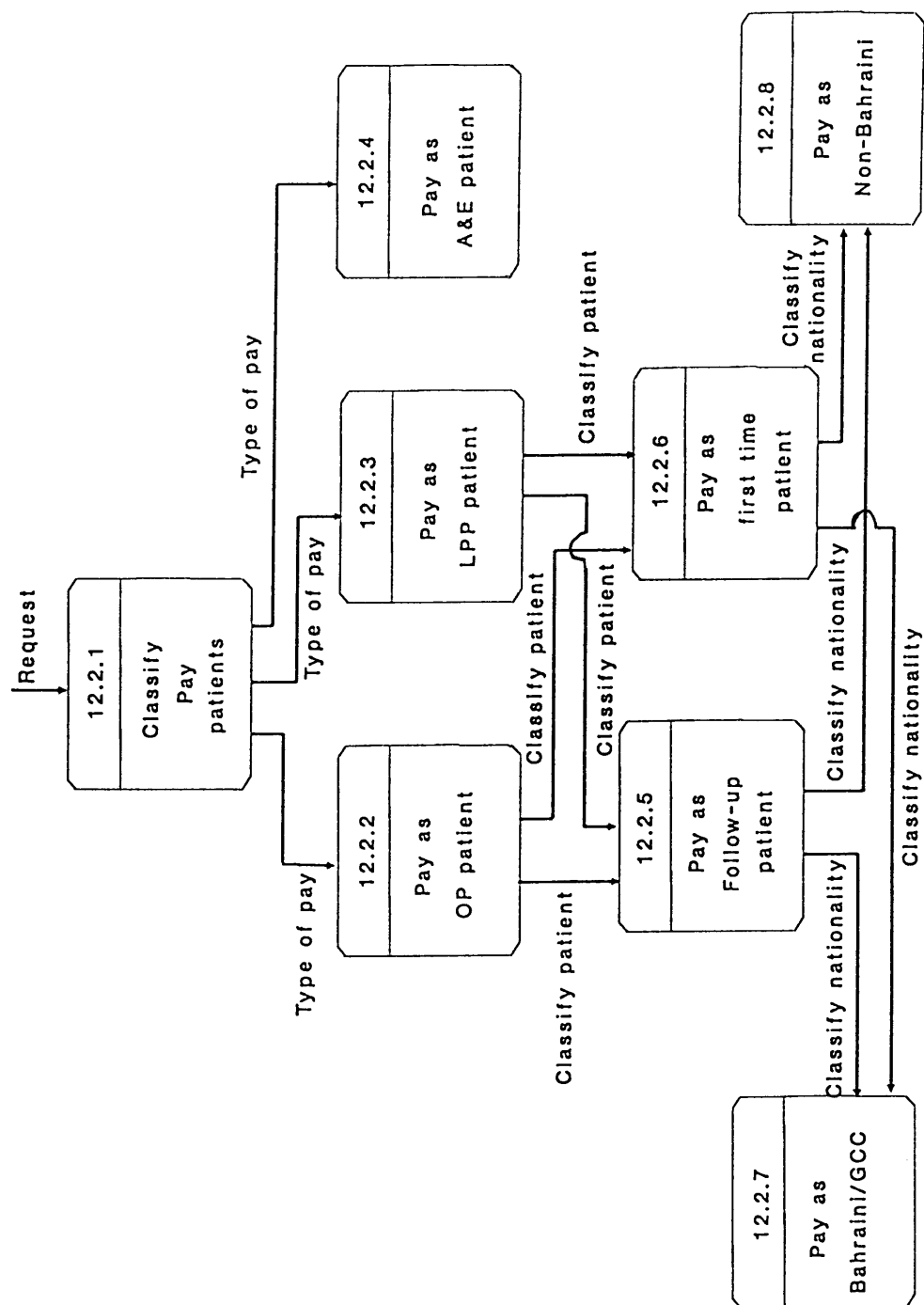


Figure 4.41 Lower level data flow diagram for type of payment

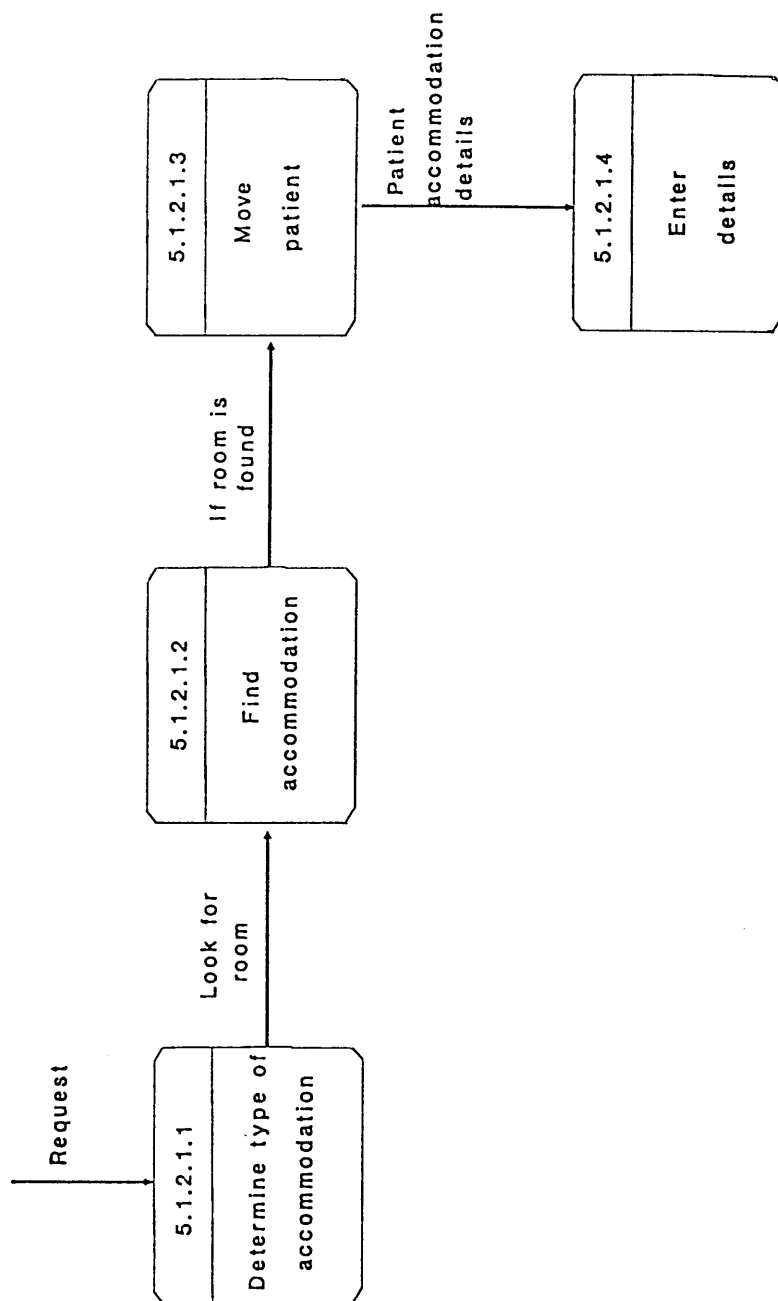


Figure 4.42 Lower level data flow diagram for patient admission

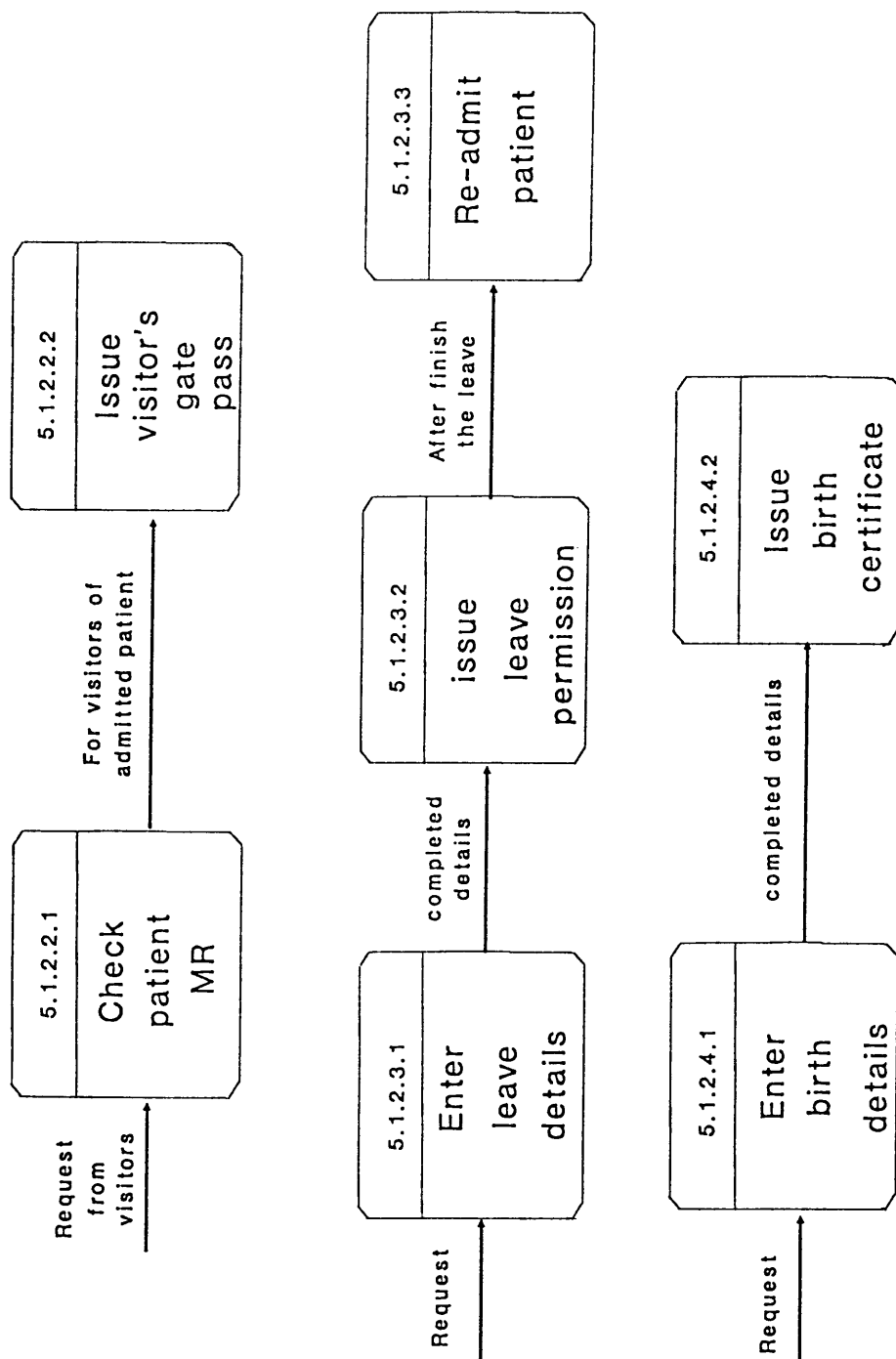


Figure 4.43 Lower level data flow diagram for patient admission

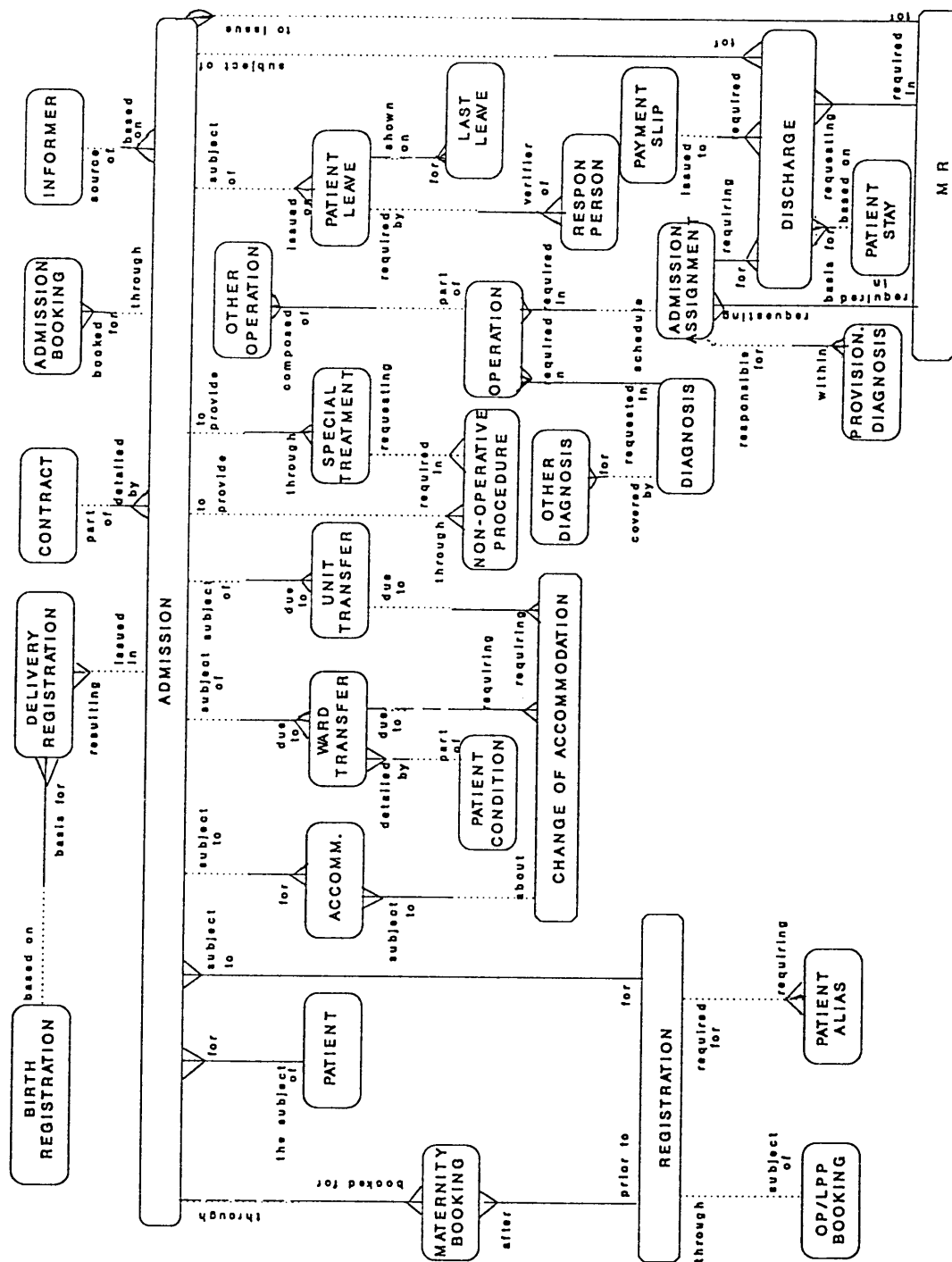


Figure 4.44 ATD entity relationship (cont.)

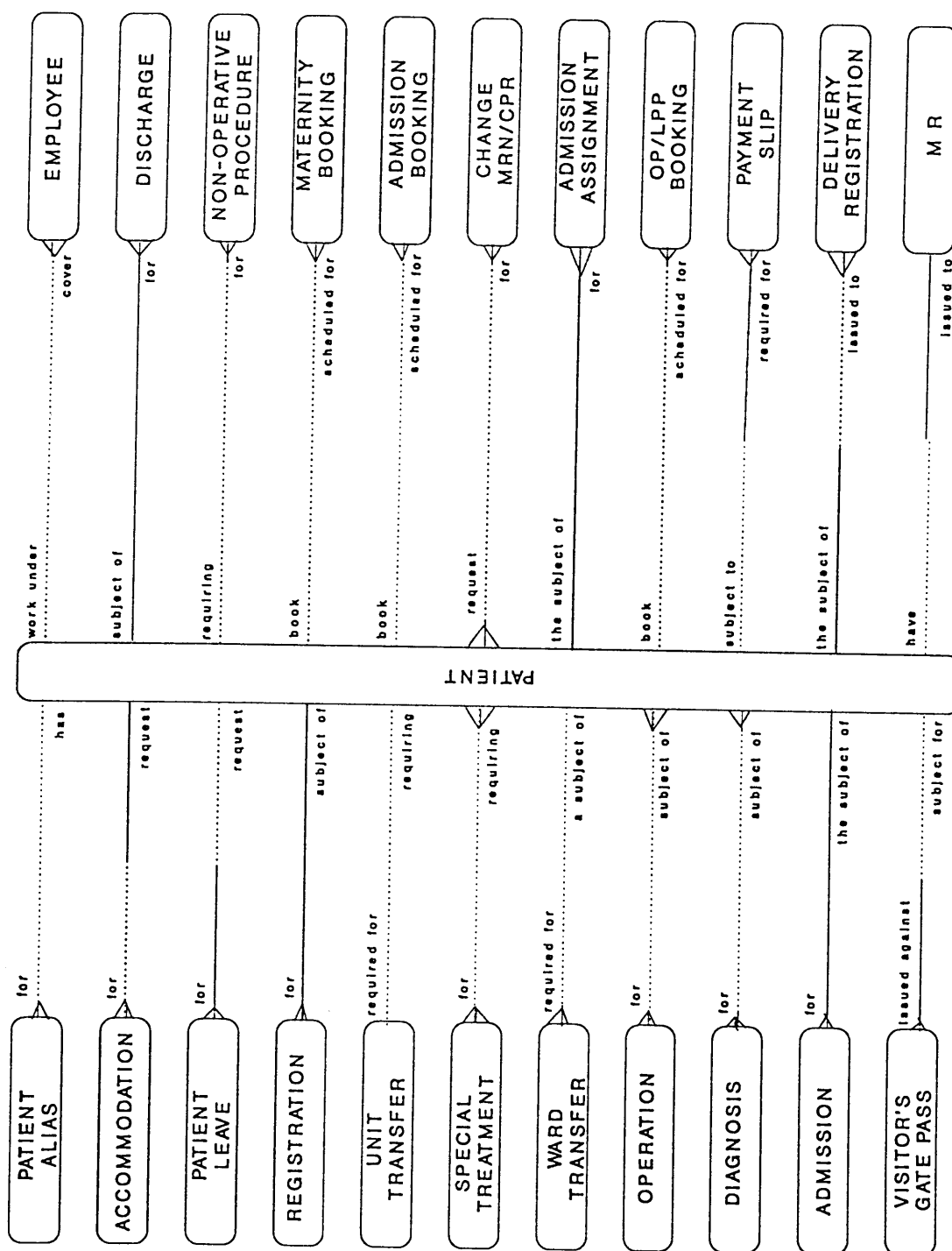


Figure 4.44 ATD entity relationship

Chapter 5: Application Design

5.1 Stage 3: Analysis and Design of Socio-Technical Aspects

5.1.1 Social Objectives

1. To be accepted by the people who perform the main roles in the Ministry of Health (MOH).
2. To deliver an improved patient service.
3. To help the different staff in providing better organised services to the patients.
4. To provide better communications between the different hospital departments.
5. To reduce the workload on the staff.
6. To encourage the researchers to do more investigations regarding different aspects of health problems.
7. To be understood by and acceptable to the staff.
8. To accept the technical jargon.
9. To accept the logical applications.

5.1.2 Technical Objectives

1. Achieve faster services for the patients.
2. Minimize patients' waiting time for any service.

3. Provide a faster and more accurate way of handling patients' information.
4. Reduce the amount of paperwork.
5. Reduce the interdepartmental communications time.
6. Provide a better integrated way of helping departmental communications.
7. Provide a faster way of storing, retrieving and updating patients' information.
8. Utilise easy to use facilities for enquiries and a report writer.
9. Provide opportunities for future integration of a patients Health Care System.
10. Provide security and controlled user access to patients' information.

5.1.3 Social Alternatives

- S1. Computerised information system with on-line facilities.
- S2. Building a new hospital and employing new staff to maintain the manual system.
- S3. Computerised information system with batch processing.

5.1.4 Technical Alternatives

- T1. Distributed data base involves the use of a number of microcomputers which are physically remote from each other, but which are linked to each other by a data transmission network.

T2. Distributed data base involves the use of a central computer and a number of independent microcomputers which are physically remote from each other, but which are linked to each other by a data transmission network.

T3. Centralised computer system with database and terminals connected on-line to them to consolidate files which hold data relating to the whole operations.

T4. Centralised Computer system with database and terminals connected on-line to them to consolidate files which hold data relating to major operations.

T5. Different information systems organised for each type of application according to the area of work. The different systems are on the same hardware system.

T6. Different information systems organised for each type of application according to the area of work. The different systems are on separate hardware systems.

5.1.5 Advantages and Disadvantages of Social Alternatives

5.1.5.1 Advantages of S1

1. Enquiries can be made of the system and transactions can be applied to it at any time during the hours that the system is on-line.

2. 'Instant' information can be retrieved from the system.

3. The speed of response is very quick.

4. Answers are up-to-date reflecting the current situation.

5. If data transmission facilities are used, then departments which are geographically remote from each other may reap the benefits of instantly-available, up-to-date

information.

5.1.5.2 Disadvantages of S1

1. The costs of direct access backing store, terminals, software and data transmission.
2. Updating-in-place is less secure.
3. A standby system will have to be provided in case of hardware or software failure.
4. Difficulty with auditing because many users, often at remote points, may have access to the system's file.

5.1.5.3 Advantages of S2

1. Reduce the workload on the staff.
2. Provide job opportunities.
3. Reduced patient's waiting time.

5.1.5.4 Disadvantages of S2

1. The cost is very high.
2. It is a short-term solution.
3. There would be no improvements regarding departmental communications.

4. Most of the objectives may not be achieved.

5.1.5.5 Advantages of S3

1. The cost is low since:
 - No special hardware, such as VDUs are required
 - Magnetic tapes can be used for data storage.
2. Most computer configurations would be able to carry out the functions.
3. No special software is needed; any operating system would be able to handle such a job.
4. Because the raw data is input in one or more batches, it is easy to control.
5. When updating by copying, a new version of the master file(s) is automatically created.

5.1.5.6 Disadvantages of S3

1. Reports are only produced once per period.
2. It is not possible to interrogate the system as and when queries arise.
3. When reports are produced, the data in them is already out-of-date.
4. The time taken to prepare the data, verify it, validate it, update the file(s) and distribute the output will mean that inaccuracies will inevitably creep in.
5. Because the update run happens cyclically, peaks of work occur in the department(s)

responsible for inputting raw data to the periodic run and dealing with its output. This, in extreme circumstances, may lead to staffing level problems.

6. Information may be incomplete if exceptional requirements are called for in a processing cycle. Only expensive changes can remedy these faults.

5.1.6 Advantages and Disadvantages of Technical Alternatives

5.1.6.1 Advantages of T1

1. A cost saving regarding the hardware and data communication.
2. Information should be available faster.
3. Local data processing may well lead to increased user involvement. This should lead to faster and cheaper systems development.
4. Back-up can be more easily provided, as the failure of one of the elements in a system does not render the whole of the system.
5. Security can be enhanced, as important documents and files do not need to be moved around physically.
6. As validation and error-correction can be handled locally, it should be more efficient.

5.1.6.2 Disadvantages of T1

1. Costs have to be carefully examined.
2. Security will have to be considered, as a badly-administered distributed data

processing system is likely to lead to abuse.

3. Much training will have to be undertaken, since increased user involvement will have to be accompanied by increased user knowledge.

4. Inconsistencies can creep in if there is increased user autonomy.

5. Thought will have to be given to the location of data. A compromise must be arrived at between minimizing communication costs and minimizing storage costs.

5.1.6.3 Advantages of T2

1. Information should be available faster.

2. The system is broader. Information about any aspect of an application can be accessed by management, as and when required, and up-to-date answers will be forthcoming.

3. Management can react more quickly and in a better informed manner when decisions need to be made.

4. Back-up can be more easily provided, as the failure of one of the elements in a system does not render the whole of the system.

5. Security can be enhanced, as important documents and files do not need to be moved around physically.

6. Control is facilitated; checks can be built into the data base system in an attempt to ensure that only correct data is used for updating.

7. The inconsistencies are eliminated.

5.1.6.4 Disadvantages of T2

1. Costs, are high.
2. Much training will have to be undertaken.
3. Inconsistencies can creep in if there is increased user autonomy.
4. Thought will have to be given to the location of data. A compromise must be arrived at between minimizing communication costs and minimizing storage costs.
5. Security problems, such as how is unauthorized access to be prevented.

5.1.6.5 Advantages of T3 & T4

1. The system is broader. Information about any aspect of an application area can be accessed by management, as and when required, and up-to-date answers will be forthcoming.
2. Management can react more quickly and in a better informed manner when decisions need to be made.
3. Resources are used more efficiently because there is less duplication all around.
4. Control is facilitated; checks can be built into the data base system in an attempt to ensure that only correct data is used for updating.
5. The inconsistencies are eliminated.

6. The data items are independent of the programs which use them. Only the software which looks after the database needs to be changed if the characteristics of a data item changes.
7. Data items can be easily found since they are arranged logically.
8. Security can be enhanced, as only authorized users will be allowed access to the data.
9. The work of auditing the system should be eased.

5.1.6.6 Disadvantages of T3 & T4

1. The complexity of each systems creates planning and coordination difficulties, and means that the time taken to investigate, design and implement such system will be greater.
2. The costs are also high.
3. The integrated nature of such systems means that they often cut across traditional departmental boundaries. This can lead to much resistance.
4. They are difficult to thoroughly test.
5. Security problems, such as how is unauthorized access to be prevented.
6. Flexibility is a problem, when circumstances change requiring alterations in the system.

5.1.6.7 Advantages of T5

1. Easy to plan, design, develop and implement.
2. Maintenance is cheap.
3. Security can be enhanced.
4. Validation and error-correction can be handled locally.
5. Back-up can be more easily provided, as failure of one of the elements in the system does not affect others.
6. Increased user involvement.

5.1.6.8 Disadvantages of T5

1. Data may well be defined and classified differently for different systems.
2. It leads to duplication of processing.
3. Data is duplicated on the files. Not only is this wasteful, but it can lead to the further problem of inconsistency.
4. If details about, for example, a patient should need to be altered, then the new items of data will have to be input separately to the different systems, and updating processes will have to be carried out in the different systems.
5. Back-up files will also hold much duplicated data.

6. The processing systems are not sufficiently broad to aid management decision making as much as they might because they each concentrate on one application.
7. The costs are high, if mini or mainframe computers are used.

5.1.6.9 Advantages of T6

1. Easy to plan, design, develop and implement.
2. Maintenance is cheap.
3. If microcomputers are used, then there will be cost savings.
4. Back-up can be more easily provided, as the failure of one of the systems does not affect other systems.
5. As validation and error-correction can be handled locally, it should be more efficient.
6. Security can be enhanced as documents and files do not need to be moved around physically.
7. Increased user involvement.

5.1.6.10 Disadvantages of T6

1. Data may well be defined and classified differently for different systems.
2. It leads to duplication of processing.
3. Problems of inconsistency.

4. If details about data items should be altered, then the new items of data will have to be input separately to the different systems, and updating process will have to be carried out in the different systems of the different hardware.
5. Back-up files will also hold much duplication data.
6. The processing systems are not sufficiently broad to aid management decision making as much as they might, because they each concentrate on one application.

5.1.7 Options Selection

The following summarizes my findings with regard to the target alternatives. I shall abandon some, explaining the reason for this abandonment, and postulate my conclusion and recommended alternative.

By assessing the social alternatives, I decided to abandon the alternative S2 - building a new hospital and employing new staff to keep the manual system. Although, this alternative may help to achieve some of the objectives, this achievement is just a partial solution to the problem and it is also short-term requiring much more money. The alternative S3 - Computerised information system with batch processing, is not feasible either. There are two reasons for this infeasibility: 1- user satisfaction would be lost using the batch system, and 2- speed of response is needed especially in answering enquiries and producing reports. So, the only option which is left from the social alternatives, is the alternative S1 - Computerised information system with on-line facilities.

By assessing the technical alternatives T5 and T6, (see Figure 5.1) I call for the abandonment of the alternatives S1-T5 and S1-T6, because they will not help achieve the proposed integrated system.

Furthermore, the four socio-technical alternatives which were viable were S1-T1, S1-T2, S1-T3, S1-T4. But, after considering the costs and benefits of these alternatives, I decided to abandon the alternatives S1-T3 and S1-T4 because they are costly.

Examining the advantages and disadvantages of the technical alternatives T1 and T2, and by presuming that the central computer is mini or mainframe in the alternative S1-T2, I decided to abandon the alternative S1-T2. Today's PCs are powerful machines, which offer the necessary processing for applications, which were only offered in mini and mainframes computers ten years ago (Cobbold 1990). PCs provide a powerful stand-alone PC-net-work, supported by the new powerful processors, megabytes of RAM and hard disk in gigabytes, to offer real competition to the mini and mainframes computers in the network computing environment (Cobbold 1990). This powerful computerisation is without a massive investment, and they are within the limits of the budget. They are available in the market with the reduced price of under BD 240 (£ 400) (Moor 1990), and with much less requirements for maintenance (Cobbold 1990). PCs are preferred by the users for their ease of use, flexibility and autonomy. Today, they are replacing the mini and the mainframes in the public sectors in general and the health sector (Bruton 1990) in particular. Many hospitals are now using PCs for their information systems.

In conclusion, I recommend distributed database involving the use of a number of microcomputers which are physically remote from each other by a data transmission network with on-line connected to them, for the proposed ATD information system.

5.1.8 Recommendations

1. Provide a user friendly menu-driven system with secured access to the information. Only authorized users should be able to log in and use the data. Controls should be varied according to the sensitivity of the data.

2. Provide an easy way to answer enquiries & generate reports.
3. Provide integration facilities between the different departments, clinics and wards.

5.1.9 Social Costs

1. Minimal training.

The College of Health Sciences (CHS) which is a part of the MOH, is providing computer courses to all the students enrolled at the different Departments in the College. These courses have been offered since 1984 to the Medical Secretary Department students and since 1988 to all the College students. The computer courses are compulsory for all the students. Many students have already graduated, and currently work at the different departments of the MOH. Part-time courses have also been offered to the MOH employees since 1988.

Training is needed for the following categorised workforce: information providers, operational information users (such as doctors and nurses) and information managers (Smith 1990).

Since some of the system users have already learnt the use of computers, this will help in the training related to the new proposed system.

2. The fear of job redundancy should be reduced, since computerised information systems creates as many jobs as it saves.
3. Even if computerising leads to job losses, the type of workers who are replaced by the computer are in the grades of labour which, in any case, exhibit high rates of labour turnover (Checkland and 1990).

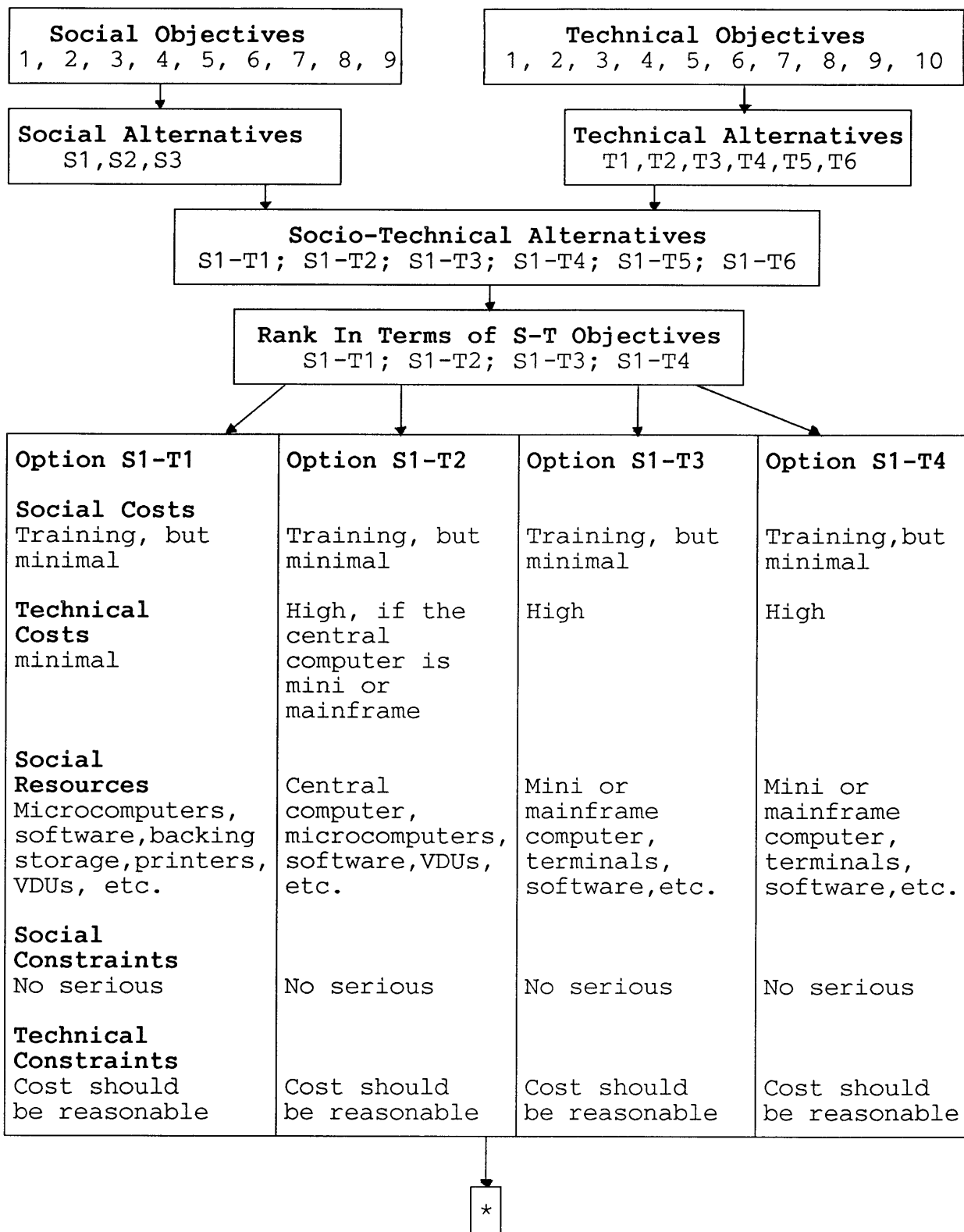


Figure 5.1 Socio-technical outline of the proposed system (cont.)

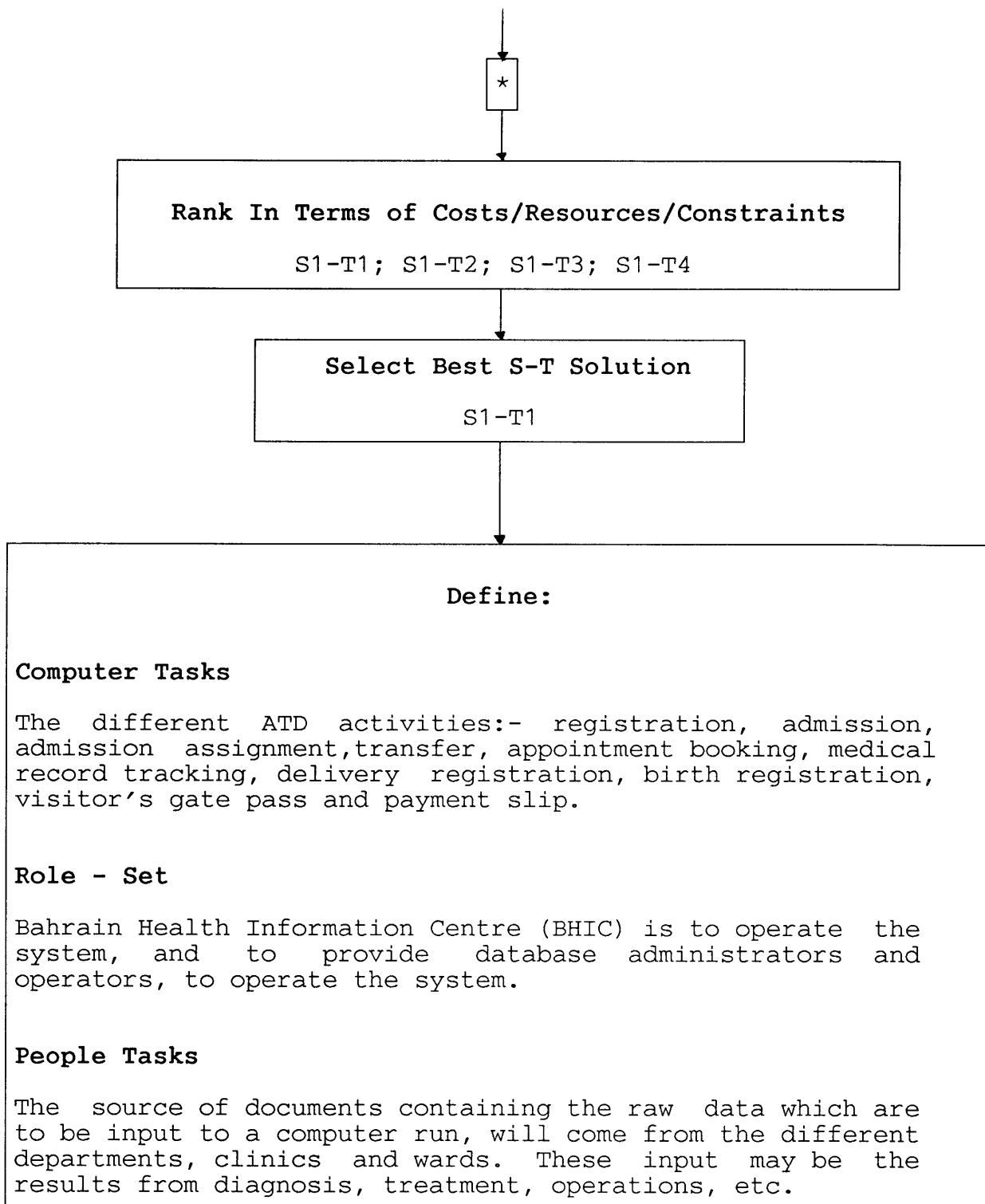


Figure 5.1 Socio-technical outline of the proposed system

5.2 Stage 4: Human-Computer Interaction

5.2.1 Human-Computer Dialogues

The users of the ATD System can be categorised as casual and regular. The regular users who are the clerical and receptionist staff may use the computer system daily to input data or retrieve information. The casual users are supervisors, ward doctors, ward nurses (who are also regarded as regular users) and top or middle level managers. But since these users are not trained operators, they may fear some technical jargons of computers. Therefore, an easy system is required for this type of users. Accordingly, a menu-driven system may help facilitate the mission of these users, in that the functions can be split into subfunctions, enabling the users to go from one function to another in a hierarchical manner. In addition, a single-use screen must be provided in order to avoid mixed and complicated transactions. This would provide a separate screen for insertion, deletion, and updating.

5.2.2 The ATD System Menus

Figures 5.2 to 5.62 show the suggested ATD System menus.

Figure 5.2 Main menu

MAIN MENU	
1.	ATD Information Menu
2.	Medical Record Menu
3.	Appointment Booking Menu
4.	Administration Menu
5.	Reference File Maintenance Menu
6.	Report Menu
7.	Query Menu

Figure 5.3 Second level of main menu; first level of ATD information menu.

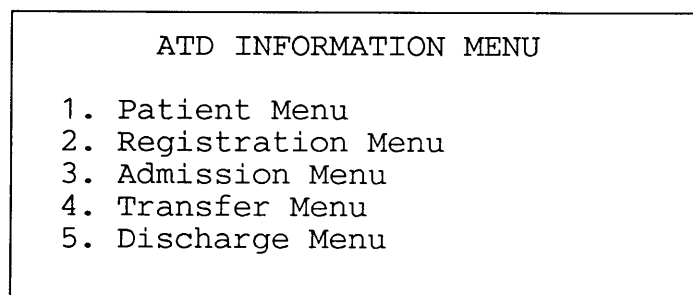


Figure 5.4 Third level of main menu; second level of ATD information menu; first level of patient menu.

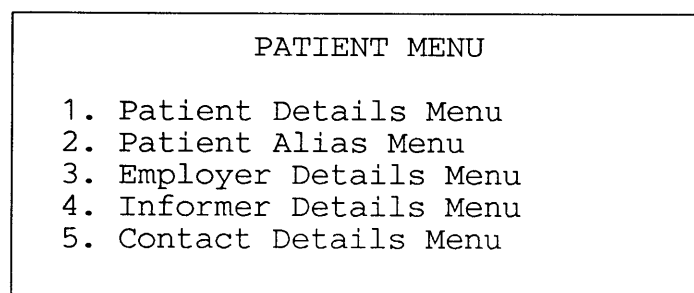


Figure 5.5 Fourth level of main menu; third level of ATD information menu; second level of patient menu; first level of patient details menu.

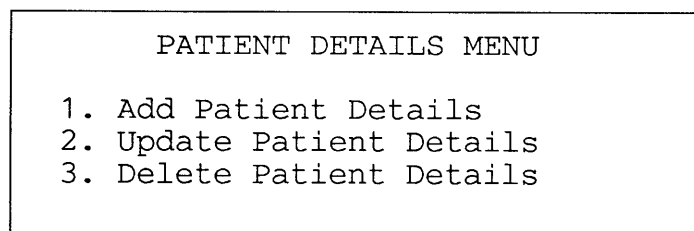


Figure 5.6 Fourth level of main menu; third level of ATD information menu; second level of patient menu; first level of patient alias menu.

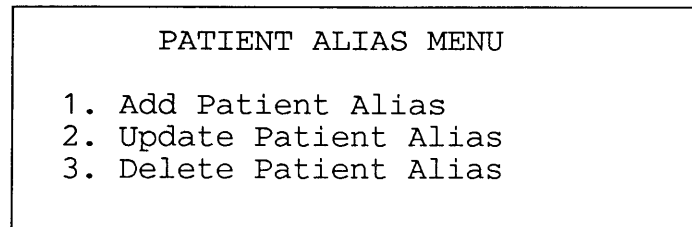


Figure 5.7 Fourth level of main menu; third level of ATD information menu; second level of patient menu; first level of employer details menu.

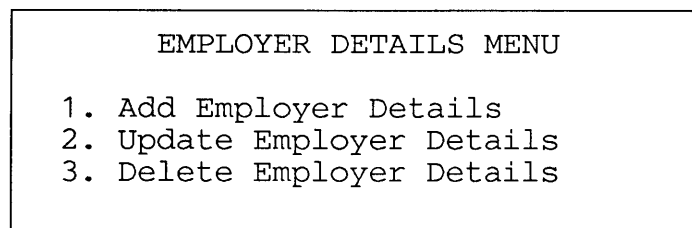


Figure 5.8 Fourth level of main menu; third level of ATD information menu; second level of patient menu; first level of informer details menu.

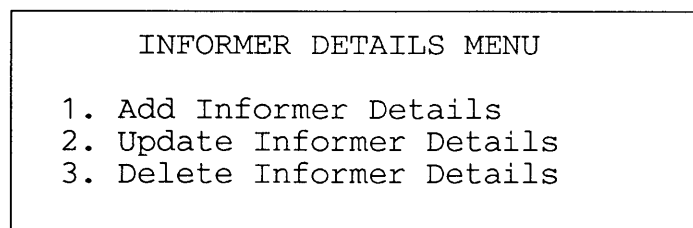


Figure 5.9 Fourth level of main menu; third level of ATD information menu; second level of patient menu; first level of contact details menu.

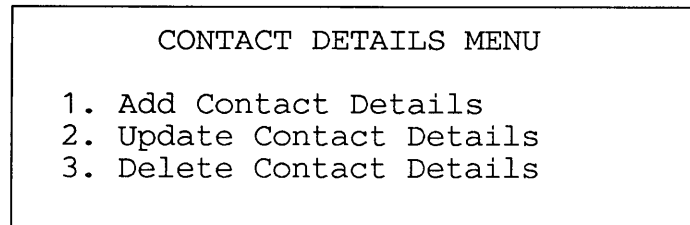


Figure 5.10 Third level of main menu; second level of ATD information menu; first level of registration menu.

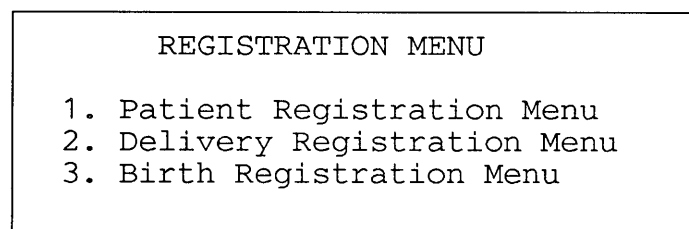


Figure 5.11 Fourth level of main menu; third level of ATD information menu; second level of registration menu; first level of patient registration menu.

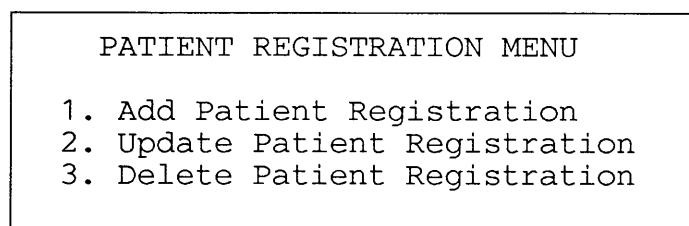


Figure 5.12 Fourth level of main menu; third level of ATD information menu; second level of registration menu; first level of delivery registration menu.

DELIVERY REGISTRATION MENU 1. Add Delivery Registration 2. Update Delivery Registration 3. Delete Delivery Registration
--

Figure 5.13 Fourth level of main menu; third level of ATD information menu; second level of registration menu; first level of birth registration menu.

BIRTH REGISTRATION MENU 1. Add Birth Registration 2. Update Birth Registration 3. Delete Birth Registration
--

Figure 5.14 Third level of main menu; second level of ATD information menu; first level of admission menu.

ADMISSION MENU 1. Patient Admission Menu 2. Admission Assignment Menu 3. Diagnosis Menu 4. Accommodation Menu 5. Operation Menu 6. Patient Leave Menu 7. Special Treatment Menu 8. Non-operative Procedure Menu
--

Figure 5.15 Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of patient admission menu.

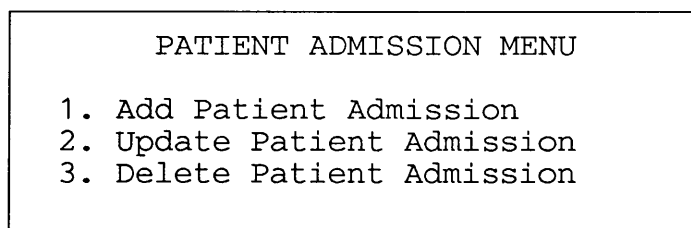


Figure 5.16 Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of admission assignment menu.

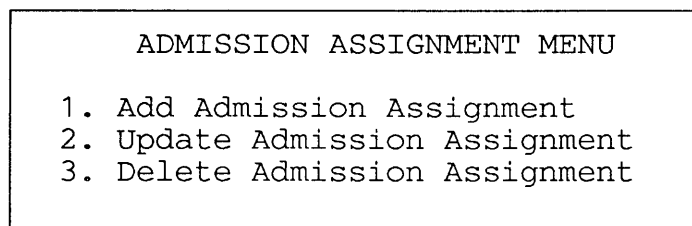


Figure 5.17 Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of diagnosis menu.

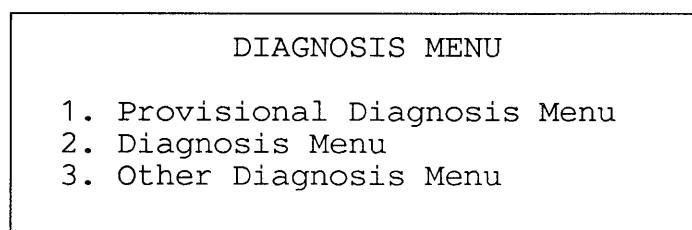


Figure 5.18 Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level diagnosis menu; first level of provisional diagnosis menu.

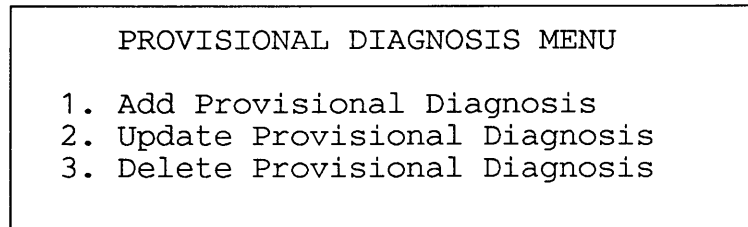


Figure 5.19 Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level diagnosis menu; first level of diagnosis menu.

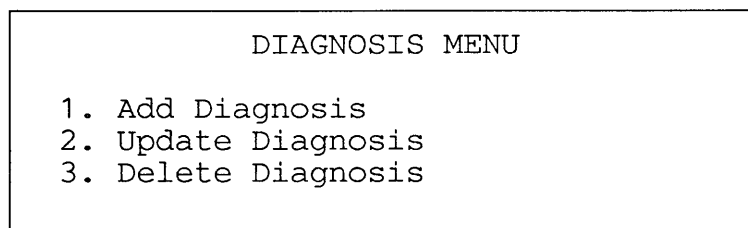


Figure 5.20 Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of diagnosis menu; first level of other diagnosis menu.

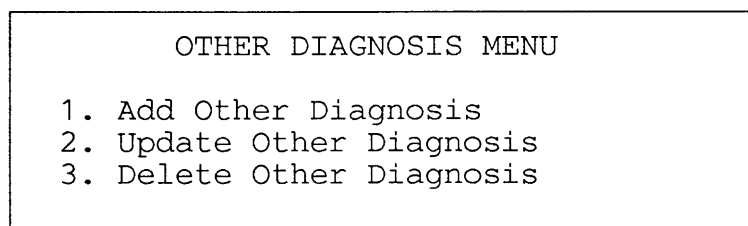


Figure 5.21 Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of accommodation menu.

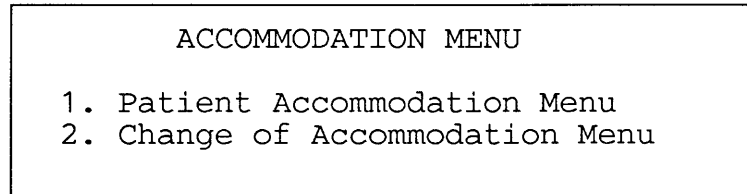


Figure 5.22 Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of accommodation menu; first level of patient accommodation menu.

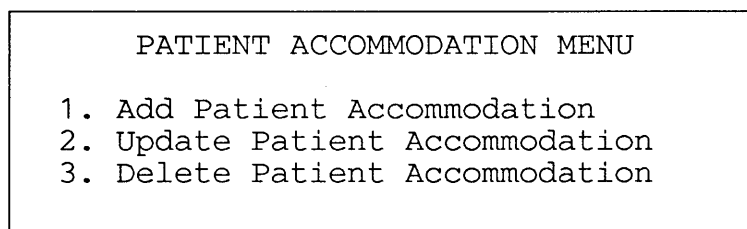


Figure 5.23 Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of accommodation menu; first level of change of accommodation menu.

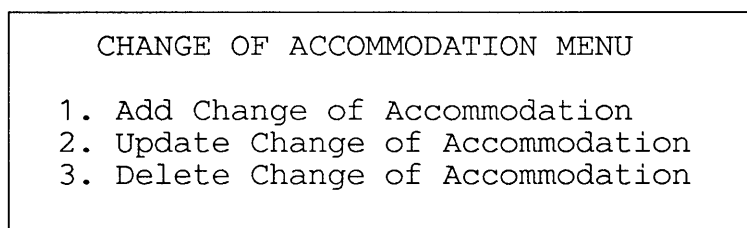


Figure 5.24 Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of operation menu.

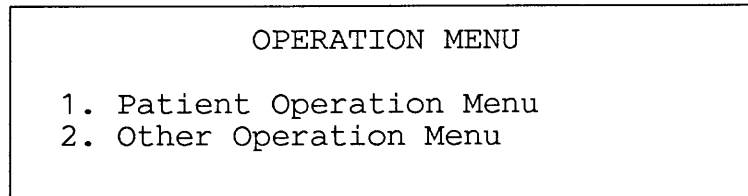


Figure 5.25 Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of operation menu; first level of patient operation menu.

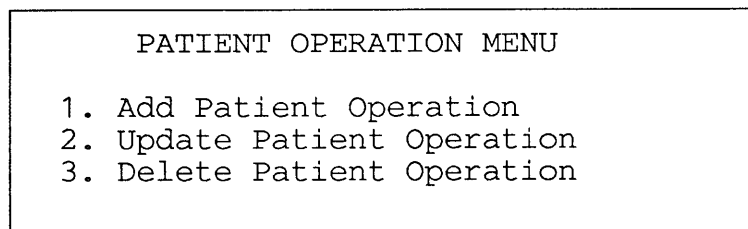


Figure 5.26 Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of operation menu; first level of other operation menu.

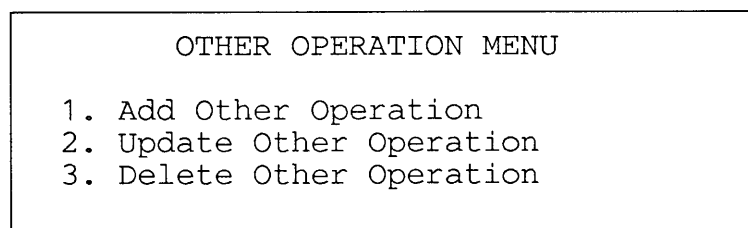


Figure 5.27 Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of patient leave menu.

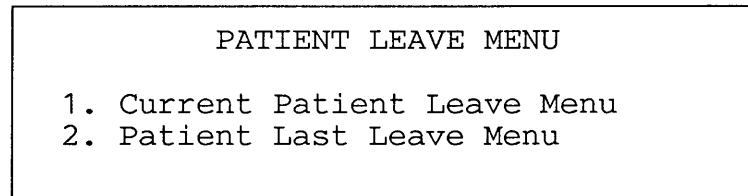


Figure 5.28 Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of patient leave menu; first level of patient leave menu.

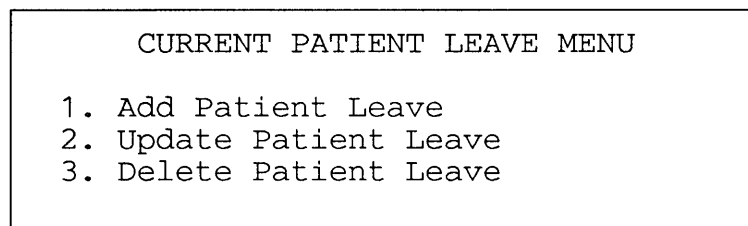


Figure 5.29 Fifth level of main menu; fourth level of ATD information menu; third level of admission menu; second level of patient leave menu; first level of patient last leave menu.

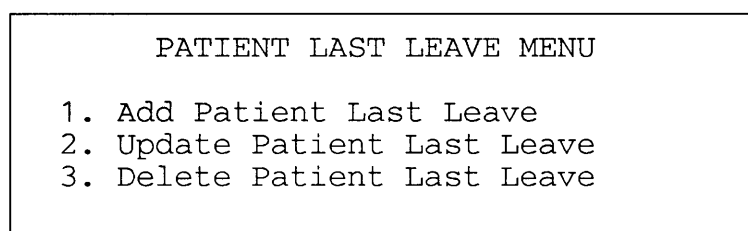


Figure 5.30 Fourth level of main menu; third level of ATD information menu; second level of admission menu; first level of special treatment menu.

SPECIAL TREATMENT MENU 1. Add Special Treatment 2. Update Special Treatment 3. Delete Special Treatment
--

Figure 5.31 Fourth level of main menu; third level of ATD information Menu; second level of admission menu; first level of non-operative procedure menu.

NON-OPERATIVE PROCEDURE MENU 1. Add Non-Operative Procedure 2. Update Non-Operative Procedure 3. Delete Non-Operative Procedure
--

Figure 5.32 Third level of main menu; second level of ATD information menu; first level of transfer menu.

PATIENT TRANSFER MENU 1. Ward Transfer Menu 2. Unit Transfer Menu
--

Figure 5.33 Fourth level of main menu; third level of ATD information menu; second level of patient transfer menu; first level of ward transfer menu.

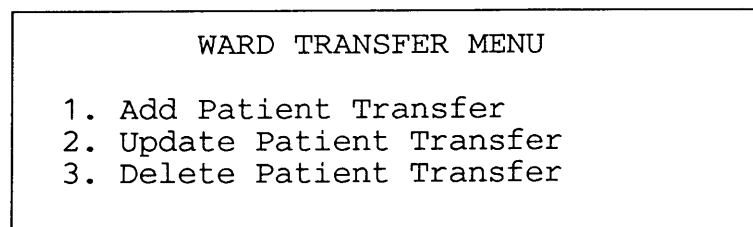


Figure 5.34 Fourth level of main menu; third level of ATD information menu; second level of patient transfer menu; first level of unit transfer menu.

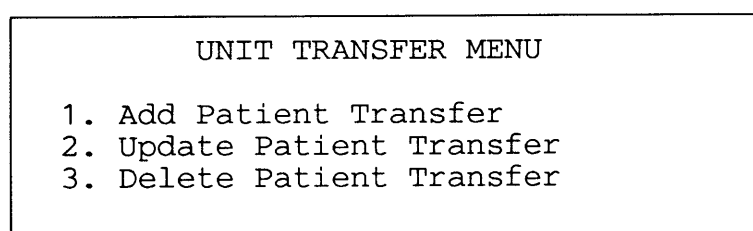


Figure 5.35 Third level of main menu; second level of ATD information menu; first level of discharge menu.

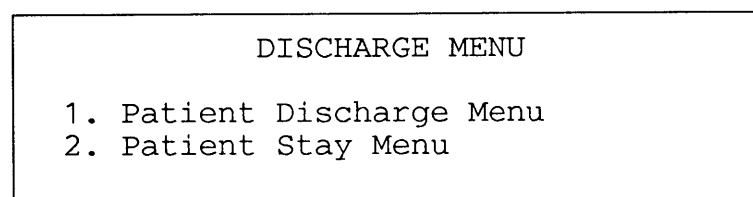


Figure 5.36 Fourth level of main menu; third level of ATD information menu; second level of discharge menu; first level of patient discharge menu.

PATIENT DISCHARGE MENU 1. Add Patient Discharge 2. Update Patient Discharge 3. Delete Patient Discharge
--

Figure 5.37 Fourth level of main menu; third level of ATD information menu; second level of discharge menu; first level of patient stay menu.

PATIENT STAY MENU 1. Add Patient Stay 2. Update Patient Stay 3. Delete Patient Stay
--

Figure 5.38 Second level of main menu; first level of medical record menu.

MEDICAL RECORD MENU 1. Issue M R Menu 2. Receive M R Menu
--

Figure 5.39 Third level of main menu; second level of medical record menu; first level of issue M R menu.

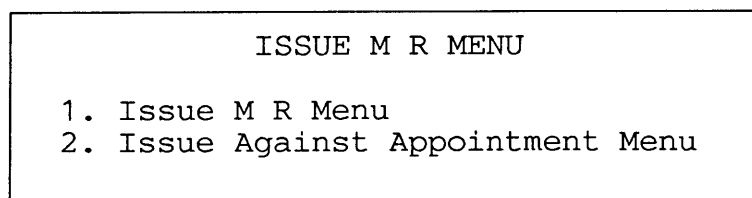


Figure 5.40 Fourth level of main menu; third level of medical record menu; second level of issue M R menu; first level of issue M R menu.

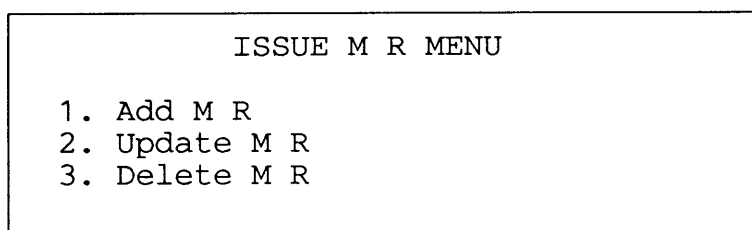


Figure 5.41 Fourth level of main menu; third level of medical record menu; second level of issue M R menu; first level of issue M R against appointment menu.

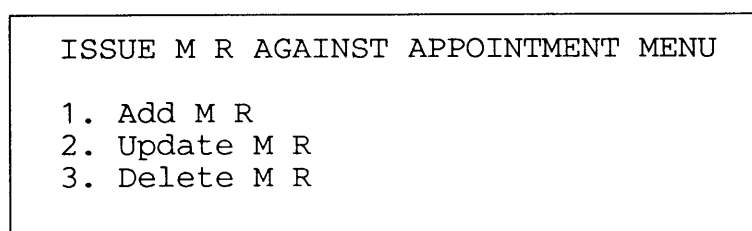


Figure 5.42 Third level of main menu; second level of medical record menu; first level of receive M R menu;

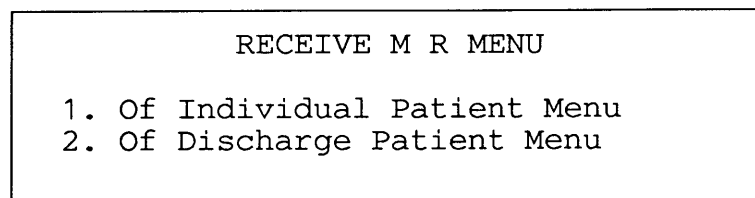


Figure 5.43 Fourth level of main menu; third level of medical record menu; second level of receive M R menu; first level of receive M R of individual patient menu.

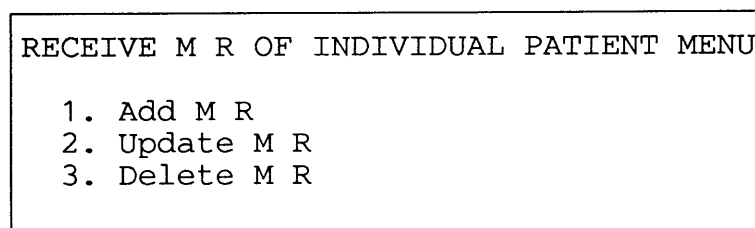


Figure 5.44 Fourth level of main menu; third level of medical record menu; second level of receive M R menu; first level of receive M R of individual patient menu.

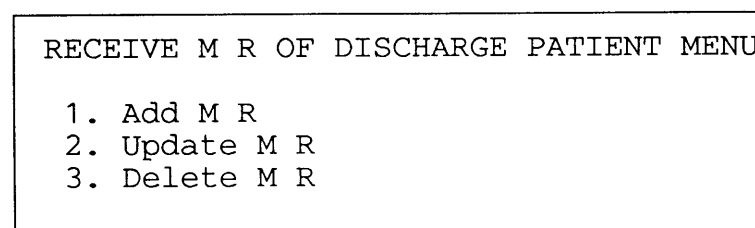


Figure 5.45 Second level of main menu; first level of appointment booking menu.

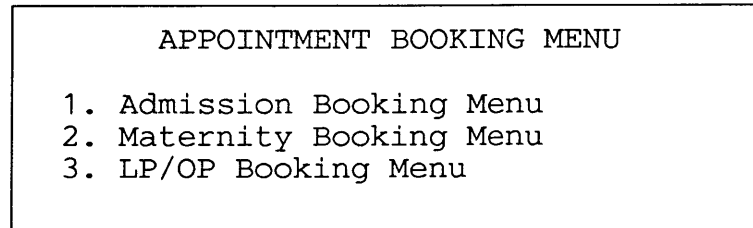


Figure 5.46 Third level of main menu; second level of appointment booking menu; first level of admission booking menu.

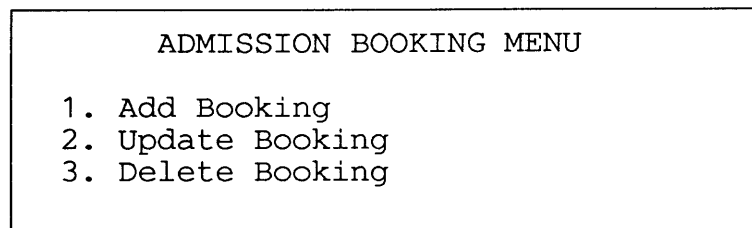


Figure 5.47 Third level of main menu; second level of appointment booking menu; first level of maternity booking menu.

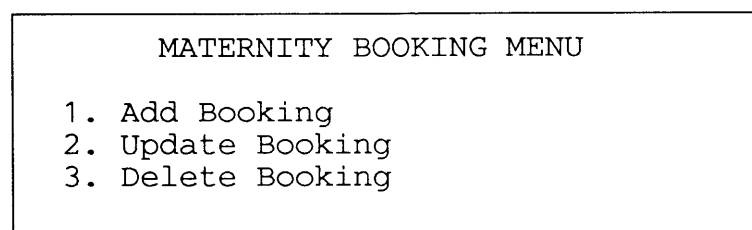


Figure 5.48 Third level of main menu; second level of appointment booking menu; first level of LP/OP booking menu.

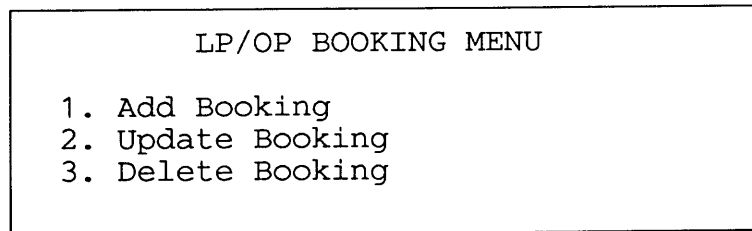


Figure 5.49 Second level of main menu; first level of administration menu.

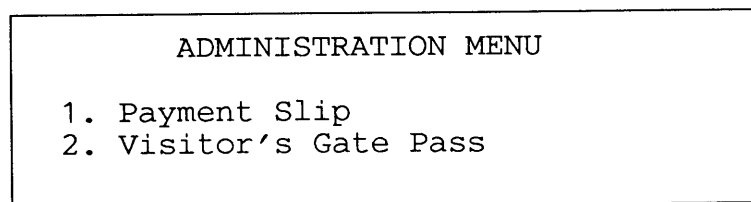


Figure 5.50 Second level of main menu; first level of reference file maintenance menu.

REFERENCE FILE MAINTENANCE MENU

1. Nationality Menu
2. Sex Menu
3. Martial Status Menu
4. Religion Menu
5. Unit Menu
6. Ward Menu
7. Area Code Menu
8. Ward Bed Menu
9. Department Menu
10. Service Menu
11. Speciality Menu
12. Admission Source Menu
13. Admission Type Menu
14. Discharge Disposition Menu
15. Discharge Destination Menu
16. Telephone Exchange Code Menu
17. Authorised Person Menu
18. Accommodation Type Menu
19. Source of Payment Menu
20. MR File Request Source Menu
21. Delivery Type Menu
22. Hospital Menu
23. Multiple Birth by Set Menu
24. Multiple Birth by Sex Menu
25. Health Centre Menu
26. OPD Clinic Menu
27. ICD Codes Menu
28. Occupation Menu
29. Doctors Menu
30. Progress of Patient Menu
31. Condition of Patient Menu
32. Respirator Menu
33. Ventilation Menu
34. Mobility Menu

Figure 5.51 Second level of main menu; first level of report menu.

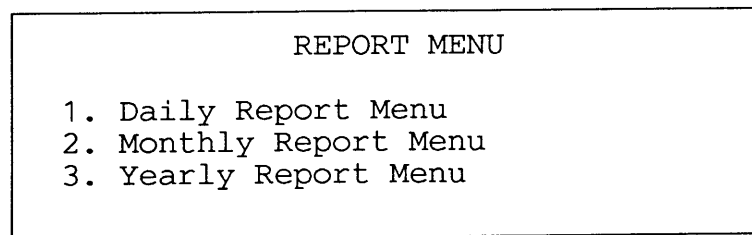


Figure 5.52 Third level of main menu; second level of report menu; first level of daily report menu.

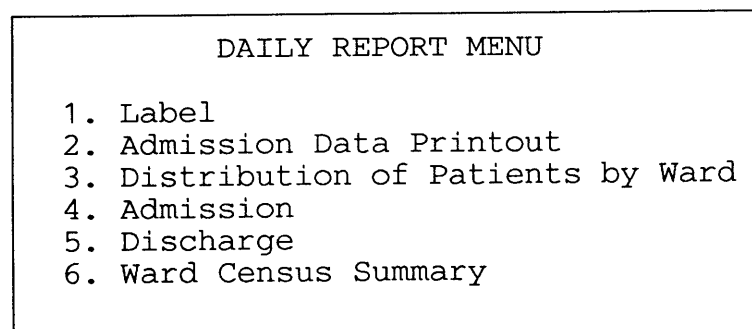


Figure 5.53 Third level of main menu; second level of report Menu; first level of monthly report menu.

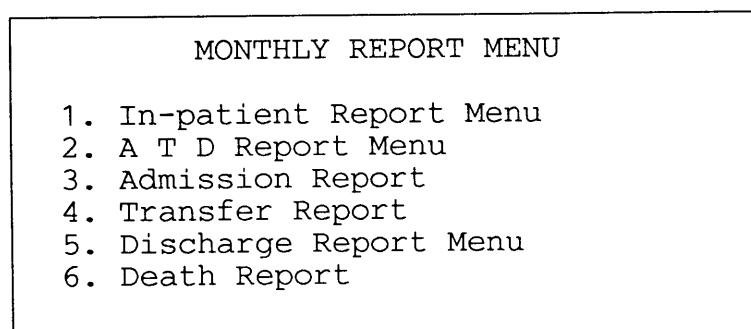


Figure 5.54 Fourth level of main menu; third level of report Menu; second level of monthly report menu; first level of in-patient report menu.

IN-PATIENT REPORT MENU	
1.	Days By Ward and Services for Special Departments and Services
2.	Total Days and Occupancy Level By Ward and Services
3.	Days By Ward & Services for North Block
4.	Total Days By Ward & Services for North Block.
5.	Death Report Main Tower
6.	Discharge Days/Mean Stay
7.	Census By Ward and date
8.	Census By Ward

Figure 5.55 Fourth level of main menu; third level of report menu; second level of monthly report menu; first level of ATD report menu.

A T D REPORT MENU	
1.	Main Tower
2.	North Block

Figure 5.56 Fourth level of main menu; third level of report menu; second level of monthly report menu; first level of discharge report menu.

DISCHARGE REPORT MENU	
1.	Days of Stay By Ward & Service
2.	Total days & Length of Stay for North Block
3.	Patients By Date & Ward

Figure 5.57 Third level of main menu; second level of report menu; first level of yearly report menu.

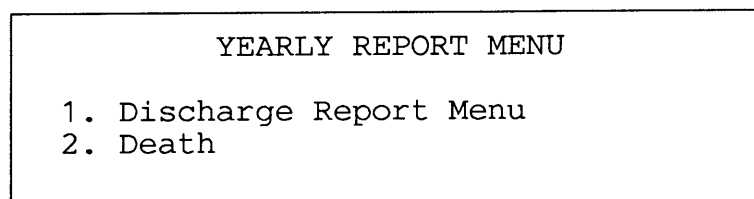


Figure 5.58 Fourth level of main menu; third level of report menu; second level of yearly report menu; first level of discharge report menu.

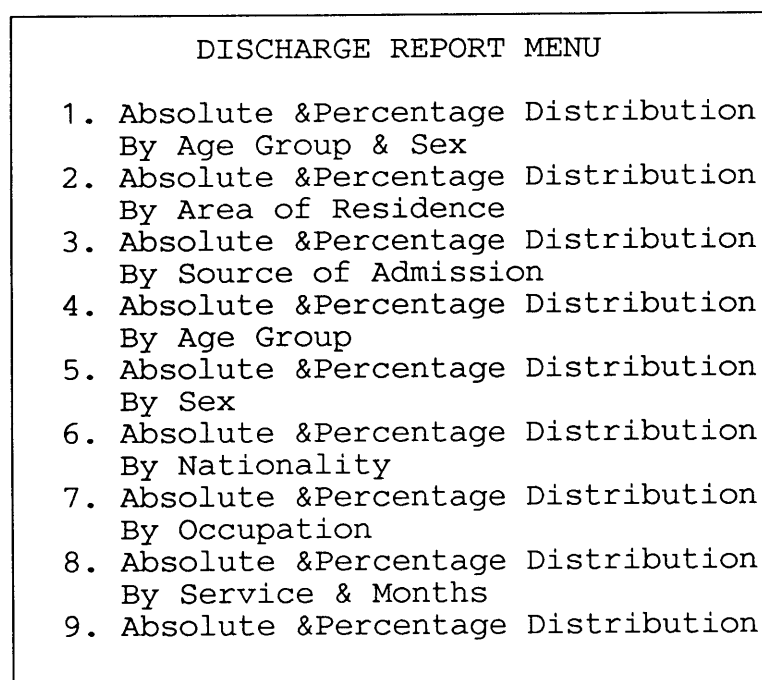


Figure 5.59 Second level of main menu; first level of query menu.

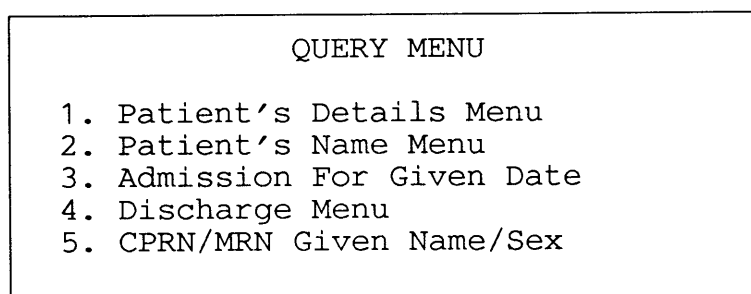


Figure 5.60 Third level of main menu; second level of query menu; first level of patient's details menu.

PATIENT'S DETAIL MENU 1. Given CPRN 2. Given MRN 3. Give Ward, Sex and Name 4. Name 5. Sex 6. Nationality
--

Figure 5.61 Third level of main menu; second level of query menu; first level of patient's name menu.

PATIENT'S NAME MENU 1. Given CPRN 2. Given MRN 3. Given Telephone No. 4. Given Sex and String of Name 5. Given Sex, String of Name & Nationality

Figure 5.62 Third level of main menu; second level of query menu; first level of discharge menu.

DISCHARGE MENU 1. For Given Date 2. For Given Date & Consultant 3. For Given Ward & Consultant

5.2.3 Users Responsible for Running the System

The following table (5.1) lists the different functions of the system, the responsible users of performing these functions and the location in which these functions take place.

FUNCTION	RESPONSIBLE USER	LOCATION
1. Patient Registration Entry	Registration Clerk Supervisor	Admission Admission
2. Patient Details Entry	Admission Clerk Supervisor	Admission Admission
3. Patient Admission Entry	Admission Clerk Supervisor	Admission Admission
4. Employer Details Entry	Admission Clerk Supervisor	Admission Admission
5. Informer Details Entry	Admission Clerk Supervisor	Admission Admission
6. Contact Details Entry	Admission Clerk Supervisor	Admission Admission
7. Patient Admission Assignment	Admission Clerk Supervisor	Admission Admission
8 Provisional Diagnosis	Supervisor	Admission
9. Ward Transfer and Enquiry	Ward Nurse	Ward
10. Unit Transfer and Enquiry	Ward nurse	Ward
11. Patient Condition Details Entry	Ward Nurse	Ward

Table 5.1 Function, responsible user and location (cont.)

FUNCTION	RESPONSIBLE USER	LOCATION
12. Correction Patient Admission Ward Details	Admission Clerk Data Quality Clerk Ward Nurse Supervisor	Admission Data Quality Ward Admission
13. Deletion of Transfer	Ward Nurse Supervisor	Ward Admission
14. Patient Discharge entry	Ward Nurse Supervisor	Ward Admission
15. Patient Stay	Supervisor Ward Nurse	Admission Ward
16. Patient Enquiry	Admission Clerk Data Quality Clerk Ward Nurse Ward Doctor Receptionist MR File Issue Clerk Supervisor	Admission Data Quality Ward Ward Reception M R Admission
17. In-Patient Enquiry	Admission Clerk Data Quality Clerk Ward Nurse Ward Doctor Receptionist MR File Issue Clerk Supervisor	Admission Data Quality Ward Ward Reception M R Admission
18. Accommodation & Change of Accommodation	Ward Nurse Supervisor	Ward Admission
19. Patient Leave Entry	Ward Nurse	Ward
20. Patient Alias Entry	Registration Clerk Admission Clerk Supervisor	Admission Admission Admission
21. Diagnosis Entry	Data Quality Clerk Supervisor	Data Quality Data Quality

Table 5.1 (cont.)

FUNCTION	RESPONSIBLE USER	LOCATION
22. Other Diagnosis Entry	Data Quality Clerk Supervisor	Data Quality Data Quality
23. Operation Entry	Data Quality Clerk Supervisor	Data Quality Data Quality
24. Other Operation Entry	Data Quality Clerk Supervisor	Data Quality Data Quality
25. Special Treatment Entry	Data Quality Clerk Supervisor	Data quality Data Quality
26. Non-Operative Procedure Entry	Data Quality Clerk Supervisor	Data quality Data Quality
27. Patient Leave Entry	Ward Nurse Supervisor	Ward Admission
28. Responsible Person Entry	Ward Nurse Supervisor	Ward Admission
29. Maternity Booking Entry	Admission Clerk Supervisor Appointments Clerk	Admission Admission Appointments
30. Admission Booking Entry	Admission Clerk Supervisor Appointments Clerk	Admission Admission Appointments
31. LPP/OP Booking Entry	Admission Clerk Supervisor Appointments Clerk	Admission Admission Appointments
32. In-patient ICD Code(s) Entry	Data Quality Clerk Supervisor	Data Quality Data Quality
33. Delivery Registration Entry	Ward Nurse Admission Clerk Supervisor Data Quality Clerk Supervisor	Ward Admission Admission Data Quality Data Quality

Table 5.1 (cont.)

FUNCTION	RESPONSIBLE USER	LOCATION
34. Birth Registration Entry	Ward Nurse Admission Clerk Supervisor Data Quality Clerk Supervisor	Ward Admission Admission Data Quality Data Quality
35. Visitor's Gate Pass Entry	Ward Nurse	Ward
36. MR Issue Entry	MR File Clerk Supervisor	M R M R
37. MR Against An Appointment Issue Entry	MR File Clerk Supervisor	M R M R
38. Entry for Receive MR of Individual Patient	MR File Clerk Supervisor	M R M R
39. Entry for Receive MR of Discharge Patient	MR File Clerk Supervisor	M R M R
40. Change of CPRN/MRN Entry	Supervisor Supervisor	Admission Data Quality

Table 5.1

5.2.4 Reference File Maintenance

Codes which may be required when running the System, can be obtained from the reference files. BHIC will be responsible for the setting up and maintenance of all the reference files. Respective persons in the hospitals will provide BHIC with the data of the reference files at the time of implementing the System and any changes needed to the reference files will be intimated on a prescribed form to BHIC. The following are the different reference files codes and the providers of these codes:

1. Administrators of the hospitals will inform BHIC if any additional code of the following has to be included:

- . Sex Codes
- . Marital Status Codes
- . Religions Codes
- . Units Codes
- . Wards Codes
- . Ward/Bed No(s)
- . Departments Codes
- . Services Codes
- . Specialities Codes
- . Admission Sources Codes
- . Admission Types Codes
- . Discharge Dispositions Codes
- . Discharge Destinations Codes
- . Leave Authorising Persons Codes
- . Accommodation Types Codes
- . Source of Payment Codes
- . M R File Request Codes
- . Sources Codes
- . Delivery Types Codes
- . Multiple Births by Set Types
- . Multiple Births by Sex Types
- . ICD Codes
- . Clinics Codes
- . Doctors Codes
- . Occupation Types Codes.

2. Supervisor of Admission Bureau will inform BHIC if any new code has to be included. The Admission clerk will inform the supervisor when he/she is unable to get a code of the following from the reference file:

- . Nationalities Codes

- . Areas Codes.

3. BHIC will include the following when a new code is introduced:

- . Hospitals Codes
- . Health Centres Codes.

4. Doctors of the hospitals will inform BHIC if any additional code of the following has to be included:

- . Patient Condition Categories
- . Patient Progress Categories
- . Ventilation Types
- . Respirator Types
- . Mobility Categories.

5.2.5 Error Prevention

To prevent errors occurring when implementing the System, the following should be provided before implementation:

1. Training on the New System should be conducted for the Users of the System. The following points have to be taken into account when conducting the training:

- How the Users are going to use the System?
- What data should they key in?
- What information should they get?

2. Provide the Users with document explaining the different aspects of operating the System. These documents should convey:

- . functions which can be performed,
- . reports which can be generated,
- . examples of correct data input, and
- . errors type ... etc.

These documents should be distributed to each department which is going to use the System.

3. A paper form should be used to support computer data entering. This form may be a copy of the screen, or a multiple of screens covering different function which are performed respectively (e.g. Registration, Admission, and Admission Assignment).
4. A help system should be provided to support keying correct data.
5. Different data codes can be requested from reference file(s), e.g. nationality code, ward code, etc.

The Data Quality Section is responsible for checking and correcting incorrect data entered by the Users. These corrections can be carried out overnight for data entered in the previous day.

5.2.6 Response Time.

The proposed system is to be implemented in a hospital environment. In this environment, most of the transactions have to be performed at the same time. The response time taken between submitting the job and the return of the result is very important. There are many cases where the computer response must be very fast such as:

- . Queries regarding the patient's bed, room, transfer ward, discharge etc.
- . Request for patient's episode by doctors.

In these cases the users can't wait until the end of the month or week, or even the end of the day to get a response. Information have to be returned in seconds. Therefore, the proposed system must be supported by an on-line facility so that a fast response can be provided.

5.3 Stage 5: Design of the Technical Aspects

5.3.1 The Application

The following table (Table 5.2) illustrates the different functions, the transactions which are to be computerised and the outcomes of these transactions after processing. The transactions can be chosen from the menu. Passwords should be built-in to prevent the access of unauthorised people. A help system should be provided to give the user help whenever it is required. The keyboard is the type of input which is to be used in the application.

Function	Transaction	Outcomes
1. Registration	Add patient's details	New record
	Update patient's record	Updated record
	Delete patient's record	Deleted record
	Add registration record	New record
	Update registration record	Updated record
	Delete registration record	Deleted record
2. Admission	Add Admission record	New record
	Update admission record	Updated record
	Delete admission record	Deleted record

Table 5.2 : Functions, transactions and outcomes (cont.)

Function	Transaction	Outcomes
2. Admission	Add employer record	New record
	Update employer record	Updated record
	Delete employer record	Deleted record
	Add informer record	New record
	Update informer record	Updated record
	Delete informer record	Deleted record
	Add contact record	New record
	Update contact record	Updated record
	Delete contact record	Delete record
3. Admission Assignment	Add admission assignment	New record
	Update admission assignment record	Updated record
	Delete admission assignment record	Deleted record
	Add provisional diagnosis record	New record
	Update provisional diagnosis record	Updated record
	Delete provisional diagnosis record	Deleted record
	Add patient record	New record
	Update patient condition record	Updated record
	Delete patient condition record	Deleted record

Table 5.2 : Functions, transactions and outcomes (cont.)

Function	Transaction	Outcomes
	Add patient accommodation record	New record
	Update patient accommodation record	Updated record
	Delete patient accommodation record	Deleted record
	Add changed accommodation record	New record
	Update changed accommodation record	Updated record
	Delete changed accommodation record	Deleted record
	Add patient leave record	New record
	Update patient leave record	Updated record
	Delete patient leave record	Delete patient leave record
	Add responsible person record	New record
	Update responsible person record	Updated record
	Delete responsible person record	Deleted record
	Add diagnosis record	New record
	Update diagnosis record	Updated record
	Delete diagnosis record	Deleted record

Table 5.2 : Functions, transactions and outcomes (cont.)

Function	Transaction	Outcomes
	Add other diagnosis record	New record
	Update other diagnosis record	Updated record
	Delete other diagnosis record	Deleted record
	Add patient operation record	New record
	Update patient operation record	Updated record
	Delete patient operation record	Deleted record
	Add other operation record	New record
	Update other operation record	Updated record
	Delete other operation record	Deleted record
	Add special treatment record	New record
	Update special treatment record	Updated record
	Delete special treatment record	Deleted record
	Add non-operative procedure record	New record
	Update non-operative procedure record	Updated record
	Delete non-operative procedure record	Deleted record

Table 5.2 : Functions, transactions and outcomes (cont.)

Function	Transaction	Outcomes
	Add visitor's gate pass record	New record
	Update visitor's gate pass record	Updated record
	Delete visitor's gate pass record	Deleted record
4. Patient Transfer	Add ward transfer record	New record
	Update ward transfer record	Updated record
	Delete ward transfer record	Deleted record
	Add unit transfer record	New record
	Update unit transfer record	Updated record
	Delete unit transfer record	Deleted record
5. Patient Discharge	Add discharge record	New record
	Update discharge record	Updated record
	Delete discharge record	Deleted record
	Add patient stay record	New record
	Update patient stay record	Updated record
	Deleted patient stay record	Deleted record

Table 5.2 : Functions, transactions and outcomes (cont)

Function	Transaction	Outcomes
6. Administration	Issue payment slip	Issued payment slip
	Issue visitor's gate pass	Issued visitor's gate pass
7. Medical Record	Add issue M R	New record
	Update issue M R	Updated record
	Delete issue M R	Deleted record
	Add issue M R against appointment	New record
	Update issue M R against appointment	Updated record
	Delete issue M R against appointment	Deleted record
	Add receive M R of individual patient record	New record
	Update receive M R of individual patient record	Updated record
	Delete receive M R of individual patient record	Deleted record
	Add receive M R of discharge patient	New record
	Update receive M R of discharge patient	Updated record
	Delete receive M R of discharge patient	Deleted record

Table 5.2 : Functions, transactions and outcomes (cont.)

Function	Transaction	Outcomes
8. File Maintenance	Add code record	New record
	Update code record	Updated record
	Delete code record	Deleted record
	Add change MRN/CPRN record	New record
	Update change MRN/CPRN record	Updated record
	Delete change MRN/CPRN record	Deleted record
9. Delivery Registration	Add delivery registration record	New record
	Update delivery registration record	Updated record
	Delete delivery registration record	Deleted record
10. Birth Registration	Add birth registration record	New record
	Update birth registration record	Updated record
	Delete birth registration record	Deleted record

Table 5.2 : Functions, transactions and outcomes

5.3.2 Information Retrieval

From the users' requirements study, 32 reports were identified. These are 6 daily, 16 monthly and 10 yearly reports. The number of queries identified was 16. The number of reference files was 34. These reference files can be retrieved if the user requires a code for a data item within a field in the database.

There are three types of information retrieval in the System. These are:

5.3.2.1 Reports

The reports which will be generated by the system are predefined ones. In the application prototype (see chapter 5), if the user selected option 6 (report menu) from the main menu (see Figure 5.2), a menu with the options: 1. Daily report menu; 2. Monthly report menu; 3. Yearly report menu, will appear on the screen. Suppose the user selected option 1, a menu will be shown on the screen (see Figure 5.52) with the options: 1. Label; 2. Admission data printout; 3. Distribution of patients by ward; 4. Admission; 5. Discharge; 6. Ward census summary. Suppose the user selected option 1, a list of labels such as the one in Figure 5.63 will be printed.

LOCATION:		
DATE: 05-30-1992		
CPR: 110011422	MRN: 65133	
Ahmed Khalifa		
Jassim		
AGE: 79	SEX: M	NATIONALITY: BAH

Figure 5.63: Admission label

Supposing that the user selected option 4, Admission. A daily admission report (see Figure 5.64) will be ready for the user to either display it on screen, print it, or save it as a printable file, ready to be printed whenever it is needed. The same will also apply if the user selects option 5, Discharge (see Figure 5.65).

If the user selected option number 2, Monthly report (see Figure 5.51), a menu (see Figure 5.53) with the options: 1. In-patient report menu; 2. ATD report menu; 3. Admission report; 4. Transfer report; 5. Discharge report menu; 6. Death report, will be shown on the screen. Supposing the user selected option 3, a monthly admission report (see Figure 5.66) will be created and will be ready for the user to either display it on the screen, print it , or save it as a printable file. Suppose the user selected option

5, a menu (see Figure 5.56) with the options: 1. Days of stay by ward & service; 2. Total days & length of stay for north block; 3. Patients by date & ward. If the user selected option 3, a monthly discharge report (see Figure 5.67) will be created and the user has to choose between either displaying the report on the screen, printing it, or saving it as a printable file.

5.3.2.2 Queries

In the application prototype, if the user selected option 7 (Query menu) from the main menu (see Figure 5.2), a menu (see Figure 5.59) will be shown on the screen with the options: 1. Patient's detail menu; 2. patient's name menu; 3. Admission for given date; 4. Discharge menu; 5. CPRN/MRN given name/sex. Suppose the user chose option 1, another menu (see Figure 5.60) will be shown on the screen with the options: 1. Given CPRN; 2. Given MRN; 2. Given ward, sex and name; 4. Name; 5. Sex; 6. Nationality. If the user selected option 1 to query patient's details with "563210163" CPR number, the user has to key: CPR = 563210163. What is underlined is already saved and the user has to key in only the CPR number and make the query active.

If the user wants to query the Bahrainis patients' details, he/she would key: Nationality = "BAH". Again what is underlined is already saved, the user has only to key in BAH, followed by the quotation mark. The preceding quotation mark is already saved.

5.3.2.3 Reference Files

In case of the user wanting to query about a code, he/she first selects option 5, reference file maintenance menu, from the main menu (see Figure 5.2). Selecting this option takes the user to the menu shown in Figure 5.50. As an example, the possible codes for marital status are as follows:

CODE	DESCRIPTION
D	Divorced
M	Married
S	Single
W	Widow

5.3.3 The Database

In the application prototype, it is noted that the software package used imposed restrictions on the database design such as:

- . The maximum possible number to link databases in a set is 10.
- . The maximum field name length in a database is 10.
- . The maximum number of reports which can be stored is 26 for each database or set.
- . The maximum number of mail labels to be designed is 26 for each database or set.
- . The number of records which can be shown on screen is 20 at any one time.
- . The maximum number of characters for each record is 4000.
- . The maximum number of characters for each row in a report is 240.

None of the above restrictions proved a problem in the application. The maximum number of linked databases can be easily avoided by creating different set each of whom links up to 10 databases. This is also useful to maximise the number of reports and labels which can be generated. The different sets can be called whenever needed from the menu. Other restrictions such as maximum field length in a database (4000), is sufficient for the application. The number of records which can be shown on screen (20) is proved to be not a problem. The maximum number of characters for each row in a report (240) is proved not to be a problem since all the reports requested by the users required less than 240 characters in each row.

5.3.4 Database Maintenance

In the application prototype, new records, amended records, and deleting old records can be saved by pressing a key (F10). However, in case the user forgot to save any of these transactions, a message reminding the user that these transactions have not been saved will be flashed on the screen. The user then has to select between either saving these transactions or cancelling them. In case of the deletion range of records, a mark preceding the deleted records will appear on the screen. This mark is a proof that the range of records are deleted. However, the deleted records can be recovered in case, for example, the deletion happened accidentally.

In the application, the following transactions are to be carried out:

- . Admitting a patient will result in open new records for: admission assignment, employer, informer, contact, accommodation and diagnosis.
- . Opening a new delivery registration record will result in the opening of a new birth registration record.
- . Opening a new discharge record will result in the opening of a new patient stay record.
- . Insertion, amending and deleting records results in an updating of the reports.
- . Booking an appointment results in the opening of a new registration record.

5.3.5 Control

5.3.5.1 Control on Data Entry

The following are the checks that can be applied concerning the ways in which invalid, incorrect, or 'suspicious' data can be identified.

5.3.5.1.1 Items of specified data type

The different fields types entries are checked by the system while creating the database. In the application prototype the patient's CPR field is numeric, if any user entered an entry in this field which is not a numeric, an output stating that the entry is incorrect will appear on the screen. The user then has to key in a numeric entry. The same applies for character, date, logic and memo fields.

5.3.5.1.2 Items within specified boundaries (range check)

Some of the data entries within the fields are to be checked for ranges, such as:

- . The maximum number of digits in the CPR number is 9.
- . The maximum number of digits in the MRN is 6, the minimum is 1.
- . The dates is checked for the year, the month and the days within each month.
- . Sex code should be a character.
- . The area code in the address should not be more than 4 digits, and it should be in the range 101 to 1199.
- . The time should be between 00:00:01 and 24:00:00.
- . The phone number should not be more than 6 digits.
- . The diagnosis codes should not be more than 9 digits.
- . The age should not exceed 3 digits.

5.3.5.1.3 Limits on the actual values that may be used

There are some limits for the items which can be selected or keyed, for example:

- . The minimum number for MRN is 1.
- . The minimum value for area code is 101 and the maximum value is 1199.

5.3.5.1.4 Items with checking mechanism

Some of the data entry items have some sort of self mechanism, such as, the different reference codes should be entered in capital letters.

5.3.5.1.5 Items with cross-checks

Cross-checks can be applied to:

- . Date of last leave should be less than current date.
- . Discharge date should be greater than admission and registration dates.
- . Admission date should be greater than registration date.
- . Transfer date should be greater than admission and registration dates.
- . Patient leave date should be greater than patient last date.
- . Visit date should be less than discharge date.

5.3.5.1.6 Missed out data

Checks should be built in for all compulsory items within the database. Skipping compulsory items should give an error message. This is to avoid users from accidentally skipping compulsory data items within a database e.g MRN and CPR.

5.3.5.2 Control on program errors

From the application prototype, or from the early usage of a system, it is impossible to prove that the program is totally correct to its specification. But better application generators are likely to produce more reliable codes in quicker time.

The user may have a lack of experience with the System, they may find errors occurring in acceptance testing that could be due to operator errors rather than program

errors. Users make mistakes on particular kinds of messages, and if validation puts to catch all these mistakes we will finish with the best solution possible in an imperfect world where human beings operate machines (Cornes 1990).

When implementing the proposed System and as stated earlier in Multiview Stage 3, the BHIC is to take the responsibility of operating the system, and to provide database administrators and operators. These operators and administrators will have the responsibility of studying the errors which may be detected by the users and trying to overcome them. A good training for the users of the system can help in reducing the possibility of errors.

5.3.5.3 Operator Error

The most common mistakes in operating the system in small machines is the failure to take backup copies of files and in loading incorrect files.

There are three types of storage media (Korth and Silberschatz 1991). These are:

- . **Volatile storage.** Information residing in volatile storage does not usually survive system crashes.
- . **Nonvolatile storage.** Information residing in nonvolatile storage usually survive system crashes.
- . **Stable storage.** Information residing in stable storage is never lost.

To assure taking backup copies of files, a stable storage may be used with several nonvolatile storage media (usually disk) with independent failure modes, and updating the information in a controlled manner.

To avoid the likelihood of mistakes in operating the system, the following (Lester 1988) should be applied:

- . Strict adherence to the standards laid down to guide the work of the operators;
- . Careful use of the operating instructions;

- . Built in checks which attempt to prevent errors.

5.3.5.4 Machine Malfunctions

Servicing arrangements should be made in advance with the computer suppliers when the users are faced with an obvious or suspected machine failure. These include: machine repair and machine service which can be on a preagreed basis between the Ministry of Health and the suppliers of the machines.

5.3.6 Recovery

It is always more difficult to recover from mistakes than it is to do thing properly in the first place 'prophylaxis better than treatment'. To reduce the need for recovery caused by the system break down due to software and hardware failures, it is better to prevent them. A good training for the users of the system with full understanding what the computer is doing with their data, helps to prevent mistakes and helps the user correct themselves of any error that might occur.

5.3.7 Monitoring

For proper management of the system it is necessary to create a monitoring system. Monitoring of activity is closely related to the control functions, as part of the system preventing unauthorised activity. It is therefore important to monitor the following:

- . Who accessed what files and at what time.
- . How many different errors were reported.
- . Whether people have been following backup and security procedures properly.

STATE OF BAIRAIN
MINISTRY OF HEALTH
SALMANIYA MEDICAL CENTRE

DAILY ADMISSION REPORT BY WARD DATE: 06-01-1992 TIME: 01:54:43

NAME OF PATIENT	CPR	MRN	SERVICE	WARD/UNIT	DEPT	CONSULTANT	NATIONALITY	TIME
Yousif Nasser		280017340	196355	MED	12	SUR 61264501	SAU	4.10
Abdulla Abdulhussain Daif		400000389	008659	MED	41	GS 61264501	BAH	4.09
Mariam Ahmed		310001765	212680	MED	CCU	MED 21345701	BAH	19.10

Figure 5.64 : Daily admission report by ward

STATE OF BAIRAIN
MINISTRY OF HEALTH
SALMANIYA MEDICAL CENTRE

DAILY DISCHARGE REPORT BY WARD DATE: 05-30-1992 TIME: 23:50:58

NAME OF PATIENT	CPR	MRN	SERVICE	WARD/UNIT	DEPT	CONSULTANT	NAT	DISCHARGE DATE	DISCHARGE TIME	DISCHARGE WARD/UNIT
Salih Hassan Abdulla		000321386	321386	MED	12	NN405612401	SAU	05-30-1992	4.50	12
Patima Ahmed		491105720	300294	MED	16	SUR520001601	JOR	05-30-1992	10.00	46
Ali Ismail Ebrahim Al Awdi		380105985	323001	ORT	ICU	GS561264501	BAH	05-30-1992	4.15	66

Figure 5.65 : Daily discharge report by ward

STATE OF BAIRAIN MINISTRY OF HEALTH SALMANIYA MEDICAL CENTRE									
MONTHLY ADMISSION REPORT				DATE: 06-30-1992		TIME : 23:57:25			
CPR	MRN	NAME OF PATIENT	ADMISSION WARD/UNIT	ADMISSION DATE	ADMISSION TIME	SEX	AGE	NATIONALITY	CURRENT DISCHARGE WARD WARD
	280017340	196335 Nasser Ahmed AlMoosa	12	06-01-1992	4.10	M	62	SAU	41
	310001765	212680 Mariam Ahmed Nasser	41	06-01-1992	4.09	M	59	BAH	54
	561204219	067231 Sami Hamad Mutar	ICU	06-10-1992	19.10	M	36	BAH	66

Figure5.66: Monthly admission report

STATE OF BAIRAIN MINISTRY OF HEALTH SALMANIYA MEDICAL CENTRE									
MONTHLY DISCHARGE REPORT				DATE: 07-01-1992		TIME: 00:26:51			
CPR	MRN	NAME OF PATIENT	DISCHARGE WARD/UNIT	DISCHARGE DATE	DISCHARGE TIME	SEX	AGE	NAT	CURRENT ADMISSION WARD UNIT/WARD
	000321386	321386 Hassan Abdulla AlTurfi	12	06-01-1992	4.50	M	72	SAU	12
	491105720	300294 Fatima Ahmed Ajjawi	46	06-06-1992	10.00	F	41	JOR	46
	500028524	245517 Fatima Saeed Ahmed	46	06-06-1992	11.15	F	40	BAH	46
	560119852	251893 Moh'd Ali Mallala	52	06-02-1992	11.54	M	34	BAH	52
	310001765	212680 Mariam Ahmed Nasser	54	06-11-1992	17.30	F	59	BAH	54
	380105985	323001 Ali Ismail Al Awadi	66	06-01-1992	4.15	M	54	BAH	66

Figure5.67: Monthly discharge report

Chapter 6: Application Prototype

6.1 Introduction

Fourth Generation Language (4GL) and a database management system are the most common elements of a prototype. A Relational Database Management System (RDMS) with an integrated 4GL will quickly generate a working model of a proposed system incorporating friendly data. RDMS allows storage structure to be modified quickly. Many commercial available packages offer the necessary flexibility and efficiency to run production systems and most of these products have forms interface that allow the application to be created using visual developed screens and menus rather than written procedures.

The RDMS tools are the ones recommended for use in prototyping (Connell and Shafer, 1989). The use of these tools provide the heart of prototyping. Forms screens, reports, and menus can be developed without the use of complex command and control syntax. RDMS prototype have a possible evolution path into production systems because the toolkit includes tools for interfacing the prototype modules and database tables with external modules developed in traditional fashion and conventional file structures.

6.2 Evaluating RDMS Products.

A complete RDMS - based prototyping toolkit is an integrated development environment which includes a fourth - generation command and query languages, fourth generation report writer, a menu-structure generator, screen generator, a function generator, visual programming tools and the ability to interface and integrate an application prototyped within the domain of the RDMS.

Not every RDMS product offers the ideal rapid prototyping toolkit. There are also many trade-offs between desirable prototyping capabilities and performance, and some flexible and hardware considerations. Therefore, no one product can be recommended as being the best. The best toolkit depends on the environment and needs.

A means of evaluating current available products would be difficult. But evaluating available products can be based on the following criteria (Connell and Shafer, 1989) that determines whether a particular product will provide an adequate prototyping environment:

- . The ability to generate functionality using 4GL modules and visually programmed modules.
- . Full support of a truly relational data model.
- . The ability to generate a flexible application control structured, interfaceable with conventionally developed modules, using either 4GL command language, visual programming or both.
- . The ability to operate with adequate efficiency on a hardware configuration available to developers and users.

6.3 Evaluation of Some Actual Products.

The evaluation of the following actual products is based on (Connell and Shafer, 1989). Table 6.1 shows a list consisting of ten RDMS products (which may have new features that will affect their evaluation) and shows a one to five star basis for each of the three categories (i.e Application Generator, Truly Relational and Visual Programming) and the availability of these products on a variety of makes and classes of computers from mainframes (MF) through minicomputers (MC), down to personal computers (PC). One of the differentiating characteristics of these products is their availability in a variety of environments.

From the list using the star ratings, it is noted that the INGRES product is one of the most powerful prototyping environments available. The INGRES application generator, referred to by the vendor as Application By Form (ABF), is perhaps it's strongest feature - significantly superior to the application generators of other vendors. The only area in which INGRES falls somewhat short of the ideal is in it's visual programming capabilities. Although, it is now available in personal computer environments, INGRES remains oriented primarily towards mainframe and minicomputer environments.

Oracle is roughly equivalent to INGRES in all features. While both INGRES and Oracle run on mainframes, minicomputers, and personal computers, Oracle runs on products made by a wider variety of hardware vendors than INGRES. Some feel this makes Oracle developed applications more portable, others feel that slight differences in the various versions of Oracle makes conversion from one machine to another often less than trivial. The authors (Connell and Shafer, 1989) argue that some users also note a performance difference between INGRES and Oracle, but this is very difficult to benchmark scientifically and, in the final analysis, observed performance differences are probably mostly attributable to database design.

Products	Application Generator	Truly Relational	Visual Programming	Host
INGRES	* * * * *	* * * *	* * *	MF, MC, PC
Oracle	* * * *	* * * *	* * *	MF, MC, PC
IDMS-R	* * *	* * *	* * *	MF, PC
DB2	* *	* * * *	* *	MF
Informix	* * *	* * * *	* * *	MC
Unify	* *	* * * *	* *	MC
Rbase System V	* * * *	* * * *	* * *	PC
Double Helix II	* * *	* * * *	* * * *	PC, MC
Dbase III+	* *	*	* *	PC
HyperCard	* * * * *	*	* * * * *	PC

Table 6.1: Some of the prototyping products (Adapted from Connell and Shafer, 1989)

6.4 Features in Oracle.

Oracle is the most widely used database in the world. It is the short name for any or all of the products that comprise the Oracle RDMS. Oracle RDMS is a database system based on a relational model. It is a collection of tools, utilities, and applications lets you manipulate an Oracle database. Many of these products are fourth-generation language tools; they let you use interactive screens to create application programs.

The Oracle database was designed using the relational model and gives users many advantages, including the following:

- . A database structure that is easy to visualize and understand.
- . The ability to create any number of temporary relationships between tables.
- . Freedom from concerns about how to query the database, through the use of SQL (Structured Query Language).
- . Tables that are easy to visualize.
- . Relational joint that provide temporary sets of data from multiple tables in the model.

In a relational database, query capabilities can be supplied by any of several query languages. The Oracle system uses the nonprocedural SQL to communicate with its database kernel.

6.5 ATD System Prototype

Alpha4 - the relational database software package from Alpha Software Corporation was used to develop the proposed ATD system prototype. The prototype is meant to show some of the capabilities which the new system can provide. These capabilities can be divided into five components. These components are:

1. The whole menu system including all the menu and submenus previously suggested in Multiview stage 4 - Design of the Human-computer Interface (see Figures 5.2 to 5.62 and Figure 6.1 to 6.7).

2. A data manipulation system - to provide the capabilities to add, update and delete records from the application databases. The adding, updating and deleting in the prototype are provided for the following functions:

- . Patient details
- . Patient registration.
- . Patient admission.
- . Admission assignment.
- . Ward transfer.
- . Unit transfer.
- . Patient discharge.
- . Accommodation.

3. A query system - to allow monitoring the records being entered in the application database. In the prototype the selected query facility is for patient details by given:

- . CPRN.
- . MRN.
- . Sex.
- . Nationality.

The selected queries are marked with '*' in Figure 6.7.

4. A report system - to produce some of the ATD reports. The selected reports are:

a) The following daily reports:

- . Admission report.
- . Discharge report.

b) The following monthly reports:

- . Admission report.
- . Discharge report.

c) Labels.

These reports are marked with '*' in Figures 6.4 to 6.6.

5. Security access to the different functions from the individual menu items to restrict them to a limited set of users.

The entities involved in the prototype are:

- . Patient.
- . Registration.
- . Admission.
- . Admission Assignment.
- . Ward Transfer.
- . Unit Transfer.
- . Discharge.
- . Accommodation.

The relationships between these entities are shown in Figure 6.8.

I was impressed by the capabilities provided by Alpha4. Building application prototype or a complete application system is very easy using Alpha4. Applications built using Alpha4 are useful for automating routine tasks, customising menus, and restricting users to a limited command set. Some of the features that Alpha4 (ASC 1986-89) can provide are:

1. Design menu structure and to record macros that execute specific functions when the application is run.
2. Create label designs, allowing you to store up to 26 mail label designs for each database or set.
3. Store up to 26 reports/forms for each database or set. The reports/forms can calculate values based upon the contents of various fields.
4. Store browse tables (showing 20 records at a time) for each database or set.

5. Forms letter.
6. Protect specific files by disallowing alterations.
7. Copying, appending to, summarising and packing.
8. Import and export data between Alpha4 and other file formats (such as dBase III).
9. Password to protect individual menu items to restrict them to a limited set of users.
10. Link up to 10 databases within a set.

Although, Alpha4 is a good software package to develop my proposed ATD system, I would suggest the Oracle Software Package for developing the proposed system, because Oracle is more substantial than Alpha4 in, for example its visual programming capabilities and its availability on a variety of makes and classes of computer from mainframes, through minicomputers, down to personal computers.

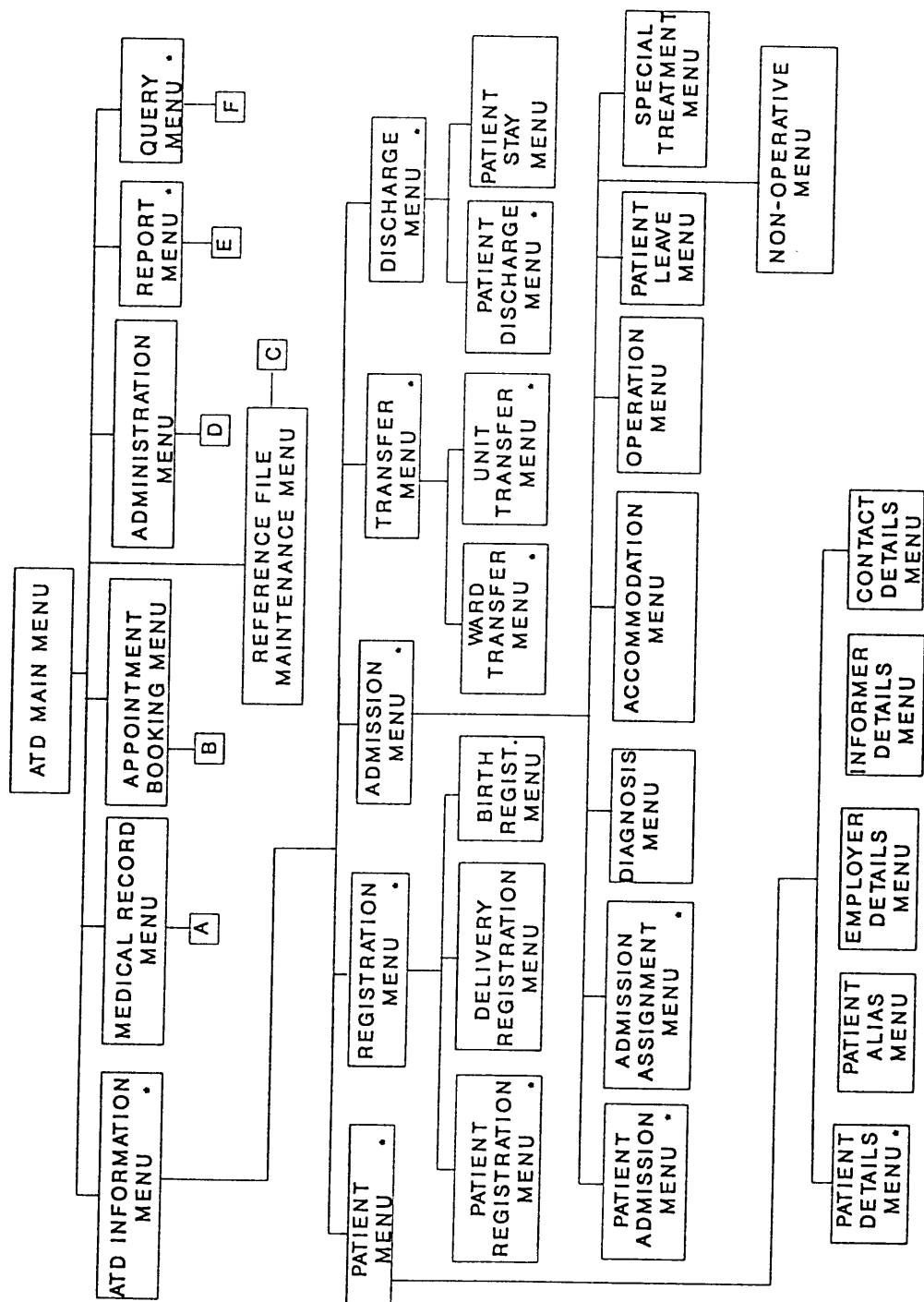


Figure 6.1: ATD system menu

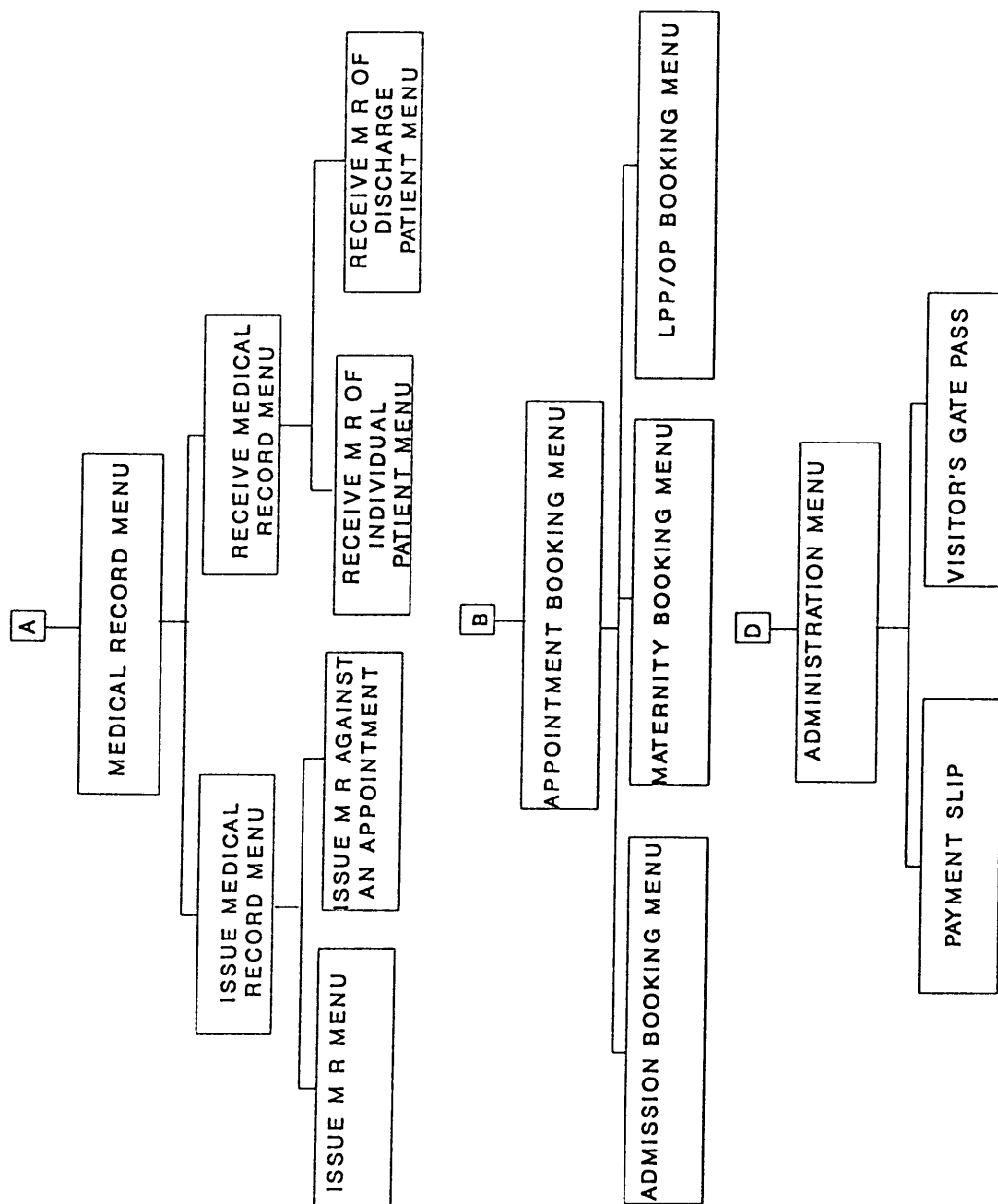


Figure 6.2: Medical record, appointment booking and administration menus

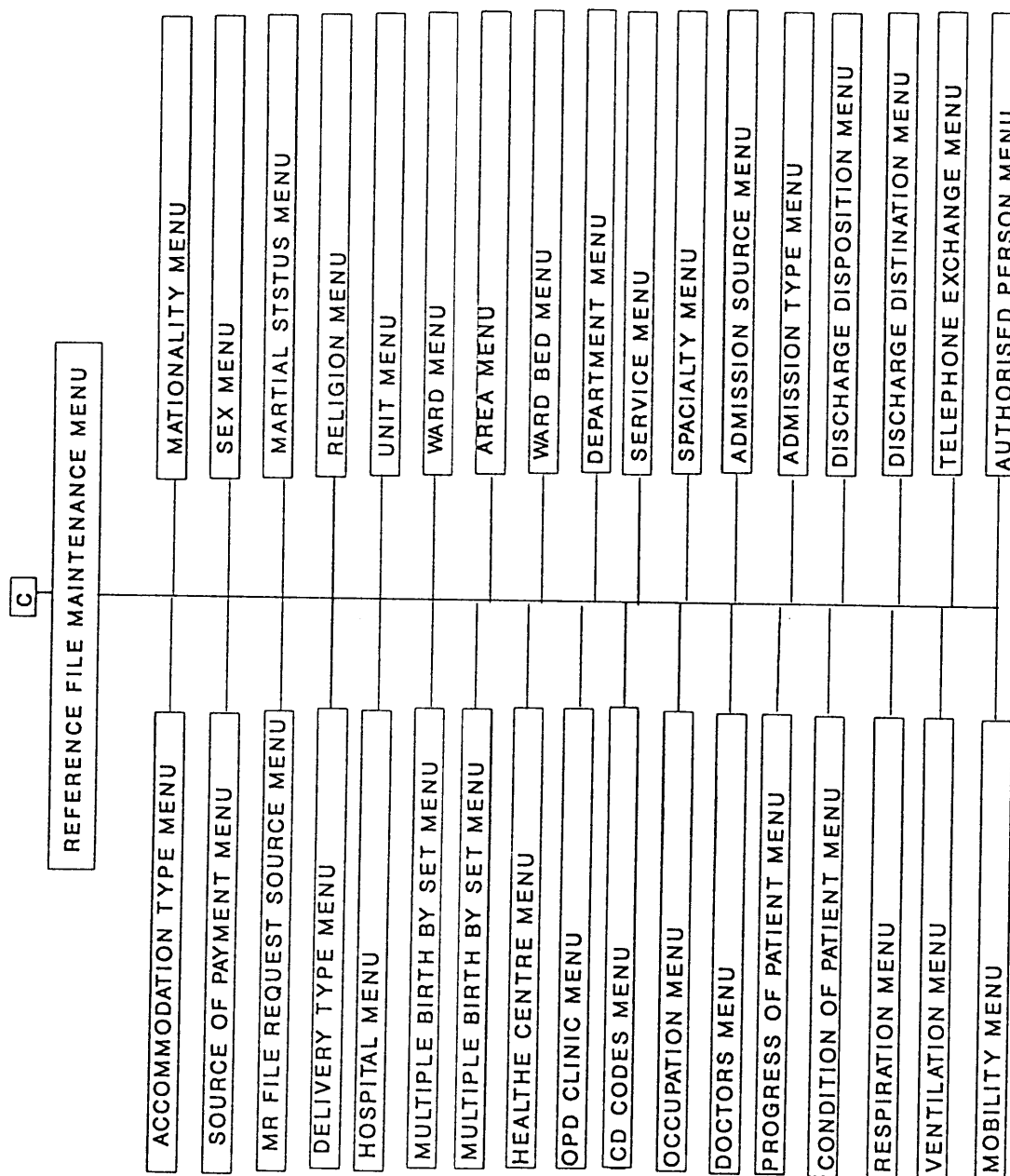


Figure 6.3: Reference file maintenance menu

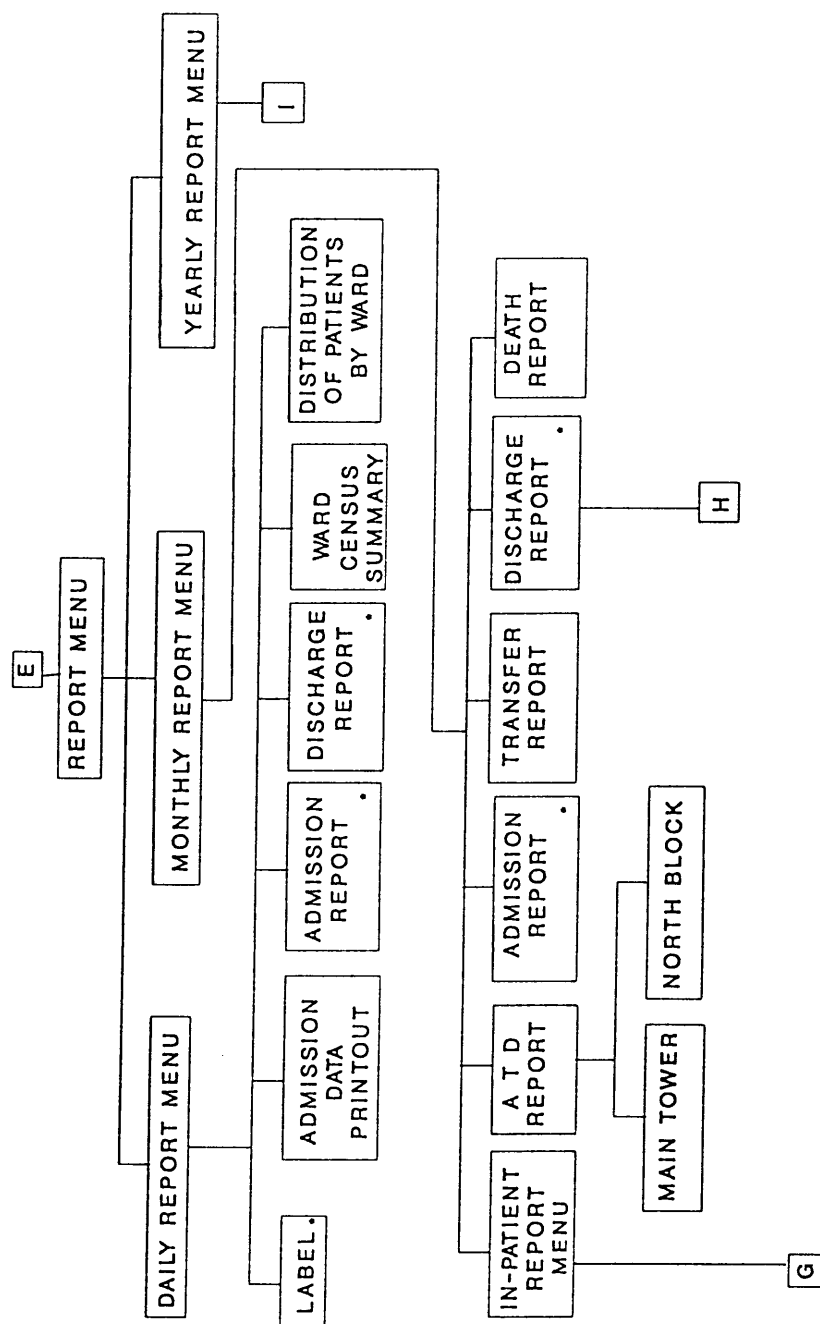


Figure 6.4: Report menu

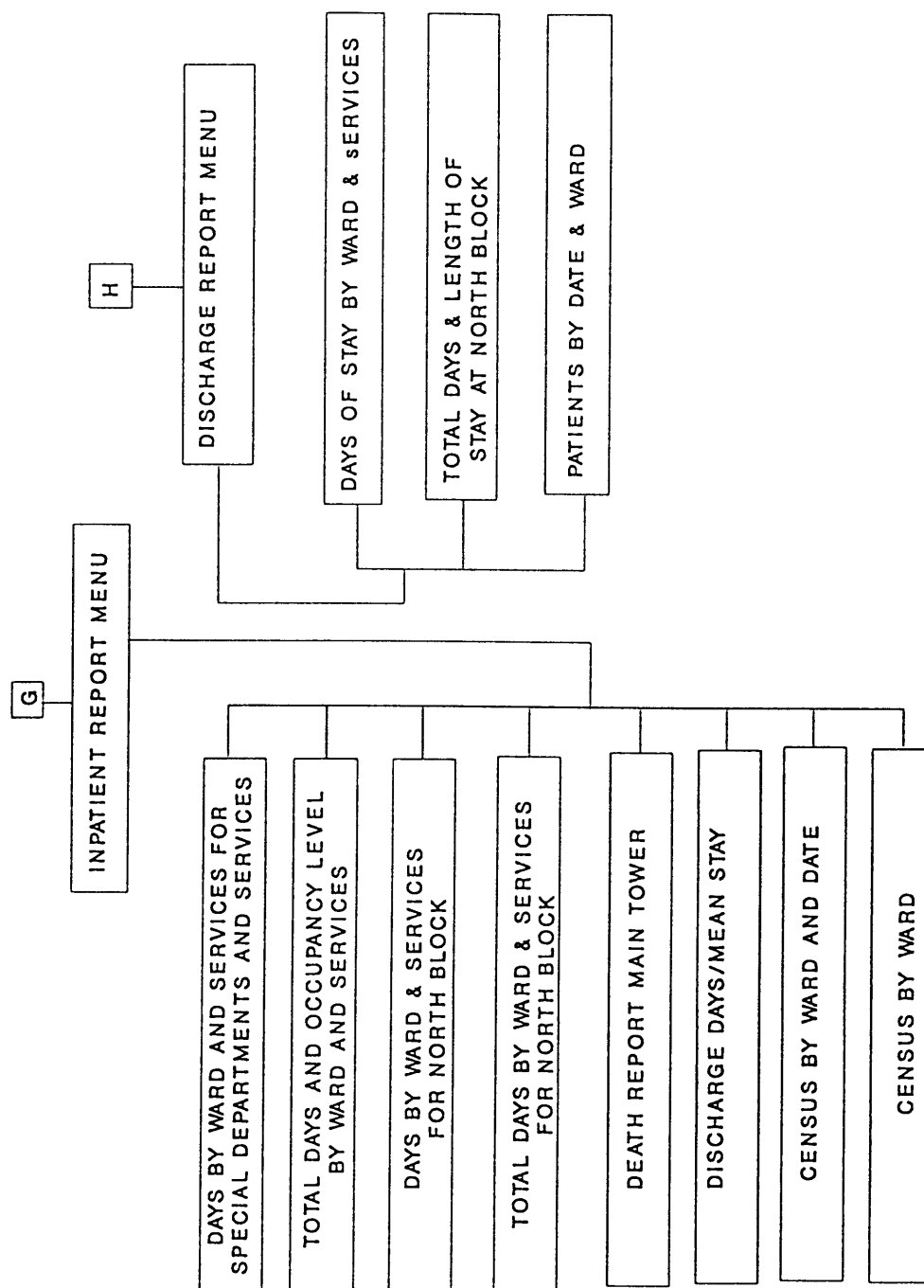


Figure 6.5: Inpatient report and discharge report menus

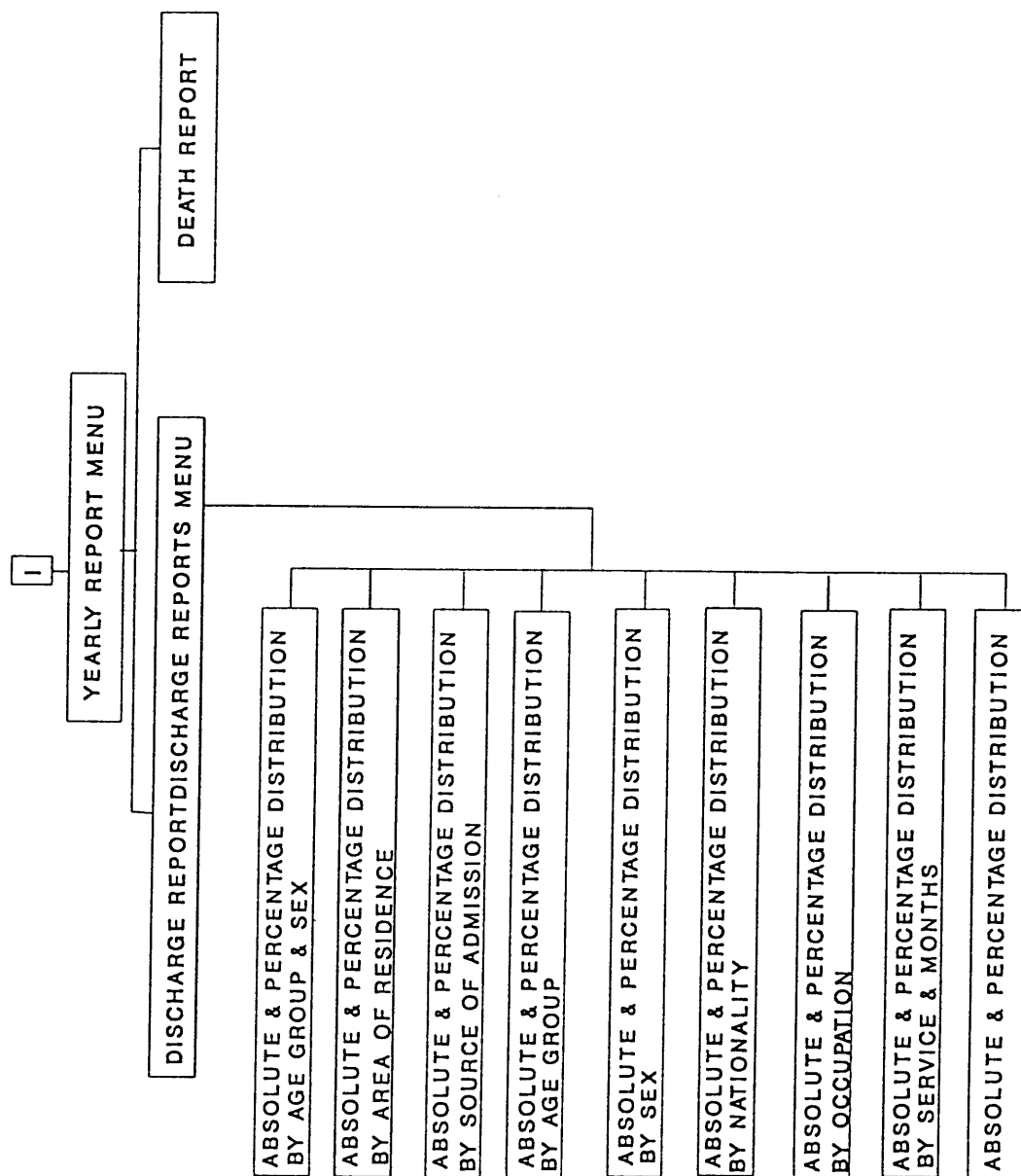


Figure 6.6: Yearly report menu

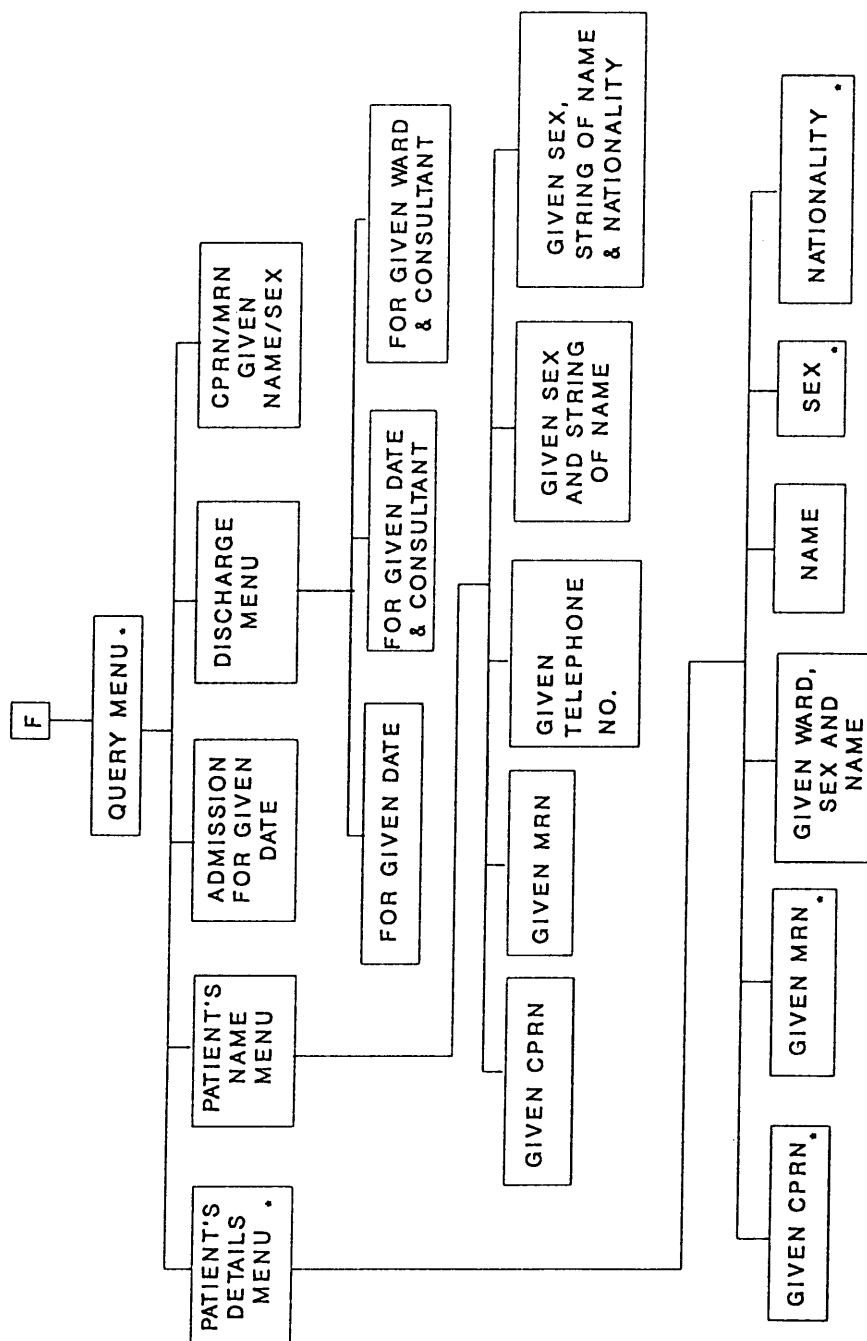


Figure 6.7: Query menu

Chapter 7: Conclusions and Recommendations For Further Work

7.1 Conclusions

7.1.1 The Information System

The information system can help to:

1. Reduce the amount of paperwork.
2. Reduce the interdepartmental communications time.
3. Provide a quick way of data transfer.
4. Reduce the data storage.
5. Provide a quick way of retrieving patient's information.
6. Provide a quick way of generating the different ATD reports.
7. Provide a fast way to query patient's information.
8. Provide a controlled access to patient's data.
9. Function in a multi hospital environment.
10. Provide opportunities for future integration of patient care system.
11. Make the job easy for the Ministry of Health Staff.
12. Help the Ministry of Health management to plan better future patient care system.
13. Help the Ministry of Health in management decision making.

7.1.2 Meeting User Requirements

The information system caters for most of the user requirements. However, some of the requirements not catered for may not be essential, or they can be easily met by providing the departments with other software packages to help them in their jobs. As an example, in the Ambulance Department the users have asked for computerisation of the preparation of ambulances maintenance schedules. This could be achieved with the purchase of a specialised package for this purpose.

7.1.3 Testing The System

Information system testing takes time, effort and organisation (Avison and Wood-Harper 1990). The ATD System is large system and to fully test the system for bugs at the time of implementation obviously requires time. When users start to use an unfamiliar system, it is often difficult to know when a fault has occurred, whether it is due to an operator error, or caused by poor documentation. Testing can be carried out without a technical support team, but this should start after some familiarity has been gained from using the system.

7.1.4 Assessing The System

It is difficult to assess information systems. Hawgood and Land (1986) describe three fundamental difficulties. Firstly, effectiveness is a subjective concept and different people may have different views on the effectiveness of a system. Secondly, information system are immensely diverse in the functions that they carry out and the objectives that they seek to achieve. Thirdly, an evaluation should compare the running of the organisation with and without the aid of the computer-based information system. This comparison, in reality, is not usually possible.

7.1.5 Continuing Change

Development of an information system is a continuing process, but once the system has been accepted, there are three types of maintenance that have to be carried out. These are bugs to fix, change of details and additions. There needs to be a strategy which takes account of this continuous need for changes. In particular, there should be regular reviews of the Ministry of Health needs and whether the information system is serving those needs.

7.1.6 The Multiview Methodology

With regard to the Multiview Methodology, the following points can be concluded:

1. While on field study in Bahrain, I noticed that the users of the system, including some Ministry Officials, believe that computer-based information system is the solution to their current problems. They further believe that the implementation will not affect jobs. But, I think that this attitude may affect some crucial decisions like selecting the best socio-technical alternative (in Multiview Stage 3 - Analysis and Design of Socio-Technical Aspects).
2. The Health Service System in both Bahrain and the U.K. are very similar. Nevertheless, the service in the latter is computerised. Therefore, we might be able to draw some lessons from the British experience. A fact which is in support to point no. 1.
3. As mentioned in my research (cf. Multiview - Stage 3), some users of the system took some computer courses becoming more familiar with computers and their importance nowadays. Again, this point can be taken as a piece of evidence for the point no. 1.

4. A decision for a computerised system in the Health Service in Bahrain is political. I realise that decision has been taken by top officials in the Government, this decision, in turn, may affect the alternatives (cf. point no 1).

7.2 Recommendations For Further Work

The ATD system provides a basis towards the future integration of Patient Care System. It forms a part of Patient Care System, but to achieve the total integration of Patient Care System, other parts should be developed. These are:

- . Medical Record
- . Order Communications
- . Laboratory
- . Radiology
- . Blood Bank and Donor
- . Pharmacy and Drug Information
- . Nursing Service
- . Resource Scheduling
- . Catering and Dietetics
- . Patient Progress Recording.

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Abbreviations

A&E	-	Accident and Emergency
ABF	-	Application By Form
ASC	-	Alpha Software Corporation
ATD	-	Admission, Transfer and Discharge
BD	-	Bahraini Dinar
BHIC	-	Bahrain Health Information Centre
BIAIT	-	Business Information Analysis and Integration Technique
BJHC	-	British Journal of Healthcare Computing
BP	-	Blood Pressure
BSB	-	Business Systems Planning
CAMSL	-	Computer Aided Medical Systems Limited
CASE	-	Computer Aided Systems Engineering
CATWOE	-	Customer, Actor, Transformation, Weltanschauung, Owner, Environment
CCU	-	Cardiac Care Unit
CHS	-	College of Health Sciences
CIAM	-	Conceptual Information Analysis Methodology
CPR	-	Central Population Registration
CPRN	-	Central Population Registration Number
CTG	-	Cardiotocograph
DADES	-	DATA oriented DESIGN
DBMS	-	Database Management System
DFD	-	Data Flow Diagram
DMM	-	Directorate of Material Management
ECG	-	Electro Cardio Graphy
ENT	-	Eye, Nose and Throat
ETHICS	-	Effective Technical and Human Implementation of Computer-based Systems
GCC	-	Gulf Co-operation Council
GOSI	-	General Organisation for Social Insurance
GP	-	General Practitioner
HAA	-	Hospital Activity Analysis

HC	-	Health Centre
HCI	-	Human-Computer Interface
ICD	-	International Code for Diagnosis
ICU	-	Intensive Care Unit
IS	-	Information Systems
ISAC	-	Information Systems Work and Analysis of Change
ISD	-	Information Systems Development
ISD	-	Information Systems Development Methodology
IV	-	Intravenous
LABDEL	-	Labour Information and Administration Module
LAN	-	Local Area Network
LPP	-	Limited Private Practice
LSCS	-	Lower Segment Caesarean Section
MC	-	Minicomputer
MF	-	Mainframe
MICU	-	Intensive Care Unit
MOH	-	Ministry Of Health
MR	-	Medical Record
MRN	-	Medical Record Number
NCC	-	National Computing Centre
NET	-	North East Thames
NHS	-	National Health Service
NHS ME	-	National Health Service Management Executive
OP	-	Out-Patient
OPCS	-	Office Population Censuses and Survey
OPD	-	Out-Patient Department
PAS	-	Patient Administration System
PC	-	Personal Computer
PHI	-	Primary Health Insurance
PMI	-	Patient Master Index
RDMS	-	Relational Database Management System
RHA	-	Regional Health Authority
RTA	-	Road Traffic Accident

SSADM	-	Structured Systems Analysis and Design Methodology
SCBU	-	Special Care Baby Unit
SMC	-	Salmaniya Medical Centre
SQL	-	Structured Query Language
SSM	-	Soft Systems Methodology
VDU	-	Visual Display Unit

Appendix : Study of User Requirements

1. Introduction

Interviews have taken place at the department/sections of the MOH hospitals in Bahrain with the key people who are going to use the system, to identify the following with regard to patients' admission, transfer and discharge activities:

- . the functions which they are performing,
- . the current procedures followed to perform these functions,
- . the type and number of transactions performed, and
- . the user's requirements of the system.

The study is emphasised on the SMC - the main hospital of the MOH, where all the ATD activities are performed.

2. SMC Departments/Sections

2.1 Admission Bureau (SMC & Maternity Hospital)

2.1.1 Functions

1. Registration of new patient.
2. Admission of patient.
3. Admission assignment of patient.
4. Transfer of patient.
5. Discharge of patient.
6. Bed control.
7. Opening of new medical record file.
8. Patient information.

2.1.2 Current Procedures

1. Source of patients for admission.

The sources of patients for admission are as follows:

- . Referrals from Out-patient (OP).
- . Accident and Emergency (A & E).

- . Limited Private Practice (LPP).
- . Private.
- . Health centres.
- . New born in the Maternity Hospitals.

2. Registration of new patient.

For each patient it is checked if he/she is already registered. This check is done using maintained index cards. If registration has been done previously, a patient registration form is given to the patient/informant to fill in. Searching for a patient's file is done either by CPRN or MRN when CPRN is not available. During the registration the following important information should be filled in by the clerk:

- . CPRN.
- . MRN.
- . Name.
- . Date of birth.
- . Father's full name.
- . Mother's full name.
- . Address of patient.
- . Date of registration.
- . Registration clerk's CPRN.

The following information is also required:

- . Sex.
- . Marital status.
- . Area.
- . Religion.
- . Source of payment.
- . Type of accommodation.
- . Source of referral.
- . Ward of admission.
- . Time of admission.

The following additional information is optionally added:

- . Telephone No. of employer.
- . Telephone no. of informant.
- . Telephone no. of contact.
- . Bed no. in the ward of admission.

A check is made for duplicate records for patient with same date and CPRN. However, re-admission of a patient is allowed on the same day.

Any corrections are done by the clerks and deletion of invalid admission records is permitted by a privileged person who is normally the supervisor.

3. Admission Assignment of patient.

For each admission a standard panel is invoked for admission assignment. This panel contains the following admission details:

- . Hospital code.
- . Hospital name.
- . CPRN.
- . MRN.
- . Date of admission.
- . Time of admission.
- . Date of birth.
- . Name of patient.
- . Father's name.
- . Admitting consultant's CPRN.
- . Admitting resident's CPRN.
- . Ward no.
- . Bed no.

The following information is also required:

- . Reasons for admission.
- . Department No.

- . Service.
- . Specialty.
- . Admitting clerk's CPRN.

The following additional information is optionally entered:

- . Date of scheduled surgery.
- . Provisional diagnosis codes.

The following list should be provided at the time of admission:

- . Department - full list.
- . Specialty - full list.
- . Service - full list.

4. Prepare patient labels.

A set of labels containing the following details are prepared:

- . Location.
- . Date.
- . CPRN.
- . MRN.
- . Name of patient.
- . Age.
- . Sex.
- . Nationality.

The above labels are used for posting on the copies of inpatient data abstract, a new MR file, request papers, instruction papers, test samples sent to laboratory and x-ray reports etc.

5. Copies of patient information.

Copies of patient information in the registration, admission and the admission assignment is provided for the ward and the Admission Bureau.

6. Revised set of labels and admission data.

The previous day's Daily Ward Bed Statement is sent to the admission counter from the ward. If any correction is required in labels and admission data, it is done then and sent to the Admission Counter. The errors are highlighted by Data Quality Section also. The clerk at the Admission Counter reconciles Daily Ward Bed Statements with the duplicate copies of admission data. If any errors are detected, the necessary corrections are made and the labels are prepared once again.

7. Prepare additional labels.

On request, additional labels are prepared for ward.

8. Ward transfer of patient.

From the Ward Bed Statement, the new ward of any patient is recorded when the patient is transferred.

9. Discharge of patient.

From the Ward Bed Statement, the discharge of a patient requires the following information:

- . Date of discharge.
- . Time of discharge.
- . Discharge consultant's CPRN or staff no.
- . Discharge resident's CPRN or staff no.
- . CPRN of discharge clerk.

10. Prepare daily report of patient's admission. This report is for the following purposes:

- . To check the discharge of patients reported in Ward Bed Statement.
- . To make a statistical report concerning the admission.
- . To enable the collection files of discharged patients from all wards.

11. Prepare daily report of discharged patients.

The daily report of discharged patients is for the following purposes:

- . To check discharged patients reported in Ward Bed Statement.
- . To make statistical reports concerning discharged patients.
- . To enable the admitting consultant to know about discharged patients.
- . To enable the collecting of files of discharged patients from all wards.

12. Prepare requisition for MR files from the Filing Section.

Normally the MR file is sent along with patient/informant to the ward with these labels and admission data. A requisition is prepared by the admission clerk for getting MR files.

13. Maintain a register of MR files not sent to the ward.

When a MR file of the patient is not immediately available, a note is made in a register recording the following information:

- . Date.
- . MRN.
- . Name of patient.
- . Ward.

14. Opening of new MR file.

For the new registration of an inpatient a MR file is opened, where label, admission data, appointment card and inpatient data abstract are kept. At the ward additional reports pertaining to the patient are added.

15. Send MR to the ward with patient/informant.

The MR file, inpatient data abstract, label and admission data are enclosed in an envelope and given to the patient/informant to take to the ward.

16. Register of admission.

A register of admission is maintained in which the following information is noted:

- . Serial no.
- . Date.
- . MRN.

- . Name.
- . Age.
- . Sex.
- . Brief address.

17. Enquiries regarding inpatient.

People make enquiries at the admissions counter regarding patients. Enquiries are also made by phone. The enquiries can be answered by referring to the index cards of patients.

18. Maintaining a file of admission documents.

- . The following documents are filed in a separate file.
- . Copy of admission form.
- . Copy of patient abstract.
- . Copy of patient admission data.
- . Daily admission report.
- . Daily discharge report.

2.1.3 Transactions

The approximate average volumes are:

- | | |
|----------------|-------------|
| . Registration | 20 per day. |
| . Admission | 90 per day. |
| . Transfer | 15 per day. |
| . Discharge | 90 per day. |

2.1.4 Requirements

The computer system should be able to cater for the following:

1. Registration of patient.

The following are required at the registration:

- . Recall of previously recorded data.
- . Obtain a MRN.
- . The registration if the first contact of patient.

- . Facility to update and delete previously recorded registration data.
- . Control duplicate MRN.
- . Enquiry facility for:
 - . Nationality code.
 - . Occupation code.
 - . Religion code.
 - . Area code.
 - . Health centre code.
- . Enquiry facility for a patient by any of the following:
 - . CPRN.
 - . MRN.
 - . Telephone number.
- . Search facility (ordered by name) by:
 - . sex and string of name.
 - . sex, string of name and nationality.
 - . sex, string of name, nationality and area code.
- . Search facility (ordered area) by:
 - . sex and part string of name.
 - . sex, part string of name and nationality.
 - . sex, part string of name, nationality and area code.

2. Admission of patient.

The following are required at the admission:

- . Retrieval of the patient registration details.
- . Facility to update and delete previously recorded admission data.
- . Automatic correction of admission records while updating registration information.
- . Printing requisition for MR file from Filing Section.
- . Enquiry facility for:
 - . Source of payment code
 - . Accommodation type code.

3. Admission assignment of patient.

The following are required when performing the Admission Assignment:

- . Correct previously recorded admission assignment details with proper security and integrity.
- . Enquiry facility for:
 - . Department code.
 - . Specialty code.
 - . Service code.

4. Transfer of patient.

The following facilities are required for the transfer of patients:

- . On-line facility at ward to effect the transfer.
- . Printing Inter-ward Patient Transfer Notice.
- . Facility to enter and save the following information:
 - . Transfer of ward.
 - . Source of payment.
 - . Type of accommodation.

5. Discharge of patient.

The following are required at the discharge of patient:

- . On-line facility at the ward to effect discharge.
- . Enquiry facility of patients discharged covering:
 - . The given date.
 - . The given date for the given consultant.

6. Printing reports.

The following reports are required:

- . Admission report for the given period ordered by ward, sex and name.
- . Current patients by ward, sex and name.
- . Bed availability by ward.
- . Current patients in private rooms by ward.
- . Patients belonging to a clinical service not normally provided in the ward.

- . Ward availability in private rooms by ward.
- . Transfer report for the given period ordered by ward and sex.
- . Discharge report for the given period ordered by ward and sex.
- . Admission register.
- . Transfer register.
- . Discharge register.

7. Enquiry facility.

The following enquiries facilities are required:

- . Admission for the given date ordered by ward, sex and name.
- . Current patients by ward, sex and name.
- . Vacant bed availability by ward.
- . Current patients in private rooms by ward.
- . Vacant bed availability in private rooms by ward.
- . Discharge for the given date ordered by ward.
- . Transfer for the given date ordered by ward, sex and name.
- . Patient CPR/MRN for the given name/sex.
- . Current patient details for the given CPRN/MRN.
- . Current patient details for the given CPRN/MRN.

2.1.5 Data Links With Other Department/Section/System

Department/Section/System	Data	Mode
. A & E	Admission Form	Input.
. OPD	Admission Form	Input.
. LPP Clinics	Admission Form	Input.

2.2 Filing Section (SMC)

2.2.1 Functions

1. Prepare Index Card of new patient.
2. Keep the Index Cards on index machine card racks.

3. Keep the MR files in the racks in the order of MR no.
4. Send the MR files to the authorised persons when requested.
5. Keep track of requested unavailable files for sending them subsequently.
6. Collect daily the files of discharged patients from all wards.
7. Keep track of files received from wards after discharge of patient.
8. Attend to all enquiries about the patient's MR file.

2.2.2 Current Procedures

1. Track of MR file.

The following procedures are performed to keep track of MR files:

- . For storage of MR, files are kept in racks arranged in the order of MR No.
- . When a patient is admitted, the Admission Bureau request the patient's MR file from Filing Section.
- . Whenever a patient is transferred from one ward to another ward, the file is also transferred with the patient.
- . The files of discharged patients are collected from the ward every day by the Filing Section staff.

2. Track of files not received from the wards.

Every day, the Filing Section collects a copy of the Daily Discharge Statement from the Admission Bureau and keeps it in a file where details of MR files to be received from the wards are noted. A staff from Filing Section goes to all the wards to deliver the files which could not be sent to the ward along with the patients, and to collect the files of the discharged patients. The signature of the authorised person from the ward is obtained on a register against the MRN when the files are delivered. Also he/she signs on a register maintained by the ward for files received. An entry is made on the daily discharge report for the files received. If for any reason, a file is not received, it is mentioned in the daily discharge report.

The staff of the Filing Section carry the following during collection of files from the wards:

- . The register which gives details of MR files to be delivered.
- . The file where daily discharge reports are filed.
- . The files to be delivered.
- . The files of discharged patients collected from other wards.

3. Issue of MR files.

The MR files are issued against Requisition Slips received from the Admission Bureau, Consultants, Wards and A & E. When a file is taken out from the rack the requisition is kept in a folder. OPD does not prepare a requisition separately. It sends the list of scheduled appointments two days in advance. The Filing Section takes out all the files shown in the list, and replaces them by patient record tracer card. The Requisition Slip contains the following information:

- . Date of issue.
- . Patient's name.
- . MRN.
- . Location.
- . Sent to (name).
- . Signature.
- . Written by.

The OPD appointment contains the following information:

- . Consultant's name.
- . Date.
- . Specialty.
- . Time.
- . Serial no.
- . Patient's name.
- . Appointment time.
- . MRN
- . X-ray no.
- . Bahraini/Non-Bahraini.
- . Old patient/ new patient.

- . Arrival time.
- . Seen (yes/no).

The following information is entered by the Filing Section in the patient record tracer card:

- . Date.
- . Sent to.
- . Department.
- . Patient's full name.
- . MRN.

4. Register of files to be sent.

When a file could not be issued because of its non availability, an entry is made in a register which gives the following details:

- . MRN.
- . Name.
- . Location to be sent to.

5. Typing Index cards.

For first time patients from OPD or A&E, an index card is prepared by typing relevant information given in the registration form filled in by patient/informant. The typing job is performed by a typist attached to the MR Department.

6. Storage of Index cards.

For the Bahraini patient, index cards are stored in index machines arranged in name order. If there are too many cards for the same name then they are arranged in the order of name and area. The index cards for non-Bahraini patients are kept in racks arranged in the order of nationality and name.

7. Attend Enquiries regarding MRN.

The Admission Bureau makes enquiries regarding the patient's MRN either by phone or in person. The index cards of the patients are given to the Admission Bureau if the patient has previously registered. These index cards are returned after the discharge of the patient. In the case of enquiries from OPD, index cards are not given but only MRN is given to enable them to note it down on the appointment card. If the Index card is not available the Admission Bureau or OPD will open a new MR file with a new MRN. Accordingly, an index card is typed from the patient registration form.

2.2.3 Transactions

The approximate average volumes are:

. Index cards - Admission	90 per day.
. Index cards - OPD	45 per day.
. Files requested - Admission	90 per day.
. Files requested - OPD	750 per day.
. Files collected from ward	90 per day.
. Files collected from OPD	750 per day.

2.2.4 Requirements

The Proposed computer system should cater for all the functions as defined in the current procedures. More specifically it should have the following capabilities:

1. The ability to handle details of more than one MRN of same the patient given by different health centres.
2. Identify the location of the file given the following:
 - . Hospital.
 - . Building.
 - . Room number.
 - . Rack number.
 - . Shelf number.
 - . Ward.

- . Name of person (to whom it is issued).
3. Update details of the location of an individual file or files of patients discharged on a given date on query basis.
4. Enquiry facility for:
- . Files of discharged patients and those still lying around in the ward.
 - . Files missing in ward and MR Department.
 - . Files which could not be issued when requested.
5. Searching facility for files given the following:
- . CPRN or MRN.
 - . Sex, string of name and nationality ordered by area.
 - . Sex, string of name and area code arranged by nationality and name.
6. Produce the following reports:
- . Cumulative Index ordered by nationality, name and MRN.
 - . Cumulative Index ordered by CPRN.
 - . New additions to index by nationality, name and MRN.
 - . New additions to index by CPRN.
 - . List of files which could not be issued when requested.

2.2.5 Data Links With Other Department/Section/System

Department/Section/System	Data	Mode
. A & E	Patient details	input
. OPD/LPP Clinics	Patient details	input
. Nursing Station	Patient details	input

2.3 Data Quality (SMC)

2.3.1 Functions

1. Verify the admission data.
2. Codify and update operation and diagnosis details by International Codes for Diagnosis-9 (ICD-9 codes).
3. Update operation and diagnosis codes.
4. Posting daily details in a statement.
5. Prepare monthly statistical reports and compile annual statements.
6. Check for incomplete patient files and take appropriate action.
7. Verify Index cards.

2.3.2 Current Procedures

1. Verify admission data with the admission form.

The data is verified using the admission data and admission form. If there is any error, the Admission Bureau is informed allowing them to make any necessary corrections.

2. Write/update reasons for the admission of patients.

The reasons for admission are checked for any errors (written by the Admission Bureau) and corrected if necessary.

3. Verify the daily admission and discharge statements against daily ward/bed statement.
Daily admission and discharge statements received from the admission Bureau are used to verify the Ward Bed Statement. If there is any error, the Admission Bureau is requested to make the necessary corrections.

4. Index cards verification.

The index cards are verified.

5. Coding operation and diagnosis details by ICD.

After the discharge of the patient, a copy of Inpatient Data Abstract is received. The operation and diagnosis are coded referring to the International Code for Diagnosis.

6. Update operation and diagnosis codes.

7. Posting daily details in a statement.

Using the Daily Ward Bed Statement, Daily Admission Statement and Daily Discharge Statement, the following statements are compiled:

- . Admission/Discharge/Transfer Report by ward.
- . Daily Ward Census Summary by ward, date and department.
- . Length of stay by ward and date.
- . Transfer out days for ICU and CCU by date.

8. Check for incomplete MR files.

The MR files received from the wards after the discharge of the patient are verified and appropriate actions taken to complete them.

9. Prepare the following monthly statistical reports:

- . Admission, Transfer and Discharge for all wards by date.
- . Admission, Transfer and Discharge for the full month by ward.
- . Inpatient days by ward and services.
- . Total inpatient days and occupancy level by ward.
- . Discharge days and length of stay by ward.
- . Death report.
- . Deliveries and births reports including: deliveries by date, type of delivery, Bahraini/Non-Bahraini and Multiple births.
- . Admission/deaths in Special Care Baby Unit (S.C.B.U.).
- . The average daily census of S.C.B.U.
- . The percentage occupancy for the S.C.B.U.
- . Total deaths for the S.C.B.U.
- . Gross death rate for the S.C.B.U.
- . The mean length of stay for S.C.B.U.
- . Total number of deliveries.
- . Total number of births.

10. Ad-hoc reports for educational/research purposes.

Prepare any ad-hoc report requested by doctors or administration.

2.3.3 Transactions

The approximate average volumes are:

- . Index cards - Admission 90 per day.
- . Index cards - OPD 45 per day.
- . Files requested - Admission 90 per day.
- . Files requested - OPD 750 per day.
- . Files collected from ward 90 per day.
- . Files collected from OPD 750 per day.

2.3.4 Requirements

1. Facility to update with proper security and overall system integrity details of:

- . Registration.
- . Admission and discharge.
- . Admission assignment.
- . Transfer.

2. Produce the following daily report for any given date:

- . Admission ordered by ward, sex and name.
- . Transfer ordered by ward, sex and name.
- . Discharge ordered by ward, sex and name.
- . Remaining census by ward.

3. Produce the following monthly statistical reports:

- . Admission, transfer and discharge for all wards by date.
- . Admission, transfer and discharge for full month by ward.
- . Inpatient days by ward and services.
- . Total inpatient days and occupancy level by ward.
- . Discharge days and length of stay by ward.
- . Death report.

- . Total admissions from A & E.
- . Admission to SMC by source of referral.
- . Highlights of the month - Main Tower, including:
 - . Total admissions.
 - . Percentage of total admissions.
 - . Average daily admissions.
 - . Peak day for the month.
 - . Total No. of admissions for the peak day.
 - . The average daily census.
 - . The percentage occupancy.
 - . Total deaths.
 - . Gross death rate.
 - . The mean length of stay.
 - . Ward where length of stay is high.
 - . Inter-ward transfer.

4. Enquiry facility for:

- . Nationality code.
- . Occupation code.
- . Religion code.
- . Area code.
- . Health centre code.
- . Source of payment code.
- . Accommodation type code
- . Department code.
- . Specialty code.
- . Services code.
- . ICD code of common diseases.

5. System to highlight incomplete information.

6. System to limit access to authorised staff only.

7. System to highlight exceptions.

2.3.5 Data Links With Other Department/Section/System

Department/Section/System	Data	Mode
. A T D	Admission, Transfer & Discharge details	input.
. OPD	Episode details	input.

2.4 Ward (Inpatient-Nursing Station)

2.4.1 Functions

1. Acknowledge Inter-Ward Patient Transfer Notice.

2. Maintain the following:

- . Register of patients admitted.
- . Register of patients discharged.
- . Register of test requests.

3. Prepare the following:

- . Daily Ward Bed Statement.
- . A report giving details of single room occupancy and patients belonging to a clinical service not normally provided in the ward.
- . Inter-ward Patient Transfer Notice.
- . Routine test requests required for the patients over 40 years of age.
- . Specific test request recommended by the doctor.
- . Agreement for payment of single room fees.
- . Visitor's Gate Pass.
- . Operation consent form.
- . Pre-operation Check List.
- . Operative Report.
- . Various documents related to the discharge of patients.

4. Seek clinical/other appointments.

2.4.2 Current Procedures

1. Maintain a register of patients admission, transfer and discharge. The register is updated on three different occasions. When a patient arrives on the ward the following information regarding the patient is noted in the register:

- . Serial number.
- . MRN.
- . Name.
- . Brief address.
- . Date of admission.
- . Time of arrival of patient.

When the patient is transferred from the ward the following information is noted in the same register:

- . Ward number to which the patient is transferred.
- . Date of transfer.

When the patient is discharged, the following information is noted in the same register:

- . Date of discharge.
- . Time of discharge.

ICU at SMC maintains additional information in their register as detailed below:

- . Age.
- . Nationality.
- . Any previous diagnosis.
- . Discharge disposition such as Cured, Improved, Died etc.
- . Final Diagnosis.

2. Maintain a register of patients discharged.

When the patient is discharged the following information is noted in a register of discharged patients:

- . Date of discharge.
- . Time of discharge.
- . Name of patient.

3. Prepare Ward Bed Statement.

At midnight a Ward Bed Statement is prepared referring to the register of admission and register of discharge. The following information is required in the statement:

- . Admission - MRN, name & time.
- . Transfer in - MRN, name & from.
- . Transfer out - MRN, name & to.
- . Discharge - MRN, name & admission date.
- . Deaths - MRN, name & admission date.
- . Calculation of census.
- . Census by service.

4. Prepare a report giving details of single room occupancy and patients belonging to a clinical service not normally provided in the ward.

Details of single room occupancy are given as shown below:

- . Ward no.
- . Date.
- . Time.
- . Service.
- . Room no.
- . Patient's name.
- . MRN.
- . Date of admission.
- . Category - (Charge, Medical grounds & Space shortage).
- . Doctor.
- . Details of patients belonging to a clinical service not normally provided in the ward are given as below:
 - . Patient's name.

- . MRN.
- . Clinical service.
- . Doctor.

5. Prepare Inter-Ward patient transfer Notice.

When a patient requires transferring to a different ward, an Inter-ward Patient Transfer Notice is prepared.

6. Acknowledge Inter-Ward Patient Transfer Notice when a patient arrives at the ward of transfer.

7. Prepare request for certain tests for patients of age 40 years old and above.

From the Admission Data the date of birth of the patient is given, and requests for certain tests are made for all patients of age 40 years old and above.

8. Prepare other test requests.

After the doctor examines the patient, he/she recommends certain tests and radiology depending on the condition of the patient on the progress sheet. The nurse prepares test requests and radiology requests.

9. Maintain a register of test requests.

In a register, test requests are noted down. The register contains the following information:

- . Date of request.
- . MRN.
- . Patient's name.
- . Description of test.

10. Prepare an agreement for payment of single room fees.

On request from the patient for a single/private room, an agreement for the payment of fees is made.

11. Prepare Visitor's Gate Pass.

A Visitor's Gate Pass is prepared for the visitors requesting visits on certain days.

12. Prepare Operation Consent Form.

When a patient has to undergo any surgical operation, a consent form is filled in obtaining the consent of the patient.

13. Prepare a Pre-Operative check list

Before any surgical operation, a Pre-operative Check list is prepared.

14. Prepare Operative Report.

After any surgical operation, an operative report is made.

15. Prepare various documents relating to discharge of patient.

When a patient is discharged, one or more of the following are prepared depending on the requirement:

- . Discharge information record.
- . Obstetric discharge summary.
- . Discharge of baby record.
- . Medical certificate.
- . Medical certificate showing the cause of death.
- . Appointment card.

2.4.3 Transactions

The approximate average volumes are:

- | | |
|-------------|-------------|
| . Admission | 90 per day. |
| . Transfer | 15 per day. |
| . Discharge | 90 per day. |

2.4.4 Requirements

The proposed computer system is to cater for the following:

1. On-line updating at the ward, covering the following:

- . Transfer of patient.
- . Discharge of patient.
- . Change in type of accommodation.
- . Change in terms of payment.
- . Leave record.
- . Pre-operative check list.

2. An enquiry facility for files by one of the following:

- . CPRN.
- . MRN.
- . Telephone number.

3. An enquiry facility by patient information - MRN, CPR or sex, nationality and name for the following:

- . Past admission data.
- . Past history of illness.
- . Demographic data.
- . Contact data.

4. An enquiry for admission details for a given date - ordered by ward, sex and name for the following:

- . All wards for the given consultant.
- . A given ward.

5. An enquiry for details of all current patients by ward, sex and name for the following:

- . All wards.
- . A given consultant.

6. An enquiry for details of private room's patients by ward sex and name for the following:
 - . All wards.
 - . A given consultant.
7. An enquiry for census and availability of vacant beds by ward.
 - . Private plus general.
 - . Private only.
8. An enquiry for the occupancy of private room by payment terms and the reason for privacy.
9. An enquiry for details of discharge for any given date (ordered by ward, sex and name) for:
 - . A given ward.
 - . A given consultant and all wards.
10. An enquiry for details of transfers for the given date (ordered by ward, sex and name) for:
 - . A given ward.
 - . A given consultant and all wards.
11. An enquiry for patient's pre-operative check lists.
12. An enquiry for test results due and pending - ordered by date.
13. An enquiry for consultation due ordered by the date.
14. An enquiry for patients due to return after leave.

15. A report facility for:

- . Patient's labels.
- . Request for laboratory tests, medicines from Pharmacy, Radiology and E.C.G.
- . Consultations (Maternity Hospital).
- . Agreements for payment of single room fees.
- . Visitors passes.
- . Operation consent forms.
- . Pre-operative check lists.
- . Operative reports (details of the operation is completed by the doctor).
- . Discharge information records.
- . Discharge notification logs.
- . Discharge of new born baby.
- . Post-natal discharge information.
- . Medical certificates.
- . Medical certificate showing the cause of death.
- . Appointment cards.

2.4.5 Data Links With Other Department/Section/System

Department/Section/System	Data	Mode
. ATD, OPD	Episode details	Input.
. Radiology	Test requests	Output.
. Pathology	Test results	Input.
. Physiotherapy	Service request	Output.
. Pharmacy	Prescription	Output.
. Blood Bank	Blood request	Output.
. DMM	Material requisition	Output.

2.5 Out-patient Appointment Desk (SMC)

2.5.1 Functions

1. Receive a request for an appointment.
2. Book an appointment with the doctor.
3. Inform the patient about the booking.
4. Inform the patient upon cancellation of a clinic.
5. Reschedule appointments and inform patient.
6. Prepare a MR and maintain a register of new patients.
7. Supply the list of appointments to the MR Section.
8. Supply the list of appointments to the clinic.
9. Receive the duty rota for doctors from the administration
10. Receive a list of companies of primary health.
11. Collect fees from certain patients.
12. Generate daily and monthly statistics.

2.5.2 Current Procedures

1. Receive request for an appointment.

Patients are referred to SMC OPD mainly from various health centres, A & E, Staff Clinic, other hospitals/clinics in Bahrain etc. A few walk-in patients also seek medical attention at the OPD clinics. A request to book an appointment for a patient with a doctor could be made at the appointment desk in the following ways:

- . A telephone call from a health centre on behalf of the patient.
- . A telephone call from the ward on behalf of the in-patient.
- . A visit by the patient to the appointment desk.

2. First time patient.

On the day of the appointment, the first time patient contacts the OPD appointment desk for the preparation of a MR. The new MR for the patient is prepared only after verifying with the Filing Section the absence of previously prepared MR for the same patient. The demographic details of the patient are noted in a register.

3. Follow-up visits.

The attending doctor issues a request to the OPD appointment desk to book an appointment for a follow - up visit. This request is usually noted on the appointment card of the patient. The date of the follow-up visit or the duration after which the follow-up visit should be sought is mentioned by the doctor on the request. Upon receipt of the request, the OPD appointment desk verifies the availability of an appointment and books an appointment for the patient. The actual date and time of the appointment for follow-up visits are transcribed onto the appointment card and handed over to the patient.

4. Book an appointment.

The OPD appointment desk maintains the attendance schedules of each doctor and their respective clinics. On a sheet, the doctor's name and day and date of clinic are noted and time slots of 10 or 15 minutes are set out. At times the doctor's preference of the mix of old and new patients is also indicated on the sheet. These are organised chronologically for each doctor/firm.

The appointment desk also has a list of doctors and their respective specialisations. Whenever a request to schedule an appointment is received without a specific doctor's name, this list is consulted to find the names of doctors with the desired specialisation.

As and when an appointment is sought for a particular day for a particular doctor, the patient's name, MRN, telephone number etc. are noted on a vacant time slot on the schedule of the doctor for that day. In case a vacant slot is not available on the requested date, then the appointment is booked for the next nearest available date. However, if the doctor has indicated that the patient has to be seen by him/her irrespective of the (normal) availability of a vacant slot, the appointment desk makes a booking termed as "extra" on the date requested.

The scheduled appointment is transcribed onto the patient's appointment card. The name of the doctor, date and time of the appointment scheduled are shown on the

patient's appointment card.

Often the first appointment is made on behalf of an in-patient by the nurses prior to the patient's discharge from the hospital. The appointment desk receives the request over the telephone and then schedule the time. In such cases, the ward number from where the request originated is also noted by the appointment desk staff on the appointment sheet in addition to the name and MRN of the patient. The patient at the time of discharge is given the appointment card filled in by the nurse indicating the appointment details.

Similarly, for patients referred to SMC by the health centres, the appointment is booked over the telephone by the health centre personnel. In such cases, the appointment desk staff note on the appointment sheet the name of the health centre from where the request originated. The patient is given a referral form indicating the nature of medical attention needed and details of the appointment are filled in by the health centre doctor and the health centre administrative personnel.

5. Cancellation and rescheduling.

If a doctor is unable to attend a clinic, often arrangements are made so that the patients are seen by other doctors.

If a very specialised clinic is to be cancelled, the patients are informed by telephone about the cancellation. Their appointments are rescheduled to the next sitting of the clinic.

Patients rarely inform the appointment desk about their inability to honor the appointment, resulting in a "no-show". However, if a patient informs his/her intention to cancel a scheduled appointment, the appointment desk makes a note of this and makes the appointment available to other patients previously booked. Often, such patients approach the appointment desk at a later time to seek a fresh appointment. In such cases, the nearest available appointment is booked by the desk.

6. Preparation of a M R.

A new MR is opened for a patient only after verifying with the MR Filing Section over the telephone the absence of an existing MR for the same patient. In case an old MR (unit) number exists for the patient, the appointment desk obtains the number from the MR Filing Section.

On the first visit by the patient, the appointment desk obtains the demographic data, data about relatives etc. on a "Patient Registration Form". A MR is opened for the patient and it has the name, CPRN, nationality, sex, address and telephone number of the patient. The same information is transcribed onto the appointment card.

The registration form is sent to the Filing Section for filling in the index card. The index cards are maintained alphabetically and are used to locate the MR (unit) number of patients.

The (first time) patient information is entered into a register, maintained at the appointment desk for certain clinics.

7. Interaction with MRs Filing Section.

The appointment desk contacts the Filing Section over the telephone, to locate the unit no. (MRN) of the patient if one exists. In the case where a previous record exists then a new MR is not opened.

The sheet of appointments indicating the doctor's name, date of appointment, and the list of patients scheduled to be seen and their respective MRN (if existing) is sent by the appointment desk to the Filing Section a few days in advance of the scheduled appointment date. The Filing Section retrieves the patients' MR based on the MR (unit) number indicated in the appointment sheet. The retrieved MRs are sent to the respective doctor's clinic in time for the appointment. MRs which are not available in the Filing Section at the time of the first attempt will be traced on the day of appointment and sent to the clinics on demand.

8. Interaction with the clinic.

A copy of the current day's appointment sheet indicating the doctor's name, date of appointment (current day), list of patients scheduled for a visit with the doctor, their respective timings and MRNs is made available to the clinic in advance before its opening. In addition, the next available date for regular appointments and 'extra' appointments is indicated on the sheet. The sheet also has markings indicating whether the MR of the patient could be retrieved by the Filing Section or that it was unavailable on the first attempt. Such a sheet would be useful for the clinic to note the attendance of the patients to the clinic.

9. Duty Rota of doctors.

The surgical clinic sends to the appointment desk the duty rota of the doctors in each specialty. This list indicates the panel of doctors on duty each day of the month. The appointment desk refers to this list to locate the name of the doctor on duty using the date of referral and the specialty as indices. Whenever a first time appointment is sought by a referral to the surgical clinic, the patient is scheduled for an appointment with such a doctor.

10. Primary Health Insurance (PHI) and OPD payments.

Bahraini patients, patients from Gulf Co-operation Council (GCC) States, patients employed by the Government or by the companies participating in the PHI scheme are provided with free of charge medical attention. Other patients are required to pay BD 1 per visit to the OPD clinic. The nationality of the patient is ascertained from the CPR card. The nationality is also available on the MR and the appointment card. A list of the names of companies participating in the PHI scheme is made available to the appointment desk by the Finance Department. This list is used to check the applicability of the PHI scheme for the patient. Government employees seeking medical attention are expected to produce their identity cards indicating the staff number (employee number).

The appointment desk cashiers issue either an exemption slip (white colour) or a payment slip (pink colour), as the case may be, to the patient. This slip is used by the

doctors in the clinic as a prescription slip. The payments received at the OPD appointment desk are deposited with the cashier at the end of the day.

11. Extra Bookings.

Upon a written request from the doctor, the appointment desk makes a booking under the "extra" list whenever normal appointments are not available for the specified date.

If an "extra" booking request is received after the appointment desk sends the appointment sheet to the Filing Section, the noting is made on a separate appointment sheet maintained in a file named "extra". These sheets are also organised chronologically for each doctor/firm. Such bookings are later conveyed to the Filing section and merged with the original appointment sheet.

2.5.3 Transactions

The approximate average volumes are:

. Registration of new patients	45 per day.
. Appointments booked	750 per day.
. Cancellations	10 per day.
. Follow-up bookings	700 per day.
. Telephone appointments	70 per day.
. Telephone enquiries to Filing section	70 per day.

2.5.4 Requirements

The proposed computer system should be able to cater for all the functions associated with the out-patient appointment scheduling. Specifically, it should be able to:

- . Book appointments quickly and accurately.
- . Search quickly for an old MRN of a patient.
- . Register a new patient and allot a new unit number.
- . Answer queries about the availability of appointments.
- . Reschedule appointments and inform patients.
- . Maintain patients attendance history.
- . Maintain doctor's clinical schedules and preferences.

. Produce daily clinical schedules.

These functions must be able to give a very quick response in order to reply to telephone queries also.

The daily and monthly statistics being generated should be automated. These include reports indicating statistics of appointments booked, cancelled, rescheduled, attended, no-show, walk-ins, new referrals, follow-up cases, time spent with doctor etc. The reports produced should be based on parameters such as nationality, new or old cases, specialty/sub-specialty, source of referral etc. In addition, comparisons with statistics of previous months/years should be drawn.

The patient's medical history could be computerised. All the episode details should be stored. Details such as the service rendered to the patient and clinical notes could be computerised.

1. Queries.

The following queries should provided:

- . Given a range of dates; display a doctor's schedules.
- . Given a date; display the patients scheduled with a doctor.
- . Given the name of a patient; locate MRN.
- . Given the MRN; display the patient's attendance.
- . Given the MRN; list appointment details.
- . Given a doctor; locate the earliest appointment.
- . Given a medical speciality; display the earliest appointments for various doctors.

2. Reports.

The following reports should be produced:

- . A doctors list of patients scheduled for the day.
- . A firms list of patients scheduled for the day.
- . A MRN list of patients for each doctor/clinic.
- . A list of patients names scheduled for appointment indicating clinic, doctor, date and

time.

. Patient booking/attendance statistics based on nationality, sex, clinic, new or follow-up, source of referral etc.

. Patient registration statistics based on clinic, source of referral, nationality, sex etc.

2.5.5 Data Links With Other Department/Section/System

Department/Section/System	Data	Mode
. ATD, Health Centres	Patient medical details & Referral	Input.
. Staff Clinic, A & E	Patient medical details & Referral	Input.
. Radiology	Test request	Output.
. Pathology	Test result	Input.
. Pharmacy	Prescription	Output.
. Physiotherapy	Service request	Output.
. Administration	Doctors' clinics schedule &	
	Doctors' duty rota	Input.
. Filing Section	MR number	Input/Output.

2.6 Out-patient Clinics (SMC)

2.6.1 Functions

The functions within the out-patient clinics can be categorised as:

1. Those at the clinic reception such as verification of appointment and MR, and
2. Those with the doctor (consultation).

2.6.2 Current Procedures

1. Verification of appointments and MRs.

When the patient arrives at the clinic, the nurse at the clinic reception obtains the MR (unit) No., name of the patient and doctor's name from the patient's appointment card.

The nurse scans the appointment sheet of the doctor and verifies the booking.

The appointment sheet also has an indication whether the MR of the patient could be retrieved by the Filing Section. The nurse checks this indicator and verifies the physical availability of the file.

Patients visiting the OPD for the first time, visit the appointment desk prior to their arrival at the clinics. The appointment desk prepares the MR for such patients and sends the file to the clinic.

2. Request for MR files.

Sometimes, the MR of the patient is not available in the clinic on time. This happens whenever the Filing Section have not been able to retrieve it on their first attempt from the MRs filing room. The clinic nurse requests the MR for such patients.

A few walk-in patients also seek medical attention at the OPD clinics. For such patients also the MR is requested from the filing room.

In some clinics the nurses fill up a tracer sheet and send it to the Filing Section to obtain the MR of the patient.

3. Prepare the MR.

The MRs are made available to the clinic usually a day in advance. The nurse scans the MRs of the patients and verifies the availability of the laboratory reports etc. based on the doctor's notes made during the last visit by the patient. She/he also checks up on the laboratory reports received at the clinic, collates them, sorts and files them in the respective MR files. She/he adds fresh OPD sheets and puts the date stamp of the day of the scheduled visit.

4. Direct the patient.

After having scanned the MR of the patient, the nurse notes down the actions to be taken by the patient, prior to visiting the doctor. She directs the patient to follow the doctor's orders (issued during his/her visit to the clinic). These may include a visit to the Radiology Department to have an X-ray taken, to collect a previous X-ray report;

or a visit to the laboratory to collect a report (if not already received at the clinic); or to obtain readings of blood pressure, temperature and weight etc.

5. Sequence the patients appointments.

In many clinics the practice of 'first come first served' is followed. The nurse at the clinic notes the arrival time of the patient and arranges the patients for the visit to the doctor in the same sequence. She also notes the attendance of the patient.

6. Visit to the doctor.

The doctor sees the patients in the order set by the reception nurse. The patient's MR is made available to the doctor by the nurse. The patient is given medical attention and is usually directed to book the next appointment at the appointment desk. For this, the doctor issues a request for a booking on the appointment card of the patient. The doctor may also require the patient to undergo other tests prior to the next visit to his/her clinic. Towards this, the doctor fills in request for the patient to attend Radiology, Pharmacy, Pathology, etc.

Often a nurse associated with the doctor helps the doctor during the patients' visits. She also fills in details of the patient and details of the requests on the appropriate request forms.

The doctor is provided with a copy of the appointments scheduled for the day. On this sheet, the doctor notes down the time when a patient was seen and the time spent with the patient.

In a separate space provided on the appointments sheet, the doctor notes down the details of walk-in patients such as name, MRN and time seen and time spent.

7. Post visit guidance.

After the visit to the doctor, patients seek clarifications about the procedures to be followed. The reception nurse checks the request forms filled by the doctor for the appointment desk, Pharmacy, Radiology etc. and directs the patient as needed.

2.6.3 Transactions

The approximate average volumes are:

- . Visit by out-patients 750 per day.
- . walk-ins 50 per day.
- . requests for MR files from the Filing Section 50 per day.

2.6.4 Requirements

The proposed computer system should be able to cater for all the functions associated with the Reception at out-patient clinics. Specifically, it should be able to:

- . Verify appointments.
- . Scan the doctors' appointment schedules to locate bookings quickly.
- . Interact with the Filing Section to obtain the MR of patients.
- . Sequence the patients, and give preference to patients arriving at their respective scheduled time.
- . Maintain patients attendance history.
- . Maintain doctors' time sheets indicating the time spent with patients.

The daily and monthly statistics being generated should be automated. These include reports indicating statistics of attendance, walk-ins, load on each clinic, time spent with doctors etc. These reports should be produced based on parameters such as nationality, new or old cases, speciality/sub-speciality, source of referral etc. In addition, comparisons with statistics of previous months/years should be drawn.

The patient's medical history could also be computerised. All the episode details should be stored. Details such as services rendered to the patient and clinical notes could be computerised. Statistical reports based on diagnosis codes and demographic details could be derived. These will be useful for research purposes.

The computer system should also provide the following queries:

- . Given the MRN or CPRN; display appointment details of the patient.
- . Given a doctor and a date; display the patient scheduled and their MRNs.
- . Given the name of a patient; locate the MRN.

- . Given the MRN; display the patients attendance.
- . For a patient, prepare a check list of the doctor's orders based on previous visit.
- . Given MRN; locate the MR of the patient in the Filing Section.
- . List of patients seen by the doctor.

The computer system should also produce the following reports:

- . Doctor-wise list of patients scheduled for the day.
- . Name-wise list of patients scheduled for appointments indicating the clinic, doctor, date and time of appointments.
- . Attendance of patients for each clinic based on sex, nationality, new patient/follow-up patient, source of referral etc.
- . Attendance compared to last month/same month of last year etc.
- . Attendance reports based on diagnosis and age.
- . Reports on the work-load on clinic/doctors
- . List of MRs yet to be retrieved from filing room.
- . Details of patients who have missed their scheduled appointment for the day, including MRN, telephone number, etc.

2.6.5 Data Links With Other Department/Section/System

Department/section/system	Data	Mode
. Health centres	Patient medical details & Referral	Input/Output.
. Staff Clinic, A&E	Patient medical details & Referral	Input.
. Radiology	Test request	Output.
. Pathology	Test results	Input.
. Physiotherapy	Service request	Output.
. Administration	Doctors' clinics schedule &	
	Doctors' duty rota	Input.
. MR	MRN	Input.

2.7 Day Case Unit

2.7.1 Functions

1. Book appointments.
2. Complete Pre-operative formalities.
3. Provide post operative care and complete other forms.
4. Referrals for follow-up treatment.
5. Provide medicines.
6. Maintain a register of patients treated.

2.7.2 Current Procedures

1 Book Appointments.

The appointments are booked through the following procedures:

. Patients are referred to the unit by doctors from the clinics for the surgery, where it is not necessary for the patient to be an inpatient. The doctor fills in a request form for a surgery appointment and a consent form which is signed by the doctor as well as the patient. The surgery form contains the patient's details, type of operation to be performed, referring doctor's details and the urgency of the operation.

. At the appointment desk, a date-wise/doctor-wise register is kept where appointments scheduled are noted.

. Depending on the doctor's recommendation and appointments schedule, the patient is given the appointment. The patient's correct address and phone number is noted on the Surgery Request form. An entry is made on the register for that date. The patient is given an appointment card which contains the date and time of the operation as well as instructions for pre-operation medication and requirements such as fasting etc.

. At the unit date-wise folders containing the patient's papers are kept in a filing cabinet. This date-wise information corresponds to the patient's date of appointment.

. If a doctor cancels his/her operation for a particular day, appointments for all the patients on that day are rescheduled and patients are informed about the change.

Similarly, any cancellation by a patient is noted in the register and the vacancy filled if possible.

2. Pre and post operation formalities.

The following procedure are followed pre and post operations:

- . One day before the appointment, a doctor-wise list of patients scheduled for the operation is prepared and handed over to the respective doctor.

- . The MR files for the patients are requisitioned and brought into the unit from the Filing Section.

- . For each patient's file, the following forms are attached to record the details of the operation:

- . Pre-operative check list.
- . Order sheet.
- . Operative report.
- . Nurses progress report.

- . An order sheet is used by the doctors to instruct nurses for the pre-operative medication and other details.

- . Prior to the operation, all the columns of the pre-operative check list are verified with the patient and filled in.

- . A patient who has not followed the pre-operative instructions given, is either made to wait or sent away with a new appointment.

- . After the operation, the operative report (describing the details of the operation performed) is filled in by the doctor.

- . During the entire stay in the unit, each step from the time of arrival to the time of discharge is noted by the nurse(s) attending to the patient on the Nurse Progress report.

3. Referrals for follow-up treatment.

A form is issued if a post-operation follow-up visit is required. This form is used for the appointments at LPP/OPD clinic. Also if necessary, a referral form for attending a health centre for treatment such as the removal of stitches, dressing etc. is given.

4. Prescription for medicines.

If necessary, the patient is given prescriptions to collect medicines from the pharmacy.

5. Maintaining Register.

For all the patients treated at the unit, an entry is made in the register (Admission Register Book), which subsequently is used to prepare statistical reports.

2.7.3 Transactions

The approximate average volumes are:

. Cases handled	34-45 per day.
. Appointments	30-35 per day.
. Direct emergency cases	10-15 per day .
. Blood transfusion	10-20 per day.

2.7.4 Requirements

The computer system should provide the following:

- . A system of appointments which enables scheduling, cancellation by individuals and doctors and rescheduling of cancelled appointments.
- . A facility to request MRs from the Filing Section for a patient - given the appointment day.
- . A facility to provide the doctor with a list of patients scheduled for the procedure at the unit.
- . A facility to record details of the surgery.

- . A facility to send prescriptions to the pharmacy.

The computer system should also produce the following reports:

- . Doctor-wise list of surgeries scheduled for a day.
- . List of patients for a day for whom MRs are to be acquired.
- . Referrals to health centres/surgical clinic.
- . Monthly statistics of operations performed divided into specialties.

2.7.5 Data Links With Other Department/Section/system

Department/Section/System	Data	Mode
. Appointments	Patients details	Output.
	Scheduled appointment	Input.
. Radiology	Radiology results	Input.
. Pathology	Pathology results	Input.
. Pharmacy	Prescription	Output.
. OPD	Episode details	Output.
. DMM	Material request	Output.

2.8 Staff Clinic

2.8.1 Functions

1. Maintain the MR file for the staff member.
2. Maintain a register.
3. Examine patients.
4. Refer patients for tests.
5. Refer patients to OPD/A&E/Other clinics.
6. Prescribe medicines.
7. Issue certificate for leave.
8. Vaccinate the staff.

2.8.2 Current Procedures

1. Maintain a MR file.

For each staff member, a MR file is maintained with staff number as MRN. These files are arranged in the staff number order.

2. Maintain register.

An entry is made in the register maintained by the clinic with the details of the employee and the nature of the complaint.

3. Examination of the employees.

The employee is examined by the doctor and is given treatment from the facilities available in the clinic itself.

4. Referrals for tests.

If the employee requires any tests, he/she is referred to the laboratory concerned for such tests.

5. Referrals to other sections.

If the employee needs to consult a specialist or requires treatment in some other department, he/she is referred to the respective department along with his MR file.

6. Prescription.

If the employee requires some medication, the doctor fills in a prescription form which enables the employee to get medicine from the pharmacy.

7. Issue leave certificate.

If the employee is required to remain absent from work due to illness, the doctor enters the duration of absence on a medical certificate.

8. Vaccinate the staff.

Vaccinate the staff, specially those who are in touch with the patients, such as doctors and nurses.

2.8.3 Transactions

The approximate average volumes are:

- . Cases handled 600 per month.
- . Referrals to OPD/A&E 100 per month.
- . Requests for pathological tests 30-40 per month.
- . Requests to the Radiology section 20-25 per month.
- . Leave certificates 25-30 per month.

2.8.4 Requirements

The computer system should provide the following:

- . A facility to register employees and maintain their MRs at the staff clinic.
- . A facility to book appointments to visit other sections.
- . A facility to request tests in various laboratories and receive the results.
- . A facility to prescribe medicines.
- . A facility to issue leave certificates.

The computer system should provide the following information:

- . List of seen at the staff clinic during the month.
- . Specialty-wise statistic reports and statistics of referrals.
- . List of employees whose MR files are out of the clinic.
- . list of employees who have been given sick leave during the month.

2.8.5 Data Links With Other Department/Section/System

Department/Section/system	Data	Mode
. Appointments	Appoint. request	Output.
. Radiology	Test requests	Output.
. Pathology	Test results	Input.
. Pharmacy	Prescription	Output.
. Physiotherapy	Service request	Output.
. A & E	Episode details	Output .

2.9 Ambulance

2.9.1 Functions

1. Receive calls and fill in Triage forms.
2. Choose and send an appropriate ambulance.
3. Maintain a register.
4. Provide routine transportation services.
5. Provide Mobile Intensive Care Unit (MICU) service.
6. Administrative functions such as:
 - . Prepare duty list for staff members and annual report.
 - . Prepare ambulance maintenance schedules.
 - . Plan and conduct training programs.

2.9.2 Current Procedures

1. Receive calls and complete Triage forms.

Calls are received through '999' calls. On receipt of a call, triage nurse staff complete a triage form with details such as the patients name, his condition, the callers name, address and telephone number and the date and time of call.

2. Choose and send an appropriate ambulance.

After triage the call and from the information available from the caller, the nurse decides on the type of ambulance required for transporting the patient.

There are two types of ambulances services provided:

- i. MICU services.

These type of ambulances are used in the case when the patient is seriously ill at the site and requires immediate medical attention.

- ii. Patient transportation services.

These types of ambulances are used for providing routine transport to the patients unable to travel by normal transport such as buses, taxis or their own cars such as old patients.

The details of the ambulance and the time of departure are noted down on the triage

form and handed over to the ambulance staff.

2.9.3 Transactions

The approximate average volumes are:

. Total calls	2413 per annum.
. Brought to A & E	2236 per annum.
. Real critical cases	723 per annum.
. Transfers	474 per annum.
. Road accidents	131 per annum.
. Dead on location	172 per annum.
. Cancelled cases	177 per annum.
. Medical cases	1459 per annum.

2.9.4 Requirements

The computer system should provide the following:

- . A facility to register a call in the shortest possible time with the information available from the caller.
- . A facility to locate an ambulance for the call received and register such information such as the ambulance no, name of the driver, departure time and the time of the return to the hospital with the patient.
- . In case of a paramedic ambulance trip, a facility of recording information about the entire trip such as departure time from the hospital, arrival time at the site, departure time from the site, arrival time at the hospital, patient condition and treatment given at site and during transportation etc.
- . A facility to record ambulance details such as petrol consumption, and vehicle status like "under use", "under maintenance" or "breakdown".

The computer system should also be able to produce the following reports:

- . Monthly date-wise census reports dividing the cases into Transfer, Road Traffic Accident (RTA), medical emergency, nationality (Bahraini/Expatriate), total calls, real emergency, cancelled calls, etc.
- . Monthly ambulance usage report providing information such as no. of trips, no. of

hours used, breakdown, no. of Kms travelled, petrol consumption etc.

. Detailed emergency calls report (for paramedic ambulance trips) with information such as time taken to reach the site, condition of the patient at sight, time taken to reach the hospital, condition of the patient on arrival, etc.

2.9.5 Data Links With Other Department/Section/System

Department/Section/System	Data	Mode
A & E	Episode detail	Output.

2.10 Accident & Emergency - Registration Counter

2.10.1 Functions

1. Fill-up Emergency forms for the patients to be treated at A & E.
2. Maintain a register for the patients issued Emergency forms.
3. Collect fees from the patients not exempted.
4. Issue any Prescription Slips applicable to the patient.
5. Note down discharge disposition in the register.
6. Maintain a file for the RTA cases.

2.10.2 Current Procedures

1. Completion of Registration forms.

The registration clerk fills in an Emergency Service Report form with the details such as patient's name, address, age, nature of complaint and the name and address of any person accompanying the patient.

There are two types of emergency forms :

- . For RTA cases. This consists of three copies and the distribution is as follows:
 - . White - For the A&E unit.
 - . Blue - For the MOH.
 - . Green - For the patient.

. For other cases. This consists of two copies:

- . White - For the A&E unit
- . Green - For the patient.

The form is issued directly for the following type of patients:

- . Those referred by Health Centres/OPD clinics/other hospitals.
- . Those referred under the PHI scheme.
- . Those referred with Occupational injury under General Organisation for Social Insurance (GOSI) scheme.
- . Those brought by Ambulance/Police.
- . Those in a serious condition.

Other patients are first sent to the nurse for triaging and their registration is carried out only on the recommendation of the doctor or nurse.

2. Maintain a register.

For each form issued, an entry is made in the register maintained at the counter which contains register serial no., patient details, nature of complaint etc. The serial no. of the register is noted down on the emergency form.

3. Collecting fees.

A fee of BD 1 is charged to patients not exempt from the payment of fees. These are:

- . Bahraini and GCC nationals.
- . Those covered under PHI scheme.
- . Those covered under GOSI for occupational injury.
- . Employees of the Government Ministries.
- . Those referred by Health Centres/OPD clinics and having paid the fees at the point of referral.
- . Those brought by ambulance/police or in a serious condition.

4. Issuing Prescription Slips.

For the Bahraini, GCC nationals and the Government employees, a small slip attached to the Emergency Form itself is used as a prescription slip. A red coloured slip is issued for those who have paid BD 1, and for all others, a black coloured slip is given.

5. Completing Register entry.

After the discharge of the patient, the white copy of the emergency form comes back to the registration counter. The discharge disposition noted on the Emergency form by the doctor is copied onto the respective register entry of the patient by the registration clerk.

6. Maintaining RTA file.

A separate file is maintained for the RTA cases. This is maintained by the nursing staff.

2.10.3 Transactions

The approximate average volumes are:

. Total cases	400	per day.
. RTA	10	per day.
. Referrals	50	per day.
. Occupational	25	per day.
. Primary health	30	per day.
. Paying patients	30-40	per day .

2.10.4 Requirements

The computer system should be able to provide the following:

- . A facility to register patients on the first contact.
- . A facility to retrieve patients information as quickly as possible.
- . A facility to obtain MRN.
- . A facility to prepare a MR file.
- . A facility to get a list of doctors' duty rota and their specialisation whenever it is required.

- . A facility to register patients as quickly as possible.

The computer system should also be able to produce the following monthly reports:

- . Referral patients from Health Centres.
- . Patients treated under PHI, GOSI and Paying.
- . Bahraini, GCC and Non-Bahraini patients registered at the A&E.
- . A & E patients employed by the Government Ministries.
- . Patients and their complaints treated at the A&E.
- . Patients brought in by ambulances.
- . RTA patients registered with A&E.
- . Occupational cases registered with the A&E.

The computer system should also be able to answer the following queries:

- . Current patient details for the given name and sex.
- . CPRN/MRN for the given name and sex.
- . Given the name of a patient; locate his/her MRN.
- . Given the MRN/CPRN; display the patient information.

2.10.5 Data Links With Other Department/Section/System

Department/Section/System	Data	Mode
. OPD, Health Centres, Staff		
Clinic, LPP, Hospitals	Episode details & Referral	Output.
. Filing Section	MRs	Input.

2.11 Accident & Emergency - Treatment

2.11.1 Functions

1. Triage patients.
2. Examine patients.
3. Order tests for patients.

4. Provide treatment for the patients in the following:
 - . Treatment room.
 - . Minor Theater/Plaster unit.
 - . Nursing station.
 - . Resuscitation room.
 - . Observation room.
5. Prescribe medicine.
6. Admission of patients as in-patients into the ward.
7. Other functions such as:
 - . Maintenance of Progress reports by nurses while attending patients.
 - . Financial aspects of RTA/Occupational cases.
 - . Issuing of certificates for sick leave and so on

2.11.2 Current Procedures

1. Triageing.

The patients arriving at A&E between 7 am and 11 pm are first triaged to ascertain whether they really need to be treated at the A&E or if they should visit a health centre. The objective of this practice is to reduce the undue load on the A&E unit, and also to educate people so that in the future under similar conditions, they would visit the Health Centres. For this purpose, there is always one doctor triaging the patients during these hours. After 11 pm the triaging is stopped and all the patients arriving at the unit are seen and treated. In accident and critical cases the patients are taken for registration/treatment without triaging.

The following procedures are adopted for triaging:

- . The patient is sent to the doctor by a trained nurse for triaging with the Triage form with patient's details such as patient's name, age, sex, address, nationality and telephone no., which are usually filled in by the nurse.
- . The doctor examines the patient and completes the remaining columns in the Triage form which include the general condition of the patient, complaints, duration of complaints, whether dehydrated, whether they have been attended somewhere else, etc.
- . Depending upon the above information the doctor makes an overall assessment and

decides whether a patient should be attended at A&E and notes down his comments in the remarks column. The patient is directed to the registration counter for attention at A&E. Otherwise, he/she is asked to visit the health centre.

2. Examination by the doctor.

Emergency forms prepared at the registration counter are sent to the doctor's room. The following steps describe the way patients are distributed between the doctors.

- . In case of an emergency, the patient is immediately seen by any available doctor.
- . Other cases are evenly distributed amongst the doctors on duty at that time eg. if there are 9 cases and 3 doctors, papers of the first, fourth and seventh patients go to the first doctor, second, fifth, and eighth to the second doctor, and the third doctors gets the papers for the third, sixth and ninth patient.
- . The doctor calls the patients for examination in the sequence in which the papers are received by him.
- . The doctor, while examining the patient, notes down the details of the case on the Emergency form.

3. Ordering tests.

Equipment such as X-ray and ECG machines are available at the A&E, these tests are performed for the patients at the unit itself. For other tests, patients are referred to the respective Laboratories. The test results are received at the unit and attached along with the patient's other papers.

4. Treatment.

For treatment, the doctor notes down his orders on the Emergency form and the patient is treated as per these instructions. The patient may be treated in one of the following ways:

- . For minor treatment of wounds, injections, etc., the patient is sent to the treatment room. The nurse on duty completes the Emergency form after providing the necessary treatment to the patient.
- . For minor procedures/plastering for ordinary fractures the patient is sent to the Minor Theater/Plaster Unit attached to the A & E. An entry is made in the register with the

patient details, Emergency Registration No. details of the procedure performed, type of anesthesia given etc.

Also, a statistics book is maintained by a nurse at the Minor Theater where date-wise statistics are prepared by procedure type. These figures are compiled for the preparation of the monthly and yearly statistics for further reporting.

. For immediate emergency treatment, the patient is moved to the nursing station. The patient is given the treatment recommended by the doctor and the details are noted on the Emergency form by the nurse.

. The doctor orders the transfer of patients in a critical condition to the resuscitation room. A register is maintained at the room where in-patient details, time admitted, doctor's name, type of illness, etc. are entered. When the patient is discharged, the entry in the register is completed by entering the discharge time and other any particulars.

. If necessary the doctor at the A&E unit examining the patient may recommend that the patients progress be observed for a certain amount of time. Such a patient is moved to the Observation room attached to the A&E unit. An entry is made in the register maintained at the Observation room with the patient's details, emergency serial no., time-in etc. As per the doctor's recommendation any necessary medication is given by the nurse and the details are noted on the Nurse Progress report. At the required interval, checks (BP, temperature etc.) and tests are performed and the results noted on the Nurse Progress report. When the patient is discharged, the time of discharge and discharge particulars (allowed to go home/admitted as in-patient in the ward or transferred to some other hospitals, etc.) are noted on the register to complete the entry for the patient's stay in the observation room.

5. Prescription.

Any prescription for medicine is noted on the slip issued at the registration counter to enable patients get medicines from the pharmacy. Also if patients under treatment within the A&E unit require medicines not stocked at the unit, then they are procured from the pharmacy with a prescription.

6. Admission as in-patient.

For a patient to be admitted and treated as an inpatient, the doctor at the A&E unit places a call to the doctor of the required specialty. The concerned doctor after examining the patient decides about the admission and orders a course of treatment. If a bed is available in a ward the patient is immediately transferred, otherwise the patient will be treated with the facilities available at A & E.

7. Others.

. For the patient under treatment in the resuscitation room, nursing station, and observation room, a nurse progress report is attached to the patient's papers. Every time a patient is attended by the nurse for any purpose, a note is made with the date, time and description of the action taken.

. If necessary, the patient's MR file is requisitioned from the Filing Section.

. For RTA cases the insurance details of all the vehicles involved in the accident are noted. Charges are made for the treatment provided. The bill for the treatment with the insurance details of the vehicles are handed over to the Director of Finance for recovery.

. For occupational cases, the charges for the treatment provided to the patient is accumulated. The bill for the total charge with all the details is handed over to the Director of Finance for recovery.

2.11.3 Transactions

The approximate average volumes are:

. Total cases	400 per day.
. Admissions	30 per day.
. Procedures at Minor Theatre	35 per day.
. Occupational cases	20 per day.
. Observation	125 per month.
. Resuscitation	100 per month.
. Pending admission	10 at any time.

2.11.4 Requirements

The computer system should be able to provide the following:

- . A facility to enter triage information.
- . A facility to enter the case type, diagnosis details, patient condition etc.
- . A facility to record the time and the name of the doctor who attended the patient.
- . A facility to enter the details of treatment provided.
- . A facility to record any prescriptions.
- . A facility to refer patients to Out-patients.
- . A facility to maintain the list of patients waiting for admission to the ward as inpatients.
- . A facility to request tests in various labs and receive the results.
- . A facility to provide the Director of Finance with details of charges and insurance companies for raising bills for RTA and Occupational cases.

The computer system should also be able to produce the following reports:

- . Monthly registers of:
 - . Observation room.
 - . Resuscitation room.
 - . Minor Treatment Theater.
- . Monthly RTA report.
- . Occupational (Industrial accidents) cases report.
- . List of patients expired at A&E.
- . Date-wise monthly statistics of:
 - . Triage cases.
 - . Treatment at Minor Theater.
 - . Observation room.
 - . Resuscitation room.
- . A facility to produce ad-hoc statistical reports as and when required. These reports may be:
 - . Hourly load of patients at A&E unit during the month.
 - . Hourly load of patients on holidays & weekends.
 - . The average waiting time for patients for specific specialities such as medical,

surgical, paediatric etc.

- . Patients per hour seen by the doctor in each shift.

The system should be capable of producing similar reports on demand to help study the load pattern and the service details. Such reports can help allocate resources efficiently and improve the services at the Unit.

The system should also be able to provide the following queries:

- . A list of pending admissions.
- . A list of patients undergoing treatment at any time within the A&E.
- . A list of patients waiting for treatment at the A & E after registration.

2.11.5 Data Links With Other Department/Section/System

Department/Section/System	Data	Mode
. Ambulance	MICU form	Input.
. Admission	Admission form	Output.
. OPD	Episode details & Referral	Output.
. Radiology	Test request	Output.
. Pathology	Test results	Input.
. Pharmacy	Prescription	Output.
. Cash & Revenue	Insurance details	Output.
. DMM	Material request	Output.

3. Difference In Procedures At Other Hospitals

The following are difference in procedures followed at other MOH hospitals:

3.1 The Maternity Hospital

The procedures followed at the Maternity Hospital are similar to the procedures followed at SMC. The differences in the procedures are detailed below:

1. At the Maternity Hospital the patients do not bring admission forms. The patients bring a note from the ward nurse for admission. The Admission Bureau then follows a procedure of admission similar to the SMC.

2. At the Maternity Hospital there is no separate Filing Section and the Admission Bureau gets patient's information from the Filing Section of the SMC, mostly by telephone.

3. The index cards of current inpatients are kept separately in a box and returned to the Filing Section after the discharge of the patient. This is updated every morning with new admissions and discharges and ward transfers from the previous day. Sometimes, it is updated immediately after the occurrence of the event. This index is used to meet the enquiries of patients.

4. A visual display board is maintained in addition to separate index cards. The board is updated with admissions, ward transfers and discharges. Colour coded cards are kept in this board giving following details:

- . MRN.
- . CPRN.
- . Name.
- . Sex.
- . Age.
- . Ward.
- . Date of admission.
- . Admitting consultant.
- . Accommodation type.
- . Payment.

5. The MR files and the index card of Maternity Hospital patients are on integral part of the MRs of SMC.

6. Unlike at the SMC, the nursing station at North Block Maternity Unit compiles several reports in addition to others at wards in SMC such as:

- . Prepare a Daily Bed Statement by ward for:

- . North Block Maternity Unit.
- . Muharraq Maternity Hospital.
- . Jidhaffs Maternity Hospital.
- . Sitra Maternity Hospital.
- . Riffa Maternity Hospital.
- . Western Region Maternity Hospital.

The statement gives capacity, occupancy in general and single rooms, and vacant beds and extra beds.

- . Prepare a Daily Deliveries Statement for Maternity Hospitals. This is prepared twice a day at 6 am and at noon giving the number of deliveries against each type as detailed below:

- . Home deliveries.
- . Normal deliveries.
- . Lower Segment Caesarean Section (LSCS).
- . Other abnormal deliveries.
- . Total deliveries.

- . Prepare a monthly Activity Indicator Summary for North Block Maternity Unit and SCBU - given budgeted and actual numbers as detailed below:

- . Bed capacity.
- . Number of admissions.
- . Number of deliveries - normal, abnormal and total.
- . Number of deliveries and percentages for Bahrainis and Non-Bahrainis.
- . Number of in-patient days.
- . Occupancy level.
- . Length of stay.
- . Patient meals days.

- . Prepare a monthly record of infants given the following details:
 - . MRN.
 - . Name.
 - . Date of death.
 - . Nationality.
 - . Sex.
 - . Weight.
 - . Gestational Age.
 - . Probable Cause.
 - . Confirmed Cause.
 - . Specific Maternal Cause.
 - . Age.

- . Prepare a monthly statistical report for the type of deliveries and type of births.

3.2 The Psychiatric Hospital

The procedures followed at the Psychiatric Hospital are similar to the procedures followed at SMC. The differences are detailed below:

1. The Admission Bureau at the Psychiatric Hospital operates in a day shift only. Registration, admission, and admission assignment are done at the nursing station in the ward when the Admission Bureau remains closed. All details are noted down at the nursing station and submitted to the Admission Bureau on the following day.

2. At the Psychiatric Hospital there is no separate Medical Record Department SMC. The Admission Bureau performs the duties of MRs Department.

3. The MRs files of the Psychiatric Hospital are independent and different from SMC.

4. Unlike at the SMC, the Admission Bureau at the Psychiatric Hospital maintains details of patients visit in MRs file.

5. At the Psychiatric Hospital in certain cases, patients are sent on leave and leave records are maintained by the nursing station for these patients. The leave records contain the following details:

- . Name of the patient.
- . MRN.
- . Ward.
- . Date - Leave commenced on.
- . Time.
- . Leave period (No. of days).
- . Date due back on.
- . Accompanied by.
- . Signature.
- . Returned on date.
- . Returned time.
- . Brought by.
- . Signature.
- . Remarks.

The nursing station does the follow-up, if the patient does not return at the expire of leave.

6. The index cards of current in-patients are kept separately in a box and returned to the MR Department after the discharge of patients. This is updated every morning with new admissions, discharges and ward transfers of the previous day. Sometimes, it is updated immediately after the occurrence of the event. This index is used to meet the enquiries of patients.

7. A visual display board is maintained in addition to separate index cards. The board is updated with admission, ward transfer and discharges. Colour coded cards are kept in this board giving the following details:

- . MRN.
- . CPRN.

- . Name.
- . Sex.
- . Age.
- . Ward.
- . Date of admission.
- . Admitting consultant.
- . Accommodation type.
- . Payment.

8. At the Psychiatric Hospital, a Daily Ward Bed Statement is made in one single form covering all the wards. This statement is different from the one made at SMC, that is the details of admission contain the following additional information:

- . Age.
- . N/R - new or repeat.
- . Consultant.

9. Additional statistical reports are needed at the Psychiatric Hospitals such as:

- . Bed occupancy by month and ward.
- . Admission by month and sex (new, old, and re-admission).
- . Distribution of admission by disease and marital status.
- . Distribution of admission by disease, age, group and sex.

4. Difference in Procedures At Other Clinics

The following are difference in procedures followed at other clinics:

4.1 Al Fateh (OP) Clinics

The procedures followed at Al Fateh are similar to the procedures followed at the SMC OPD appointment desk and the SMC OPD clinics. The differences in the procedure are detailed below:

1. Preparation of MR.

At Al Fateh, the specialised clinics prepare and maintain separate MRs. These MRs are in the form of cards, while the MRs at SMC, Psychiatric and Limited Private Practice (LPP) are files. The MRs at Al Fateh clinics are independent and different from other MRs.

Gynecology and ENT clinics continue the usage of the SMC MR for patients having a MR already.

2. First appointment booking.

At SMC the referred patient's first appointment is booked with a doctor of the desired specialisation, whose name is read off the duty rota for the date of referral. At Al Fateh the practice is to schedule an appointment with a doctor with the desired specialisation at the earliest possible opportunity.

3. Clinic reception.

At SMC OPD, the appointment desk and the clinic reception are segregated, whereas at Al Fateh these two functions are often performed by a common team e.g. verification of availability of MR, sequencing the patients etc.

4. Emergency Clinics.

To cater to the urgent needs of patients an emergency clinic is scheduled on every working day in the ENT and the Eye clinics. Patients in need of immediate medical attention are provided with medical care in the Emergency Clinics without a prior appointment.

4.2 Psychiatric Clinics

The procedures followed at the OPD at the Psychiatric Hospital are similar to the procedures followed at the OPD appointment desk, the SMC appointment desk and the OPD clinics of SMC. The differences in the procedures are detailed below:

1. Referral.

The OPD clinics at SMC are referral clinics, whereas the OPD at the Psychiatric Hospital may be approached by self referral also.

2. Booking of appointments.

At the Psychiatric Hospital, upon booking an appointment, only the date of appointment is indicated. A specific time of the appointment is not given. The OPD appointment desk clerks at the Psychiatric Hospital scan the MRS of the patients at the end of the day and note the request for the next appointment from the doctor's OPD notes made during the current day's visit. This practice ensures a booking for the patient for the next visit with the doctor, even though the patient himself/herself has not booked the appointment for a follow-up. Other clinics do not follow this procedure.

Telephonic appointments booked by the patient are common at the Psychiatric Hospital, since it can be approached by self referral. The proportion of walk-in patients is high at the Psychiatric Hospital.

3. Preparation of MRs.

The Psychiatric Hospital has an independent MRs section organised on lines similar to that at the SMC. Patients visiting the Psychiatric Hospital have their MRs for that hospital prepared and maintained locally. The MRs of the Psychiatric Hospital are independent and different from SMC MRs.

4. Interaction with MRs Section.

At the Psychiatric Hospital the MRs section is integrated with the appointment desk, while at the SMC the two functions are separated.

5. First appointment booking.

At SMC, the referred patient's first appointment is booked with a doctor with the desired specialisation whose name is read off the duty rota for the date of referral, whereas at the Psychiatric Hospital the practice is to schedule an appointment with a doctor with the desired specialisation available at the earliest possible opportunity.

6. Clinic reception.

At the SMC OPD the appointment desk and the clinic reception are segregated, whereas at the Psychiatric Hospital these two functions are often performed by a common team.

4.3 Limited Private Practice (LPP)

The procedure followed at the LPP are similar to the procedures followed at the SMC OPD appointment desk and at SMC OPD clinics. The differences in the procedures are detailed below:

1. Referral.

The OPD clinics at SMC are referral clinics, whereas the OPD at the LPP may be approached by self referral. The LPP clinics operate during afternoon hours. In the LPP, the patient has complete freedom to select a doctor of his/her choice. This flexibility is limited in other clinics.

2. Booking of appointment.

At LPP the appointment desk staff note the date and time of the booking and the booking clerk's initial on the appointment sheet in addition to the patient name, MRN, telephone number etc.

3. Preparation of MRs.

The LPP has an independent MRs section organised on lines similar to that of the SMC MRs Section. The LPP patients have their MRs maintained by the LPP MRs section. The MRs of the LPP are independent and different from other MRs.

4. Interaction with MRs Section.

At LPP clinics the MRs section is integrated with the appointment desk, while at SMC the two functions are separated.

5. First appointment booking.

At SMC the referred patient's first appointment is booked with a doctor with the desired specialisation, whose name is read off the duty rota for the date of referral. At the LPP, however, the patient has the freedom to select a doctor of his/her choice.

6. OPD payments.

SMC OPD renders medical attention to patients either free of charge or for BD 1 payments, whereas the charges at the LPP are as follows:

- . BD 10 - If the patient's visit to a doctor is for the first time.
- . BD 6 - If the patient's visit to a doctor is for follow-up.
- . BD 10 is charged whenever the patient seeks medical attention from a doctor for the first time, either for the same medical condition or otherwise.

In addition, the LPP patients should also pay for service received by them at other departments such as Pharmacy, Radiology, Pathology, etc. The schedule of charges is made available to the LPP reception clerk who takes the payments.

7. Clinic reception.

At the SMC OPD the appointment desk and the clinic reception are segregated. At the LPP the reception and the LPP payments are integrated.