CHAPTER 5

METHODOLOGY

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Aim: The aim of the chapter is to specify and describe the methodology used to design and demonstrate the application of a computer database system as a research tool in an Early Communication Intervention programme.

5.1 INTRODUCTION

The research process, as a structured inquiry aiming to solve problems and creating new knowledge which is generally acceptable (Grinnell, in De Vos, 1998), is supported by well planned scientific methodology to reflect the particular characteristics of the whole research project undertaken (Leedy, 1997). Furthermore, the use of appropriate research methodology is critical to the research process as the quality of research findings is directly dependent on the accountability of the research methodology followed (Mouton & Marais, 1990). The development of discipline specific research methods and theories for the advancement of a scientific field is most important as a discipline may borrow theories and methods from other fields but those materials may not be appropriate to study its subject matter (Hegde, 1987).

The purpose of establishing a customized database system is to develop a unique ECI research tool to store and manipulate data and to extract meaning from it (Leedy, 1997) in order to contribute to the development of appropriate research methodologies in the emerging scientific field of early communication intervention (ECI) in South Africa.

Advances in database systems have opened vast possibilities of database application in different scientific fields, indicating its adaptability as a contemporary research tool suitable to meet the unique requirements of a developing field such as ECI in South Africa. Although the storing and

processing of data is not unique to the database approach (Bowers, 1993), technological developments have resulted in improved management of data and greater productivity for the database user (Connolly, *et al.*, 1996), which displays the relevancy of the database system approach as a 21st century scientific tool.

In utilizing the advantages of the latest developments in information technology, the current empirical study proposes the use of a research tool which can contribute with increased effectiveness to local ECI research needs. South Africa not only presents with an increased prevalence of infants at biological and environmental risk (CCS, 1997c), but also with a growing population of infants and their families requiring ECI services. One of the recently identified reasons for the growing population of infants at-risk is the rapid spreading of the AIDS epidemic, with increasing numbers of infants born who are HIV positive and often orphaned early in life (Strachan, 1999). It is clear that an urgent need for ECI exists in South Africa as services must be provided to diverse populations of infants and their families.

A description of the unique patterns of characteristics of the different populations of infants and their families requiring ECI services in South Africa can therefore provide valuable information regarding the planning of service provision to the diverse populations to be included in a comprehensive service delivery plan. Although ECI is established and practiced in the private sector (Haasbroek, 1999) and ECI services are emerging in the public sector (Moodley, 1999), these services are fragmented and not yet sufficient to provide in the needs of the growing population of infants and families requiring ECI services. Despite the lack of a national policy on ECI, it is, however, an opportune time to promote the development of ECI services in South Africa as the government already recognizes maternal and child health, women's health and primary health care as priority issues in the implementation of its national health policy (Department of Health, 1997). The identification of vulnerable groups in society is therefore already an important step towards the promotion of ECI services as part of the comprehensive *National Health Plan for South Africa* (ANC, 1994b).

Although ECI is still an emerging scientific field in South Africa and service delivery must yet be established in all contexts, it is clear that recent ECI research in South Africa is exploring new directions in the development of field specific scientific methods and theories. Recent ECI research projects already offer creative and innovative solutions to extend appropriate ECI services to more infants and their families and provide valuable insights into second generation early intervention (EI) research issues (Guralnick, 1997).

Delport (1998) and Moodley (1999) found that collaborative team efforts and transdisciplinary training programmes with nurses in primary health care provide a model for raising awareness about risk conditions in infants and for the earlier identification of infants at risk for communication delays. Hansen (1999) provides guidelines for developing a culturally sensitive ECI programme which proved to be effective in rendering services to a Xhosa speaking toddler with a hearing loss and his caregiver.

These three studies explored some of the issues proposed by Guralnick (1997) as second-generation EI research concerns. According to Guralnick (1997) the exploration of three elements, namely EI programme features, child and family characteristics and the nature of the outcomes can be used as a model of current research issues in EI. Figure V.I provides a schematic representation of the EI research model proposed by Guralnick (1997) which will be used as a framework for the present study.

Using the three dimensional model (Guralnick, 1997) as a guideline for investigating an ECI programme and as depicted in Figure V.I, research results can be obtained on two different levels. Firstly, as represented by the plus sign (+) in Figure V.I, the relevant features of each of the three elements of ECI can be identified and described. Secondly, interactions which are possible between the different elements can be determined as represented by the arrows in Figure V.I. Although the arrows in Figure V.I appear to indicate only uni-directional relationships, there are different possibilities for determining relationships between the different ECI elements as positive and

negative relationships can be determined (De Vos, 1998). The value of an investigation into an existing ECI programme in South Africa, is to provide a critical review of the programme features, the characteristics of the clients and the nature of the outcomes when longitudinal research is conducted, and to indicate how the different elements of the programme relate to one another. The results of the investigation can be applied to provide guidelines for improved service delivery of the specific ECI programme and appropriate service delivery in other contexts.
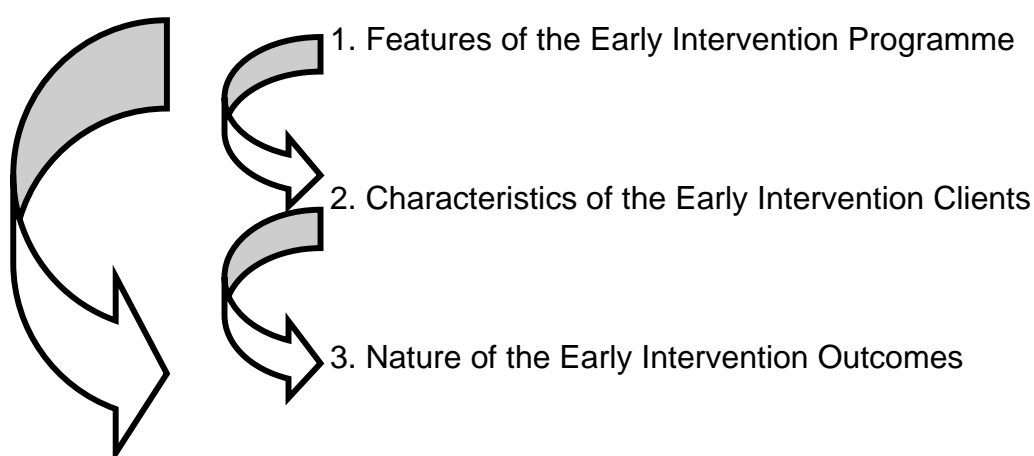

1. Features of the Early Intervention Programme

2. Characteristics of the Early Intervention Clients

3. Nature of the Early Intervention Outcomes

Figure V.I   Schematic representation of the research methodology of the present study (Based on Guralnick, 1997)

All three elements of the EI research model (Guralnick, 1997), but in particular the characteristics of ECI clients, are highly relevant research questions in South Africa. Since there is a dearth of epidemiological data on the specific characteristics of families and their infants and toddlers requiring ECI in South Africa, a specially designed research tool is required to accommodate the large numbers of subjects required for an epidemiological study. Such a research tool must also be comprehensive enough not only to describe client characteristics, but also to identify the features of the programme and determine the programme outcomes when utilized in longitudinal research. Lastly, the research tool must be sophisticated enough not only to present results as isolated characteristics, but to collect data in such a way that

relationships between the different elements of the programme can be indicated by performing statistical analysis tests.

The present study proposes to use the EI research model of Guralnick (1997) as a framework to develop a research tool uniquely designed to describe the features, clients and outcomes of a specific ECI programme and indicate the interactions among the different elements. The intended research tool must be able store large volumes of data prospectively in order to provide a comprehensive profile of the clients receiving services in a specific ECI programme and thereby establishing the same research tool for further and longitudinal research purposes in order to determine the outcomes of the ECI programme.

As database systems have been established as effective data management tools with research applications in the field of EI (Hebbeler, 1993), the utilization of a custom-designed research database is considered to be an appropriate scientific tool to be used in the methodology of the present study.

The aim of the chapter is therefore to describe the methodology employed to design and utilize a database system for the data management and research requirements of a specific ECI programme in South Africa.

5.2 AIMS OF THE STUDY

The overall *objective* of the study is to establish a database approach to collect comprehensive data on a group of infants and toddlers with communication disorders and at risk for communication delays and their families participating in an university-based ECI programme in order to describe the features of the programme, the characteristics of the clients, indicate possible interactions between the different ECI elements and to determine the nature of the ECI programme outcomes when future research is conducted.

In order to realize this objective, two main aims were formulated.

5.2.1 First Main Aim

The first main aim of the study is to *design a relational database system* which complies with the data management and research needs of a specific ECI programme in order to describe the features of the programme, the characteristics of the infants and toddlers with communication disorders and at risk for communication delays and their families participating in the programme and the nature of the programme outcomes.

In order to achieve the first aim the following sub-aims were formulated:

- To determine the essential components and functions of the proposed database system by describing the features of a specific ECI programme, namely the Clinic for High Risk Babies (CHRIB). In order to identify the specific needs for an electronic storage medium to be used for research purposes, the assessment approach, procedures and the existing conventional CHRIB filing system will be analyzed.
- To design and construct a relational database system by enlisting the help of a database system developer.
- To develop proficiency in operating the database system for the accurate entry of data, manipulation of data such as creating queries and reports and utilizing a reliable backup system to ensure the security of the data collected.

5.2.2 Second Main Aim

The second main aim is *to demonstrate the use the database system* as a research tool by presenting a multifaceted profile of a group of infants and toddlers at risk for communication delays and their families who participate in an ECI programme at the university-based CHRIB. The results of the application of the research tool will be used to determine the ECI clients'

service delivery needs and propose a conceptual framework for effective service delivery approaches and further ECI research in South Africa.

In order to achieve the second main aim the following sub-aims were formulated:

- To collect and enter the data of a group of clients participating in the CHRIB ECI programme into the database system to provide quantitative and qualitative data regarding their biographical details, family circumstances, prenatal, perinatal and later developmental histories and diagnoses and/or risk conditions for communication delay.
- To utilize the database data as a front end for the *SAS®* (1999) (Statistical Analysis System) computer package to perform a scenario analysis of the data to provide descriptive statistics of the incidence, frequency and distributions of certain characteristics of the subjects, their families, risk conditions and developmental histories.
- To interpret the results of the study within the framework of available epidemiological and descriptive data on infant populations at risk for communication delays in South Africa and to provide a conceptual framework for appropriate local service delivery.
- To determine the viability of the CHRIB database system for future epidemiological research involving larger numbers of subjects.

5.3 RESEARCH DESIGN

According to Mouton and Marais (1990) the research design of a given study provides the plan of how the research problem was executed. The research design assists the researcher in adopting a critical orientation to the systematic planning of the empirical study and the rational decision making of the research process. The aim of the research design is therefore to "plan, structure and execute the project concerned in such a way that the validity of the findings are maximized" (Mouton & Marais, 1990:193).

The research design selected for the present study is a quantitative descriptive survey which represents one of the categories of non-experimental research (Leedy, 1997). The nature of a quantitative descriptive survey is to observe and systematically record behaviours essentially in the form of discrete data and to study group differences, developmental trends and relationships among variables (Leedy, 1997; Pannbacker & Middleton, 1994). Since the aim of the empirical research of the present study is to conduct a structured and an in depth inquiry into the characteristics of the clients enrolled in a particular ECI programme, the descriptive survey design appears to be the most suitable scientific approach to explore and demonstrate the research possibilities of the relational database system which were utilized as a research tool.

The suitability of the descriptive design approach selected for the present study is further elucidated by the methodology employed for collecting and entering the data into the database system. The method of data recording in the present study was largely dependent on systematic and structured observations derived from four sources, namely:

- A questionnaire completed by the parents prior to the assessment
- An interview with the parents
- The assessment of the infant
- Medical reports on the client, when available

While some data was obtained by way of information provided by the subjects' parents and medical reports, the other data such as assessment results were derived by means of direct elicitations and observations of communication behaviours of the subjects without any attempt to control or manipulate the events or variables. Since no variables were manipulated to test cause and effect hypotheses as in true experimental designs, the ultimate research question to be answered in a descriptive study is a relationship question.

To determine possible relationships between variables, such as relationships between the different characteristics of the subjects was, however, beyond the scope of the present study. Using Figure V.I as a guideline, results were analyzed and interpreted on the first level of descriptive research methodology only, as both an in-depth and a broad description of ECI client characteristics was presented. The descriptive research design therefore provided the researcher with an accountable methodology to move closer toward a "thick description" of infants and their families (Hammer, 1998) requiring services in a particular ECI programme. The further advantage of a descriptive survey design for the present study is that the same data can later be used to present the results on a second level of analysis by determining degrees and direction of relationships between the different variables (See Figure V.I). Such an analysis of the data implies that the measuring of one variable predicts the measuring of a second variable, either in a positive or a negative way. A descriptive survey research design therefore allows the description and prediction of phenomena but no causal explanations can be constructed (De Vos, 1998; Leedy, 1997; Maxwell & Satake, 1997).

According to Leedy (1997) the data in a descriptive survey is particularly susceptible to distortion due to bias. Bias relates to any influence that may have disturbed the randomness by which the selection of a sample population has been determined. This implies that careful consideration should be given to the type, methods and procedures of sampling. Since the present study employed subjects from a particular ECI programme and no random selection procedures were adhered to, the results cannot be generalized and applied to a wider population of infants and families requiring ECI in South Africa.

The use of a descriptive design therefore provided an appropriate research plan for rational decision-making to execute the present study, which aimed to employ database methodology to develop a discipline-specific contemporary ECI research tool.

5.4 SUBJECTS

The subjects employed in the study were infants and toddlers and their families referred to and assessed at CHRIB, an ECI service delivery and student training facility. CHRIB has been operating at the Department of Communication Pathology, University of Pretoria, as a formal assessment and treatment clinic since 1990 (Annual Report 1990, Department of Speech Pathology and Audiology) and now forms part of the Centre for Early Intervention in Communication Pathology. The clinic was established to accommodate referrals of infants and toddlers at risk for communication delays and to provide a basis for undergraduate training in ECI as well as research, an initiative started by individual members of staff since the late 1970's.

The client population of infants and toddlers assessed at CHRIB is varied and depends on the referral sources. Families with infants and toddlers at risk for communication delays are referred to CHRIB by one of the following referral sources, i.e., the Facial Deformities Clinic (Department of Oral Facial Maxillo Surgery, University of Pretoria), The Down Syndrome Association, speech-language therapists referring clients to CHRIB for consultative services, occupational therapists, physiotherapists, paediatricians, child psychiatrists, nurses, other parents who previously had their young children assessed at CHRIB and self referrals (Annual Reports, Department of Communication Pathology, 1996-1999).

Since no attempt was made to include each subgroup of the population of high risk infants and toddlers in South Africa in the selection of subjects, the method of nonprobability convenience sampling was utilized (Leedy, 1997). Bias could therefore not be controlled in sampling and the subjects will not be representative of the population requiring ECI services in South Africa. The subject characteristics in the present study will indicate a bias toward families who can afford to pay for services as CHRIB is university-based and not supported by the public health system as in the case of EI clinics based at public hospitals and primary health care clinics.

5.4.1 Selection Criteria of Subjects

In order to operationalize the second main aim of the study, i.e. to demonstrate the use of the database system as an appropriate tool for continued research in ECI, the following two criteria for the selection of the subjects were applied:

- The subjects had to be assessed in CHRIB and had to have undergone the complete CHRIB Assessment Protocol (Louw & Kritzinger, 1995b) as described in under heading 5.5 of this chapter.
- Each subject had to be assessed by at least three of the four data collectors described in Table 5.5 in order to ensure consistent data collection and recording procedures.

By applying the least restrictive subject selection criteria, it could be ensured that the largest possible number of subjects could be recruited within the time constraints of the empirical study. Since it is one of the main features of database systems to store large volumes of data on large numbers of subjects, the real value of this feature of the CHRIB database will only become apparent in the future. By utilizing the largest possible number of subjects in the present empirical study, some of the benefits of the capacity of the database could already be demonstrated.

Therefore, all infants and toddlers, together with their families, who were assessed at CHRIB between March 1996 (the starting date of the CHRIB database) and October 1999 were recruited as subjects for the empirical study.

5.4.2 Selection Procedures of Subjects

The following procedures were followed in the selection of the subjects:

Since the CHRIB database was designed to serve a dual purpose, i.e. to be used as an information management system as well as a tool for research, data on all clients assessed at CHRIB was entered into the database.

Permission to use the data for research purposes was obtained prior to the assessment. As all families with infants or toddlers referred to and assessed at CHRIB received a letter to request that the data be used for research purposes (See Appendix A), all clients were regarded as potential subjects in the empirical study.

5.4.3   Description of Subjects

As the aim of the study is to demonstrate the value of the CHRIB database system in providing a comprehensive profile of the subjects and their families, a description of their characteristics is an integral part of the results of the study and will be discussed in the following chapter. An abbreviated description of the characteristics of the subjects is presented in Table 5.1 (See following page for clarification).

As indicated in Table 5.1 a total number of 153 subjects were utilized in the empirical study, the product of a three and a half year old database system.

According to Table 5.1 the ages of the subjects at their first assessment at CHRIB indicate a broad age spectrum, ranging from the neonatal period to 6 years 5 months. The average age of 18 months indicates that the majority of subjects were assessed at CHRIB at an early age, thereby confirming its function as an ECI service provider. The high upper margin of subjects' ages suggests that CHRIB received late referrals, which should be expected in a context such as South Africa where ECI is still a largely unknown field (See Figure I.I, Chapter 1). The phenomena of late identification and late referrals of children at risk for developmental delays are some of the reasons why early interventionists in South Africa are beginning to view the entire period of the preschool years as the responsibility of EI (Centre for Augmentative and Alternative Communication, 2000).

Table 5.1   Summarized description of subject characteristics (N=153)

Characteristic	Category	# Subjects or value	%
1. Age at the time of CHRIB assessment and data collection	-Range -Average age	3 weeks – 77months 18.04 months	- -
2. Main diagnostic categories of the subjects	-Cleft lip and palate -Down syndrome -Other established risk conditions* -Autism/Pervasive developmental disorder -Subjects from multiple pregnancies -Low birth weight and prematurity -Delayed speech and language development only -Tongue tie only -Hyperactivity	79 23 8 4 15 10 11 1 2	51% 15% 5% 3% 10% 7% 7% 1% 1%
3. Gender	-Female -Male	71 82	46% 53%
4. First language	-Afrikaans -English -Portuguese -Northern Sotho -Zulu -Swazi -Urdu -Turkish	101 41 4 3 1 1 1 1	66% 26% 2% 2% 1% 1% 1% 1%
5. Geographical location	-Pretoria Region -Gauteng excluding Pretoria -Northern Province & Mpumalanga -North West Province -KwaZulu Natal -Free State -Zimbabwe -Turkey	86 40 9 5 4 4 1 1	56% 26% 6% 4% 3% 3% 1% 1%
6. Population group	-White -Coloured -Indian -African	135 7 6 5	88% 5% 4% 3%

* See Chapter 6 for details

The main diagnostic categories of the subjects depicted in Table 5.1 indicate that slightly more than half of the subjects (51%) presented with cleft lip and palate, an established risk condition for communication delay. The large number of subjects with cleft lip and palate can be explained by referrals received from another university-based clinic, the Facial Deformities Clinic at the Department of Oral Facial Maxillo Surgery.

The following three diagnostic categories listed in Table 5.1 also relate to subjects with established risk conditions, namely Down syndrome,

autism/pervasive developmental disorder (PDD) and other categories of established risk conditions for communication delay as described by Rossetti (1996). A total of 74% subjects therefore displayed *established risk* conditions for communication delay. The remainder of the subjects represents *biological risk* categories, such as children with low birth weight and prematurity and children from multiple pregnancies and children with diagnostic categories associated with communication delay in the absence of the established and biological risk categories already mentioned. The distribution of the risk categories of the subjects indicates that most of the subjects were selected from the population of infants and toddlers with confirmed risk conditions which will always result in some form of communication delay. Since established risk conditions are easier to identify as a result of the visibility of the disorder (Rossetti, 1996), it offers an explanation to the increased referral of subjects from this risk category to CHRIB. The diagnostic categories of the subjects utilized in the empirical study therefore represent a different sample as statistics suggest most of the young children requiring ECI in South Africa present with low birth weight and prematurity and are from families living in poverty (CSS, 1997c).

According to Table 5.1 the subjects' gender distribution of more males than females is a phenomenon also reported in the literature. According to Lahey (1988) studies found that there is a larger proportion of boys in comparison with girls displaying communication delay.

As depicted in Table 5.1 the subjects represent a wide spectrum of eight different languages. The majority, i.e., two thirds of the subjects' first language was Afrikaans, 26% of the subjects were English speaking and the remainder of the subjects (8%) represented the other six languages listed in Table 5.1. The increased number of subjects from Afrikaans speaking families can be attributed to the fact that 56% of the subjects were from the Pretoria region, an area where the majority of people speak Afrikaans as a first language. According to Ngwezi (1999) statistics released by Statistics South Africa indicate that 4.2 million people speak Afrikaans as a first language, followed by 2.6 million Sepedi and 1.1 million English speakers in the greater Pretoria

region. Another factor explaining the Afrikaans language bias in the subjects is the fact that the University of Pretoria is mainly an Afrikaans institution. Even though the subjects spoke different first languages, most of them could communicate effectively in either Afrikaans or English and only in certain instances an interpreter was utilized to communicate with the family.

As stated earlier and indicated in Table 5.1 slightly more than half of the subjects (56%) live in the Pretoria region and that the remainder of the subjects came from Gauteng province, of which Pretoria is part, and five other provinces in South Africa. Two of the subjects are from countries with no ECI facilities at this stage, i.e. the neighbouring Zimbabwe, and Turkey, on another continent. It is clear that CHRIB provides much needed ECI services to families as the subjects reside in Pretoria and various parts in South Africa as well as from other countries. Since a substantial proportion of the subjects (44%) resides in areas outside the Pretoria region, it appears that the subjects' families had sufficient transport available to them to attend the ECI facility.

Lastly, the characteristics of the subjects utilized in the empirical study are described according to the different population groups as used by the Central Statistical Services (CSS, 1997b) and depicted in Table 5.1. By far the majority the subjects are from white families (88%) and 12% of the subjects are from coloured, Indian and African families. Since the majority of subjects are from white families, it is clear that the specific ECI service delivery programme described in the empirical study meets the needs of a specific culture not representative of the South African population.

In summary the subjects of the empirical study represent a unique sample of young children requiring ECI in South Africa. The characteristics of the sample indicate a wide spectrum of different ages, languages and geographical localities, but with more consistent features relating to the diagnostic categories and the population group they represent.

5.5 MATERIALS AND APPARATUS

The materials used in the empirical study were the CHRIB Case History Form (Louw & Kritzinger, 1995a) (See Appendix B), the CHRIB Assessment Protocol (Louw & Kritzinger, 1995b) (See Appendix C) and the CHRIB database system, modelled on these assessment materials.

5.5.1 Assessment Materials

A comprehensive assessment protocol for infants and toddlers at risk for communication delays was developed in CHRIB to meet the needs of the clients and their families. Principles of best practice regarding the assessment approach, assessment materials, parental involvement and teamwork as described in ECI literature were considered (Billeaud, 1998; Rossetti, 1996; Prizant & Wetherby, 1995).

Different sources were used to obtain reliable examples of communicative behaviours to evaluate the infant or toddler's development (Rossetti, 1990a; Ballard, 1991). The first source was the CHRIB Case History Form (Louw & Kritzinger, 1995a), a questionnaire sent to the parents and completed prior to the assessment.

5.5.1.1   CHRIB Case History Form (Louw & Kritzinger, 1995a)

The CHRIB Case History Form (Louw & Kritzinger, 1995a) (See Appendix B) consists of 5 sections with open-ended questions, requiring short descriptive responses, closed questions and dichotomous questions requiring Yes/No answers.

Careful consideration was taken to ensure that the questions were formulated clearly and not open to misinterpretation (Nichols, 1991). Different types of questions were used as different types of information were collected from the subjects' parents. Factual information was collected in the form of discrete data by posing closed questions which offers a few response choices from a

list of options and dichotomous questions with only two response possibilities (Leedy, 1997; Nichols, 1991). Closed questions are preferable in questionnaires as the responses are suitable for data entry into a database and statistical processing by computer (De Vos, 1998). In contrast with closed questions, open questions have to be processed manually, but were necessary as some data collected from the subjects' parents had too many response options to classify meaningfully. Open questions were therefore used to a limited extent as many open questions lengthen the time of completion and the parents may be tempted to omit some questions which will decrease the value of the data obtained from the questionnaire (De Vos, 1998).

The features CHRIB Case History Form (Louw & Kritzinger, 1995a) can be described as follows:

The questionnaire starts with a section on general biographical information and parents are requested to supply the child's name, date of birth, the family's address and contact numbers. Thereafter details about the referring person and other professionals who have been consulted regarding the child's condition, are requested. The following questions relate to the family and personal information about the parents. The last part of Section 1 requires short descriptive responses on when the child's problem was first noticed, the child's medical diagnosis if applicable, the course of treatment to date, related problems and hereditary conditions in the family, the child's daycare and the family's home language.

The next section, Section 2, contains 19 factual questions regarding the pregnancy and birth history. Brief descriptive responses are requested in order to identify prenatal risk factors which could have contributed to perinatal conditions experienced by the infant, which in turn, could have contributed to the child's current condition. In this way the cumulative nature of the different risk conditions can be identified, resulting in determining unique patterns of risks for each child. This can lead to a better understanding of the reciprocal influences between the particular infant and the environment over time as

described by Samerhoff (1975, in Rossetti, 1990a) when proposing the transactional model of causation in developmental disorders. The CHRIB Case History Form (Louw & Kritzinger, 1995a) was therefore constructed to include the concept of continuum of risk which implies that the origins of school failure can begin very early in a child's life (Rossetti, 1996).

Section 3 relates to the child's postnatal medical history and obtains information regarding illnesses, surgeries, hospitalizations and medications.

The remainder of the questionnaire, Section 4, relates to the child's developmental history. Parents are requested to provide age levels for the attainment of developmental milestones, closed choice questions are asked about feeding skills and hearing abilities and a descriptive response is required regarding middle ear problems experienced by the child. A list of dichotomous questions, requiring Yes/No responses, were compiled to obtain the parents' views regarding the child's interaction skills, communication development, language comprehension, speech and expressive language development.

The last four questions in the questionnaire deviate from the factual nature of the previous questions. Parents are requested to express their concerns about the child's speech-language development and hearing abilities, to describe their efforts to help the child thus far and state their expectations of the assessment.

The nature of the information obtained from the parents in the questionnaire is therefore factual data as well as perceptions, providing the assessment team with information regarding the parents' knowledge of and attitudes regarding their child's condition. According to Girolametto, Weitzman & Clements-Baartman (1998) and Rossetti (1998), it is now generally accepted that parents are reliable sources of information about their children, although they may lack the specialized knowledge to interpret the information correctly. By obtaining parents' opinions about their children's conditions, a family-centered approach to data collection could be achieved.

It is clear that the CHRIB assessment does not only involve parents as providers of information regarding their child, but also values their opinions. During the interview on the day of the assessment the parents are afforded a further opportunity to express their views, enabling the ECI team members to identify family strengths and needs and involve them in decision making about their child.

The next source utilized to obtain examples of the child's communicative behaviour is the CHRIB assessment itself.

5.5.1.2   CHRIB Assessment Protocol (Louw & Kritzinger, 1995b)

The CHRIB Assessment Protocol (Louw & Kritzinger, 1995b) (See Appendix C) was developed to provide the child with opportunities to display a variety of spontaneous and elicited communicative behaviours which were interpreted by utilizing developmental criteria, a variety of developmental scales and three norm-referenced measurements. The CHRIB Assessment Protocol (Louw & Kritzinger, 1995b) is based on the Stage Process Model of Early Development and adapted from the Holistic Assessment Model for Infants with Cleft Lip and Palate developed by Louw (1986).

Certain principles regarding infant-toddler assessment as outlined by Prizant and Wetherby (1995) were adhered to. Table 5.2 was compiled to provide the complete list of developmental areas with related assessment materials and measurement criteria used in CHRIB and upon which the CHRIB database system was modeled.

According to Table 5.2 a comprehensive communication assessment protocol, covering all developmental areas is utilized in CHRIB. The underlying principle to this integrative approach is that communication development is closely related to all other aspects of development and an assessment protocol should address these relationships (Louw, 1986; Prizant & Wetherby, 1995).

Table 5.2 Communicative Assessment Materials used in CHRIB

Developmental Area	Assessment Material	Measurement Criteria
1. Behaviour, attention, emotional independence and cooperation during the assessment	- Behaviour observation throughout assessment	- Developmental criteria according to age levels (Williamson & Zeitlin, 1990)
2. Hearing sensitivity	- Behaviour Observation Audiometry or - Visual Reinforcement Audiometry or - Play audiometry according to child's developmental age	- Standardized norms according to child's age (Northern & Downs, 1991)
3. Middle ear functioning	- Otoscopic examination - Basic immittance measurements	- Assessment guidelines according to Stach (1998) - Standardized norms established according to age (Silman & Silverman, 1991)
4. Listening skills	- *CHRIB Listening Scale* (Hugo, Louw, Kritzinger & Smit, 2000) - Clinical observations	- Description of listening skills according to a Likert-type Scale - Recording of behaviours
5. General development	- *Developmental Assessment Schema* (*DAS*) (Anderson, Nelson & Fowler, 1978) - *Developmental Activities Screening Inventory* (*DASI II*) (Fewell & Langley, 1984) - Clinical observations	- Developmental criteria according to 3 month age intervals - Standardized norms and computed developmental quotient - Recording of behaviours
6. Play Behaviour	- *The Rossetti Infant-Toddler Language Scale* (Rossetti, 1990b) - Clinical observations	- Developmental criteria according to 3 month age intervals - Recording of behaviours
7. Communication skills (means, turntaking and function)	- *The Rossetti Infant-Toddler Language Scale* (Rossetti, 1990b) - *Expression of Communicative Intent* (Wetherby & Prizant, 1989) - Clinical observations	- Developmental criteria according to 3 month age intervals - Description of communicative behaviours - Recording of behaviours
8. Oral-motor functioning and feeding skills	- *Oral-Motor/Feeding Rating Scale* (Jelm, 1990) - *Developmental Pre-Feeding Checklist* (Morris & Klein, 1987) - Clinical Observations	- Description according to a Likert-type Scale - Developmental criteria according to age levels - Recording of behaviours
9. Genetic anomalies	- *Genetic Screening Checklist* (Kritzinger & Louw, 1998) - Clinical observations	- Listing and description of anomalies - Recording of behaviours
10. Expressive language skills	- Phonetic Inventory - Phonology - Word Type and Syntactical Analysis (Manolson, 1992) - Pragmatics - *The Rossetti Infant-Toddler Language Scale* (Rossetti, 1990b) - *DAS* (Anderson, *et al.,* 1978) - Clinical observations	- Listing of phonemes - Analysis of phonological processes - Categorization of words and analysis of sentences - Recording of pragmatic behaviours - Developmental criteria according to 3 month age intervals - The same as above - Recording of behaviours

Table 5.2 continued

Developmental Area	Assessment Material	Measurement Criteria
11. Receptive language skills	- *The Rossetti Infant-Toddler Language Scale* (Rossetti, 1990b) - *DAS* (Anderson, *et al.,* 1978) - Clinical observations	- Developmental criteria according to 3 month age intervals - The same as above - Recording of behaviours
12. Parent-infant-communication interaction	- *Mother/Infant Communication Screening* (Raack, 1989) - *Observation of Communicative Interaction* (Klein & Briggs, 1987) - Clinical observations	- Description of interaction according to a Likert-type Scale (Both instruments) - Recording of behaviours

Another principle stressed by Prizant and Wetherby (1995) is the notion that communication is a social activity and occurs in almost all situations the infant or toddler encounters and that assessment information must be collected over time. The different developmental areas listed in Table 5.2 allow the assessment of communicative behaviours in at least three different contexts, i.e. two play-based situations, one with the data collector and one with the parents, as well as the hearing-testing situation conducted in a different room.

The CHRIB assessment is considered as the first of regular serial assessments carried out during the period the infant or toddler receives ECI (Rossetti, 1996). The CHRIB database system was specifically designed to allow multiple entries of data for one client in order to accommodate the periodic serial assessments and provide the opportunity for longitudinal research. This implies that data can be recorded from subjects at numerous times over several years (Leedy, 1997) as the research tool developed by García-Sánchez as the *Individual Following Record to Early Intervention* (García-Sánchez, 1998).

When studying Table 5.2 it is clear that the different assessment materials require a number of assessment strategies to be used for collecting the data. According to Prizant and Wetherby (1995) reliability of assessment findings can be increased when similar patterns of communication are observed

across different contexts and when different assessment strategies are employed.

The guidelines for the administration of *The Rossetti Infant-Toddler Language Scale* (Rossetti, 1990b) require that samples of communicative behaviours are collected using three strategies, namely parental report, direct observation and elicitation of behaviour in a play-based context. As this specific instrument is widely used in ECI research (Rossetti, 1998) these guidelines were followed in collecting all the data on the subjects' communication behaviours. Careful consideration was given not to compromise the integrity of the research process and to ensure the reliability and validity of the different measuring instruments used in the data collection (De Vos, 1998). Research conducted by Calhoon (1997) indicates that the play-based assessment procedures recommended by *The Rossetti Infant-Toddler Language Scale* (Rossetti, 1990b) provide a broader picture of the child's emerging communication skills than when norm-referenced standardized measuring instruments are used. Calhoon (1997) concluded that preliminary results indicated that *The Rossetti Infant-Toddler Language Scale* (Rossetti, 1990b) has face validity as it accurately measures the communication skills under consideration and that it appears to be a relevant measure of these particular communication skills.

As infant and toddler communicative behaviours are often subtle non-verbal signals, short in duration and often not repeated (Owens, 1989), a video recording is used as a strategy to ensure that important data are not missed and to validate observed behaviours.

Guidelines proposed by most leading authorities on infant-toddler assessment and followed in CHRIB, recommend the measurement of the child's communication functioning in terms of developmental criteria instead of measuring the child against the norms set by typically developing children (Billeaud, 1998; Rossetti, 1998). Table 5.2 indicates that criterion-referenced assessment instruments are mostly used as part of the CHRIB assessment protocol as these instruments provide the most useful intervention guidelines.

The use of norm-referenced instruments is limited to the *DASI II* (Fewell & Langley, 1984) and the two hearing tests. The results of the hearing tests were interpreted according to the norms for auditory stimuli and levels of response as described in the Auditory Behaviour Index for Infants (Northern & Downs, 1991).

According to Table 5.2 most assessment instruments are domain-specific, with the *DAS* (Anderson, *et al.*, 1978) as the only global assessment scale. This implies that unnecessary repetition of test items is prevented as domain-specific instruments allow in-depth assessment of all the different facets of infant-toddler communication development and reflects the synergistic nature of early development (Louw, 1986; Owens, 1989).

In order to obtain the relevant assessment information a team of four early interventionists is involved in the CHRIB assessment. Two of the team members are specialists in early communication intervention and the other two members are specialized in pediatric audiology. Apart from the professionals eliciting communication behaviours from the infant or toddler, parents are also requested to elicit communicative behaviours from their child.

As indicated in Table 5.12 two scales are used to rate the parents' interaction with their child. This feature of the CHRIB assessment both adds to the parent's active involvement and provides a more familiar context for the child to express communicative behaviours (Prizant & Wetherby, 1995).

The CHRIB Assessment Protocol (Louw & Kritzinger, 1995b) provides an in depth description of a wide range of developmental areas related to early communication development which can immediately be translated into intervention goals and strategies as components of an individualized ECI programme. The information obtained from the CHRIB Case History Form (Louw & Kritzinger, 1995a) and the subsequent information gained from the parent interview and the CHRIB Assessment Protocol (Louw & Kritzinger, 1995b), provide shared information between the professionals and the family to jointly decide on courses of action to be taken.

All information obtained from the CHRIB assessment is documented and stored in separate files for each client and becomes part of the departmental filing system kept in a filing room which can be accessed by members of staff and students. The format of the CHRIB information storage system is therefore as efficient and as secure as a conventional filing system will permit, but does not afford the clinic with the advantages which database technology can offer (Bowers, 1993).

According to Connolly, *et al.* (1996) the disadvantages of laborious data retrieval from a conventional paper-based information storage system can be overcome by a computer database system which can efficiently manage large volumes of information for the benefit of administration and research purposes (Connolly, *et al.*, 1996). While paper-based record systems will always be necessary, a clinic such as CHRIB can become competitive in research output as the data, additionally stored in a computer database system, can be retrieved and manipulated at a greater speed and with much more sophistication. The links already established between the different files in a database system are an inherent feature of a relational based database which demonstrates its indisputable advantage over a paper-based filing system (Bowers, 1993).

The preceding analysis and discussion of the CHRIB assessment and filing system provides a framework of the special features required by a customized CHRIB database system to be used in the current study.

5.5.2 Features of the CHRIB Database System

The database designed for the current study is a *Microsoft® Access* (Aitken, *et al.*, 1997) relational database management system, structured according to the fifth normal form, then denormalized according to practical needs.

According to Connolly, *et al.* (1996) the relational model is based on the mathematical concept of a relation, which is physically represented as a table with columns and rows. This implies that data is structured in certain

relationships and accurate representation of the data, its relationships and constraints, is required when a database is designed for a relational system. The technique used to produce a suitable set of relations for a specific database system is known as normalization. Normalization is performed as a series of tests on a relation to determine whether it satisfies or violates the requirements of a given normal form. Three normal forms were originally proposed and two higher forms, the fourth (4NF) and fifth (5NF) normal forms, are now used to deal with practical situations relating to the specific nature of a database to be designed (Connolly, *et al.*, 1996).

The relational based data management system is based on an advanced data structure design and has the additional benefit of allowing logical and mathematical operations to be done on an entire file and can create new sets of data out of combinations of existing records (Aitken, *et al.*, 1997; Schrodt, 1987).

The CHRIB database is Windows® based, i.e., a graphical user interface system which is client centered, function orientated and allows uncomplicated implementation. *Microsoft® Access* is a relational database programme which meets the requirements of the current study and was employed to design the customized database.

The special operating features of the customized CHRIB database system are in logical order described by Aitken, *et al.* (1997) as follows:

- The data entering level is completely mouse-driven and does not require program coding.
- A special feature of the database is the dynamic look-up tables, which implies that categories to be added to pick lists do not first need editing.
- The database files contain all information created for the database, i.e. the data, customized forms, reports and indexes.
- All data is entered into the database by means of special on-screen forms and stored in tables. A single form can be used to enter data into several tables concurrently.

Tables are the central focus of a database and the CHRIB database consists of 16 different tables as described in Table 5.3.

Table 5. 3   List of tables, their descriptions and types of data entered in the CHRIB Database

Table	Description	Types of Data (Maxwell & Satake, 1997)
1. Client	ID number, biographical data, antenatal and perinatal history, postnatal development	- Numerical and text data
2. Parentship	Data on mother, father and family	- Numerical and text data
3. Persons involved	Professionals consulted relating to the child's problem	- Text data
4. Referring persons	Data on person or professional who referred the family to CHRIB	- Text data
5. Persons	Name, address and contact numbers of persons involved in Nr3 and Nr4	- Numerical and text data
6. Diagnosis	Client's diagnosed condition according to the *ICD-10 International Statistical Classification of Diseases and related Health Problems* (CSS, 1996)	- Numerical and text data
7. Language	Family's home language	- Text data
8. General illnesses	History of client's past illnesses and hospitalizations	- Text data
9. Surgery	History of surgeries performed on client	- Numerical and text data
10. Medication	List of medications used by client, especially ototoxic medications	- Text data
11. Viral infections	List of viral infections contracted by mother during her pregnancy with client	- Text data
12. Perinatal	List of perinatal conditions of the client	- Text data
13. Assessments Main	Assessment data relating to client's hearing abilities, general development, cognitive development, play behaviour, receptive and expressive language development	- Text and interval data (age intervals)
14. Assessment Main 2	Assessment data relating to the client's language use, genetic anomalies and feeding skills	- Text and interval data (age intervals)
15. Parent-child-interaction	Assessment data on parent-child-communication interaction	- Numerical data
16. Memos	Descriptive data on each of the assessment areas	- Text data (longer descriptions)

- Table 5.3 describes each table and indicates which types of data were entered in the CHRIB database. The tables were labeled in abbreviated format on the Main Form as Client, Parentship, Persons involved,

Referring persons, Persons, Diagnosis, Language, General illnesses, Surgery, Medication, Viral infections, Perinatal, Assessments, Assessment on the Main Form 2, Parent-child-interaction and Memos. The contents of the CHRIB Database were based on the main features of the CHRIB Case History Form (Louw & Kritzinger, 1995a) and the CHRIB Assessment Protocol (Louw & Kritzinger, 1995b), but do not contain all the detailed information from the two sources as it would have become too time consuming and impractical to enter each subject's data. The structure of each table of the CHRIB database is outlined in Appendix D.

- The CHRIB database allows damage control in the form of automatic corrections and question and answer possibilities.

- Links were created to indicate the relationships between the 16 different tables. Figure IV.II represents the printed format of the CHRIB database illustrating the relationships between the different tables.

- Each of the tables has rows and columns, containing all the data in the database, but excluding the rules, relationships and programming.

- Each database entry is stored in its own row and is referred to as a record. This implies that each client's data is stored in a different row and the number of rows therefore represents the total number of clients in the Main Table of the database.

- The columns are the collections of all discrete values of each *field*, representing all the different categories of data collected, e.g. the client's name is contained in one field and the client's address in another. All the client addresses in the entire table are collectively known as the client address field. At the intersection of a field and a row is the individual bit of data for that particular record, known as a *cell*.

- Forms are used to enable end-users to enter data in an intuitive way, while guiding the data entry and validating the values entered. Reports are designed to be printed. Reports are therefore specially formatted collections of data, organized according to the user's specifications. The ability to extract and present data in coherent report format depends on the type of queries the database operator is able to generate.
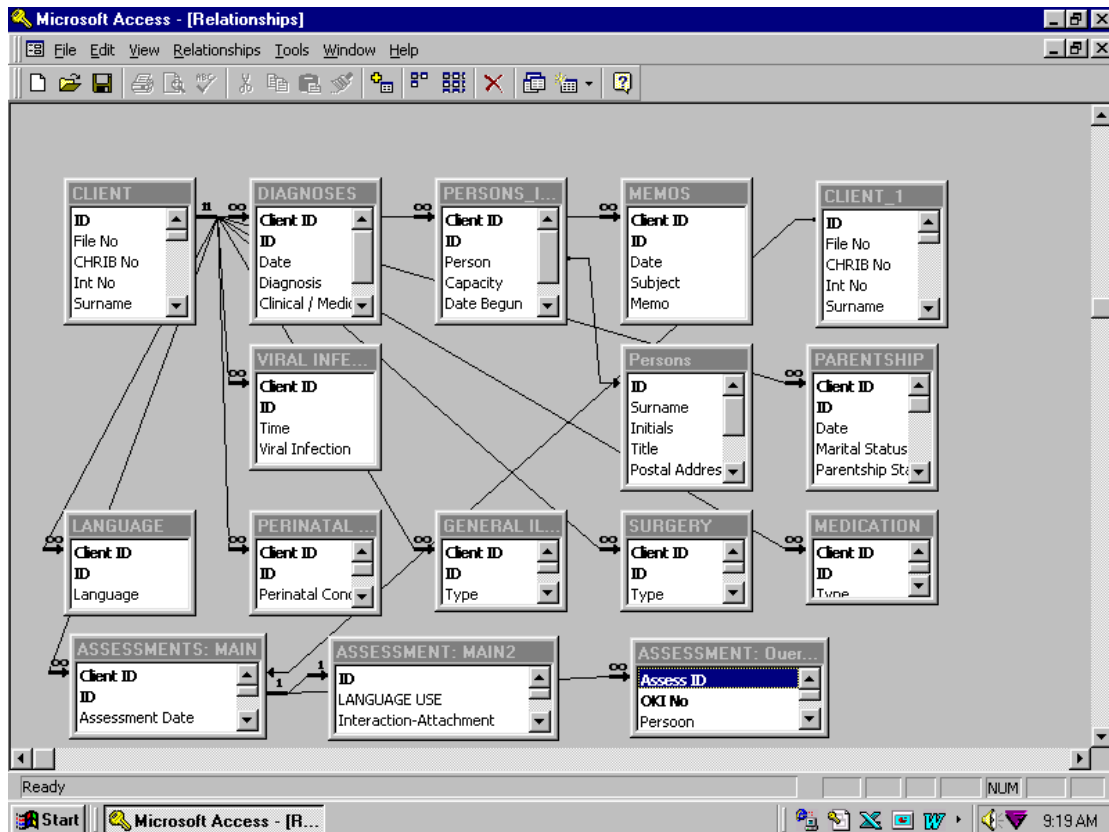
Figure V.II   Print out of relationships between the tables of the CHRIB Database

- Queries are formal ways to sort and filter the data and enable the operator to specify the fields, their order, the filter criteria for each field and the order in which each field has to be sorted and appear in a report, unique or summarized. Simple as well as advanced data reporting are functions of sorting and filtering.

- Hyperlinks can be assigned between objects on forms or reports. (An object represents any control such as a field name or title). This implies that a report in *Microsoft® Access* format can be saved in *Microsoft® Word* format and hyperlinks will be activated when the document is opened in *Microsoft® Word.* By means of embedding a copy of an object can be inserted into another file while maintaining a link to the source file.

- By means of corresponding fields two database tables can be linked to one another, releasing large amounts of data for research purposes within a very short time.

Figure V.III   Print out of a CHRIB Database form for phonetic inventories of vowels and consonants

-   Different front ends can be applied to the same data, opening vast possibilities for data processing and further statistical analysis. The CHRIB *Microsoft® Access* database has data exchange interfaces for software programs such as *Microsoft® Word, Microsoft® Excel, Oracle, SQL Server* and the *SAS®* (1999) computer package and allows data to be accessed in these programs.

-   *Microsoft® Access* is a software program with applications on the Internet, a vast collection of connected computer networks. This implies that visitors to a website via an Internet host can read data in the CHRIB database when the data is presented in hypertext markup language (HTML). This application is, however, not yet implemented. In order to be accessible to national and international links, an international alphanumeric code classification system for client diagnoses, the *ICD-10 International*

Statistical Classification of Diseases and related Health Problems (CSS, 1996) was selected in designing the CHRIB database. As the database is centrally controlled, measures can be taken to protect sensitive information such as client names and addresses when linking with the Internet is considered in the future.

The preceding discussion on the structural and operational features of the CHRIB database system served to illustrate its sophisticated design and dynamic potential to store and process data for clinical use and extensive short-term and longitudinal research projects. In order to operate the *Microsoft® Access* database certain conditions for computer hardware and software are required.

5.5.3 Apparatus Requirements

The empirical study required the use apparatus for the design and utilization of the computer database system, recording and processing of the CHRIB assessment and conducting of the hearing testing.

5.5.3.1 Apparatus Requirements for the CHRIB Database System

- The CHRIB database system was installed in an *Intel Pentium Windows®* based system and the following hardware specifications were sufficient to support the software of the CHRIB database system:

  - Intel Pentium II 333 MMX CPU with cooling device, 512 kb Cache
  - PII motherboard, AGP, PCI, ISA, ECP EPP, 2x 16C550, PCI IDE 16 Bit sound
  - 64MB SDRAM 168 pin 8 ns 100 MHz
  - 4.3 GB UDMA 33 hard drive
  - 4 MB AGP Matrox Millenium VGA card, Y2K compliant
  - 36X CD ROM Drive, 160W speakers
  - AT mini tower case

The software package is *Microsoft® Office Professional 97*, made available by the University of Pretoria and operating on *Microsoft® Windows 98*. Authorization to use the *Microsoft® Office Professional 97* software was obtained by purchasing a *Microsoft® Open License* (Licensee reference: BN: 130108).

5.5.3.2 Apparatus Requirements of the CHRIB Assessment Recordings

- A video camera with the following specifications was used to record the CHRIB assessments: *Panasonic R33 VHSc Movie Camera NV* with a *Hi-Fi Stereo* microphone, a 10x wide lens with a power zoom.
- The assessment was recorded through a one-way mirror and an additional public address stereo amplifier (*Weltec Solid-State*) was used to enhance the quality of the sound.
- To ensure that no data is lost an additional audio recording of the interview with the parents was made using a *National Slimline Audio Recorder* Model RQ-2102.

5.5.3.3 Apparatus Requirements for Hearing Testing

- The hearing testing was conducted in a soundproof booth, using a *Welch Allyn GSI 61 Clinical Audiometer* equipped with a Visual Reinforcement Audiometry system. Visual Reinforcement Audiometry was used with children between six months and two years developmental age and the procedures of this technique were followed as described by Northern and Downs (1991).
- The Hear-Kit (Northern & Downs, 1991) with preselected and premeasured toys was used for Behavioural Observation Audiometry with neonates and infants under six months developmental age. The guidelines provided by Northern & Downs (1991) were adhered to when this procedure was carried out.

- A *Grason-Stadler GSI 28A Auto Tymp* was used in the clinical assessment of the middle ear function. The guidelines for basic immittance measurements as described by Stach (1998) were followed.

- A hand-held otoscope was used to for the visual inspection of the ear canal and tympanic membrane prior to the hearing testing procedures (Stach, 1998).

5.6 PROCEDURES

The procedures followed to conduct the empirical research included the design of the CHRIB database system, gaining proficiency in data entry into the database, collecting and analyzing the data.

5.6.1 Design of the CHRIB Database System

In association with a computer system developer specializing in research database designing and programming, the CHRIB database system was designed over a period of 9 months. The process entailed preliminary discussions to establish common ground regarding the rationale, the functions and requirements of the database system. Examples of existing databases designed by the programmer, such as the Paediatric Oncology Database at Kalafong Hospital, were reviewed to orientate the researcher to the application of database systems in research.

A total number of 112.5 hours were spent in developing the CHRIB database system and the computer system developer and researcher spent 38 hours in joint consultation sessions (Personal records of B. Nieuwoudt, database programmer, 1995-1996).

The operational strategy employed during the developing phase of the database involved a continuous process of assessment, analysis and action (Patel, 1993). The *assessment* involved critical thinking regarding requirements for research, training and service delivery at CHRIB in order to

analyze the CHRIB Case History Form (Louw & Kritzinger, 1995a) and the CHRIB Assessment Protocol (Louw & Kritzinger, 1995b) so that *action* could be taken by way of designing the database system. A continuous process of assessment and analysis therefore preceded every step of the programming phase in order to best represent the comprehensive CHRIB assessment protocol and procedures in the database system. The operational framework of assessment, analysis and action ensured that changes and corrections could be implemented on a continuous basis which made a separate pilot study superfluous. According to Nieuwoudt (1999) a research database system requires continuous changes to suit the aims of the research whereas a production database system can operate with intermittent adjustments once programmed. Rapid application development, i.e. prototyping and production, is unique to a research database (Nieuwoudt, 1999).

The last step in the design of the database system involved the independent entering of data in the database system by the researcher. Four working sessions under supervision of the computer system developer took place so that the researcher could develop proficiency in the process of data entering and in using the back-up system to secure that data that had been entered (Nieuwoudt, 1991). Thereafter independent use of the database system was maintained but regular contact with the computer system developer was kept in order to ensure that problems could be discussed and minor adjustments could be made to the database.

5.6.2 Data Collection

The general and specific procedures regarding the data collection can be described as follows:

- Parents with infants and toddlers at risk for communication delays contact CHRIB when they have been referred and the CHRIB Case History Form (Louw & Kritzinger, 1995a) is sent to them. When the completed form is received back by CHRIB, an assessment date is arranged with the parents.

- A letter, sent out together with the CHRIB Case History Form (Louw & Kritzinger, 1995a), obtained the parents' or caregivers' consent to utilize information gained from the assessment for research and student training purposes. In the letter the assessment procedures were explained to the parents and they are requested to bring the child's favourite toys and a snack for the feeding evaluation (See Appendix A).

- The following step is the CHRIB assessment itself and entails the parent interview, assessment of the child's communication skills, hearing testing, opportunity for parent-child interaction while the data collectors observe from the behind the one-way mirror for the duration of the observation of the parent-child interaction, and feedback to the parents. The communicative assessment materials and procedures for data recording and interpretation as described in Table 5.2 were used. Table 5.4 describes the specific sequence of assessment procedures, participants and measures undertaken to ensure reliability and accuracy of data collection.

Table 5.4   Sequence of data collection procedures during CHRIB assessment, participants and recording measures to ensure reliability and accuracy

Sequence of Data Collection Procedures	Participants	Recording Measures to Ensure Reliability and Accuracy
1. Interview*	Parents, or caregivers when parents do not come, members of the extended family if present and a data collector	- Audio-recording of interview - Case History Form completed by parents - Reports from other professionals - Data collector's notes
1.Assessment of communication skills*	Child and first or second data collector	- Video recording - Record forms of assessment instruments - Data collector's notes
2. Hearing testing	Child, parents and third or fourth data collector	- Record forms of assessment instruments - Data collector's notes
3. Parent-child communication interaction	Child and parents play on their own	- Video recording - Record forms of assessment instruments - Data collectors' notes
4. Feedback session	Parents and data collectors	- Video recording - Summary form completed by data collectors

Key*
- Interview with parents and assessment of child's communication skills occur simultaneously in the same room

- As indicated earlier, CHRIB is also used as an undergraduate and postgraduate training facility and students observing the assessment were employed to carry out the video recordings from behind a one-way mirror.

- According to Table 5.4 four data collectors are involved in the CHRIB assessment. The data collectors are all qualified professionals specializing in EI as indicated in Table 5.5. Turns to conduct the assessment of the subject's communication skills were equally shared by the first two data collectors, while the interview was carried out by either of the four professionals involved. The third and fourth data collectors who specialize in pediatric audiology always conducted the hearing test. As all data collectors were experienced and familiar with the materials used as well as the data collecting procedures, consistency and accuracy in data collection could be ensured (Mouton & Marais, 1990).

Table 5.5   Qualifications and experience of data collectors

Data Collector	Qualifications	Years of Experience in ECI
First data collector	D Phil	20 years
Second data collector	M Log	13 years
Third data collector (audiologist)	M Log	3 years
Fourth data collector (audiologist)	B Log	1 year

- After an assessment the results of each subject was recorded and entered into the CHRIB database in the form of text data, numerical data and age interval data as indicated in Table 5.2. In order to control the accuracy of information in the databasis, the data entering was done by the researcher only. The data entering process took approximately 45 minutes per subject, totaling approximately 114.75 hours for the 153 subjects. The utilization of a database system in the current study allows the systematic recording of data related to the characteristics of the subjects which is immediately accessible for statistical analysis, resulting in economic time management.

5.6.3 Validity and Reliability

In order to ensure that the empirical study has generated accurate and valid findings of the characteristics of the subjects which have been studied, careful consideration was given to the internal validity of the study and the performance reliability of the measuring instruments used (Leedy, 1997; Mouton & Marais, 1990).

The theoretical validity of the materials and apparatus used were demonstrated by the fact that the CHRIB Assessment Protocol (Louw & Kritzinger, 1995b) was based on theoretical models of early development and assessment developed by Louw (1986). The Stage Process Model of Early Development and the Holistic Assessment Model for Infants with Cleft Lip and Palate (Louw, 1986) were developed mainly for research purposes and were therefore considered as a valid theoretical framework for the assessment protocol and the structure of the CHRIB database in the current empirical study. Careful consideration was given to the selection of assessment materials in order to ensure their reliability as instruments yielding the same results under comparable conditions (De Vos, 1998). Guidelines for the administration of the different assessment materials listed in Table 5.2 were adhered to in order to ensure consistent data collection procedures by all the data collectors.

In order to obtain accurate and reliable data the same assessment materials and procedures were used to collect data from each subject. The same data collectors were utilized consistently and they were all familiar with the data collecting procedures. Data entering into the CHRIB database was done by the researcher only so that consistency and accuracy could be maintained. Before the process of data analysis began, the researcher and the database application programmer reviewed the data in Microsoft® Excel files format so that inaccuracies could be detected and corrected. Data from the CHRIB database was manipulated by using the different functions of the software and different tables were created. The quantitative and qualitative data in the tables was examined more than once to ensure accurate presentation. A

statistician was consulted in order to ensure relevant analyses for the particular type of data. The last step employed to demonstrate the internal validity of the empirical study was to ensure that the final conclusions of the research were adequately supported by the data (Mouton & Marais, 1990).

In order to increase the quality and the value of the data, validity and reliability considerations were therefore regarded as central to the integrity of the research process undertaken.

5.6.4 Data Analysis and Interpretation

In order to perform statistical analyses the data in the CHRIB database system was converted to a flat-file structure in *Excel* (*Microsoft® Office 1997*) so that the data could be processed and analyzed by the *SAS®* (1999) computer package. Table 5.6 provides the two sub-aims of the empirical study which required statistical analysis. As indicated in Table 5.6 the different fields or data categories were analyzed by calculating frequency distributions, means and two-way frequencies in some circumstances. Text data was analyzed and described qualitatively.

Table 5.6   Sub-aims of the empirical study and statistical procedures

Sub-aims	Statistical Procedures
To manipulate the data using the various functions of the software to: - Create new tables in the datasheet view - Edit the data in a table - Sorting and filtering data - Creating queries	No statistical procedures
To utilize the database system as a front end for the *SAS®* (1999) computer package to perform a scenario analysis of the data	Descriptive statistics to calculate the means and frequency of variables describing selected characteristics of the subjects

5.7 CONCLUSION

The research problem to be investigated by the empirical study pertains to the development of a contemporary ECI research tool in South Africa for future utilization in an information age driven by rapid technological advances. Using the framework of second-generation EI research (Guralnick, 1997) the application of such a research tool will contribute to the exploration of three elements, namely a specific ECI programme's features, the characteristics of the subjects participating in the research and the nature of the outcomes. The methodology employed in the empirical study stipulates that a uniquely designed database system will be used to provide a comprehensive description of the subjects so that valid and accurate inferences can be drawn from the results. A description of the CHRIB database indicated that the data generated by this customized research tool can be used to identify specific assets and needs of the ECI programme which will lead to the development of a conceptual framework for improved service delivery in CHRIB, thereby contributing to the developing field of ECI in South Africa.

5.8 SUMMARY

The chapter described the planning and implementation of the empirical study. The first main aim of the study was to design a database system as an ECI research tool and a detailed description of the database structure and features was provided. The database system was modeled on the assessment materials and procedures employed at CHRIB, an ECI service delivery facility. A quantitative survey methodology was selected to conduct the second main aim of the empirical study. Data of 153 subjects assessed at CHRIB was collected and entered into the database system over a period of three and a half years. The data analysis procedures were described so that use of the database as a research tool may be demonstrated when the specific population of infants and toddlers receiving ECI services at CHRIB is described.