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thesis entitled

ADEQUACY OF IMMUNIZATION
FOR CHILDREN
BY AGE TWO YEARS

presented by

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has been accepted towards fulfillment
of the requirements for

Master of Science degree in Nursing

Rachel F Scruggs
Major professor

Date November 5, 1996

ADEQUACY OF IMMUNIZATION FOR CHILDREN BY AGE TWO YEARS

by

Patricia Mary Jurcich

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE IN NURSING

College of Nursing

1996

ABSTRACT

ADEQUACY OF IMMUNIZATION FOR CHILDREN BY AGE TWO YEARS

By

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This study explored the level of adequacy of immunization rates in a local county health department immunization clinic for children under age two years. The Starfield model guided this retrospective review of 101 immunization records randomly selected from 551 eligible records. Analysis of the data included three categories for adequacy of care: complete, adequate, and inadequate.

The major findings of this study were that immunization rates remain low with only 60% of the sample starting their immunizations on time, 6.9% receiving complete care, and only 28.7% of the children receiving adequate care. These findings will assist the advanced practice nurse in improving immunization coverage rates for children under age two through education, dissemination of research and periodic assessment of coverage levels, and clinical application in practice. Two recommendations for future research include development of a system for assessment of immunization rates and investigation of perceived barriers to vaccination.

ACKNOWLEDGMENTS

This author would like to acknowledge and thank my thesis committee chairperson, Rachel Schiffman, R.N., Ph.D., who provided the support, time, encouragement, and understanding I needed to assist me in creating this finished product. I would also like to thank my thesis committee members Patty Peek, R.N., M.S. and Linda Spence, R.N., Ph.D. for their time and constructive help to ensure a quality product.

Also, I would like to thank Pat Burke of the Muskegon County Health Department for all the time he spent assisting me in collection of the data.

Last, but most definitely not least, I would like to thank my husband, John, for without his support this project would not have been possible.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

Introduction

The meaning of health has changed dramatically over the past century. In the first half of the twentieth century, health was defined as the "freedom from disease" (Pender, 1987, p. 17). This definition required providers to only treat the disease with which the client presented. Health and illness were viewed as the extremes on a continuum; the presence of one indicated the absence of the other. Changes have come about which place the definition of health as an individual perception of his/her complete physical, emotional, and social status. This transformation of the definition of health has been reflected in the delivery of health care that has changed from a primarily disease intervention focus to an illness prevention and health promotion focus. National health policy has responded to public pressure and changed dramatically, with disease prevention and health promotion emerging as major goals. In 1979, the Healthy People report, published by the Surgeon General of the United States, introduced broad goals for Americans for improving health by the year 2000 (U.S. Department of Health, Education, and Welfare, 1979). This report came about as a reaction to the realization that the health of the country for the rest of the century would have more to do with health promotion than disease intervention. Americans have recognized the advantages of maintaining and promoting health and utilizing strategies for disease prevention.

Since the discovery of vaccines which can prevent common childhood illnesses and decrease morbidity and mortality rates, immunizations have been viewed as one of the major illness preventive strategies in a child's life (Fielding, Cumberland, & Pettitt, 1994; Michigan League for Human Services (MLHS), 1995). "Immunization provides the starkest example of the power of prevention to save or prolong lives, prevent significant

disability, and lower medical costs" (Office of Technology Assessment (OTA), 1988, p. 11). According to the KIDS COUNT in Michigan 1995 Data Book, every one dollar spent on immunizations saves ten to fourteen dollars in direct medical costs and indirect costs such as missed work by parents who care for the sick child (MLHS, 1995).

The purpose of this study was to investigate the adequacy of health care of children by analyzing immunization coverage rates for two-year-old children. The family is the primary social structure for health promotion within society. It is within the family that health behaviors are learned and patterns of healthy living emerge (Pender, 1987). Within the family parents have the responsibility for health education of their children, family nutrition, and health care planning. Children learn early in life how to maintain and promote their health from the examples set by their parents and the community. The first opportunity a parent has in encouraging health promotion and illness prevention after their child is born is through well-child care. The overall goal of well-child care is to improve the physical, cognitive, and psychological health of children (OTA, 1988). Well-child care incorporates immunizations and health supervision as the two main aspects of illness prevention and health promotion (OTA, 1988). The second aspect, health supervision, is important for health education, parental guidance, and screening for physical or developmental problems.

Children are currently immunized in the United States against nine diseases: diphtheria, pertussis, tetanus, measles, mumps, rubella, poliomyelitis, Haemophilus influenza type B (Hib), and hepatitis B (Centers for Disease Control and Prevention (CDC), 1994a). Many states have in place laws which require immunizations to be up to date before entry in elementary school. These laws result in reported vaccination levels of greater than 90% for school-age children (Vetter & Johnson, 1995; Zell, Dietz, Stevenson, Cochi, & Bruce, 1994). However, proper immunization is necessary much earlier in life because many diseases are more serious before age two and often pose a higher risk of mortality if contracted at an early age. To achieve the maximum

effectiveness of vaccinations to prevent illness, children must receive their immunizations according to the schedule recommended by the Advisory Committee on Immunization Practices (ACIP), the American Academy of Pediatrics (AAP), and the American Academy of Family Physicians (AAFP) (CDC, 1994b). This immunization schedule recommends children receive 80% of their vaccinations before age two. Timing of vaccinations is also important especially in the prevention of Hib and pertussis, which have their highest morbidity in the first year of life. The most recent statistics from the National Immunization Survey (NIS) indicate that for children age two, estimated coverage levels range from 63 to 86 percent across the 50 states (CDC, 1996). Michigan has the lowest rate for the 50 states at 63% coverage. This is equivalent to about 200,000 children in Michigan who have spent their early childhood vulnerable to disability or death from preventable diseases (MLHS, 1995).

Due to the low immunization rates which have been estimated over the past few years, the national government has established goals for the nation's immunization rates and several programs to meet these immunization objectives. The Healthy People 2000 report established broad goals regarding the health and well-being for Americans by the year 2000 (U.S. Public Health Service, 1990). Specifically, this report established the goal of increasing immunization levels to 90% for the basic immunization series among children under age two.

One of the first programs established to help meet the 90% immunization goal was President Clinton's "Childhood Immunization Initiative" (CII) which was a proactive movement to set goals of eliminating indigenous cases of six vaccine-preventable illnesses, increasing vaccination coverage levels, and establishing a vaccination-delivery system which maintains and further improves coverage levels (CDC, 1994a; Osguthorpe & Morgan, 1995; Robinson, Evans, Mahanes, & Sepe, 1994). The CII called for major steps to address the barriers to immunization and to improve the delivery of childhood immunizations.

A second public policy to increase the rate of immunizations for children in America is the "Vaccines for Children" (VFC) program which provides free vaccines to eligible children at various public and private locations (Osguthorpe & Morgan, 1995). An anticipated benefit from the VFC program is the reduction of the number of referrals from private to public health care providers for children who do not have immunization insurance coverage. This benefit may increase immunization rates and decrease fragmentation of care.

There has also been progress toward collaboration of the public and private health care sectors to increase vaccination levels. The "Standards for Pediatric Immunization Practices" resulted from a meeting of public and private health care provider groups to address barriers to vaccinating preschool-age children (CDC, 1993). This type of collaboration can help to decrease fragmentation of services which results from families receiving well-child care from their primary care provider and obtaining immunizations from the public sector health care. Pruitt, Kline, and Kovaz (1995) found that the use of multiple providers in the private and public sectors left incomplete records and inaccurate pictures of a child's immunization status.

The issue of immunization coverage rates in children is of central concern in a primary care setting. According to Starfield (1992), primary care practices have a large percentage of prevention-related visits. Many children receive well-child visits and immunizations in a primary care office. Advanced practice nurses (APNs), as primary care providers, develop continuous relationships with their pediatric clients and the clients' families. The APN can use this relationship to encourage vaccination practices and identify which children have not received their immunizations.

Statement of the Problem

With this knowledge of the benefits, cost-effectiveness, and health promoting effects of immunizations and the multitude of national programs to encourage high levels of immunization rates, why are the nation's children still falling well below the goal of

90% at the age of two? Many barriers to obtaining and receiving vaccination are listed in the literature. The three main categories of barriers include those from the parents' view, the provider's view, and missed opportunities. Some of the most commonly cited barriers from a parents' view include vaccine cost, parental knowledge and attitudes regarding cultural beliefs and side effects, misunderstandings of true contraindications for administration of the vaccine, and inaccessibility of the health care systems (Dixon, Keeling, & Kennel, 1994; Kefelas, 1993; Lyznicki & Rinaldi, 1994; Miller, Hoffman, Baron, Marine, & Melinkovich, 1994). Barriers within the health care system, from the provider's view, include lack of knowledge of the true contraindications of administering immunizations, continually changing recommendations for vaccine administration, inefficient record and tracking systems, and inadequate access to health care.

The last barrier is missed opportunities (MO) which is a problem within the health care system. An MO was defined by the CDC in a report as a "health care visit during which a child eligible for vaccination on the day of the visit and with no contraindication for vaccination failed to receive the needed dose(s)" (1994b, p. 710). According to this CDC report, estimated coverage of immunizations in four major cities would have increased 12 to 80 percentage points for children aged 24 months if the MOs had been eliminated.

National immunization programs designed to help increase immunization rates must have involvement of community agencies to be successful at the local level. One of the agencies which becomes involved in many local health programs is the public health department. Most county health departments are major sources of services for immunization in communities. It is through the health department that children can receive free or reduced cost vaccinations. Health departments can help to increase immunization rates for communities; however, in order for the county health department to address the immunization concerns, information is needed about the types of problems requiring attention such as low immunization rates and the extent of these problems.

Study Purpose and Research Questions

The purpose of this study was to analyze the adequacy of immunization of children in one local county from health department immunization clinic records, by age two years. This study was modeled after Ambrose (1995) and addressed the questions:

1. What percentage of children from the Muskegon County Health Department obtain complete care, adequate care, or inadequate care with respect to all immunizations by age two years as recommended by the Advisory Committee on Immunization Practices (ACIP)?
2. For each series of immunizations, what percentage of children received complete care, adequate care, and inadequate care?
3. What patterns of immunization are evident for those children receiving adequate inadequate care with respect to initiation of immunizations and the spacing of those immunizations by age two years?
4. For the subset of children who received complete care for the first set of immunizations, what is the percentage of complete, adequate, and inadequate care for subsequent immunizations?
5. What are the differences by race in the percentage of complete, adequate, and inadequate care for all immunizations?

This study did not address the reasons behind compliance or noncompliance of receipt of immunizations but served to assess the number of children who are receiving their immunizations in a timely fashion which will help to reduce the morbidity and mortality associated with these preventable diseases. To enhance the health and well-being of American children by reducing the morbidity and mortality attributed to preventable diseases it is important to continually assess the current level of coverage of vaccinations. With this knowledge, the APN in primary care can focus interventions to increase the immunization coverage of children.

Theoretical Framework

The Starfield Model

The variables to be used in this study were derived from the Starfield model for evaluating primary care (Starfield, 1992). This method of evaluation emphasizes the measurement of adequacy of care by inspecting the structure and process components of a health care system which affect the desired outcomes.

Determinants of health, according to Starfield, include genetic structure, social and physical environment, individual behaviors, and health care services. The health of an individual is predetermined by genetic structure which is modified by the individual's physical and social environment, learned health behaviors, and interaction with health care systems.

Each health service system has three components, structure, process, and outcome, which are three of the major elements of the Starfield model (Figure 1). The fourth component is the social and physical environment which influences the structure, process, and outcome. The interaction of structure, process, and social and physical environment determines whether the desired health status, or outcome, will be attained.

In Starfield's model there are nine main components of the structure variable (See Figure 1). These components are utilized to assess the structure of a health care system and include: 1) personnel; 2) facilities and equipment; 3) range of services; 4) organization of services; 5) management and amenities and governance of the health care system; 6) mechanisms for providing continuity of care; 7) mechanisms for providing access to care; 8) arrangements for financing; and 9) population eligibility.

The processes of a health care system are comprised of two elements (See Figure 1). First is the process which represent the provision of care by the providers. This includes problem recognition, diagnosis, treatment, and reassessment. The second element of process is that which represents receipt of care by the patient. This includes utilization, acceptance and understanding of the services, and satisfaction and

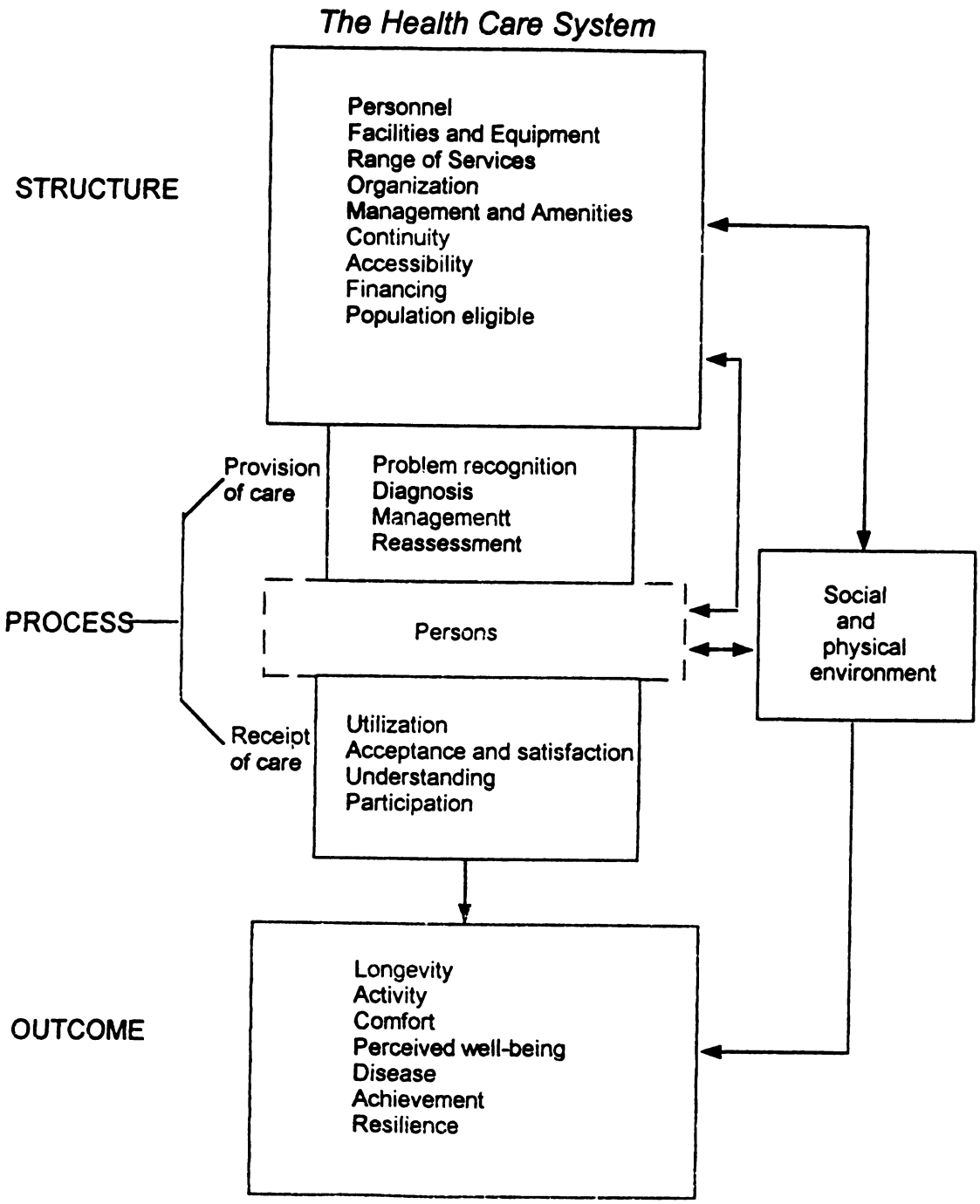

Figure 1. Starfield Model: A Basis for Evaluating Primary Care (Starfield, 1992).

participation with the health care provided.

The outcome of primary care is conceptualized by Starfield (1974, 1992) as the health status of an individual. This outcome is the cumulative effect of the client's health behaviors, influence of the structure and process, and the effects of the social and physical environment of the client and provider. Health status has seven parts: longevity, activity, comfort, perceived well-being, disease, achievement, and resilience (See Figure 1). These seven elements are all measured on a continuum.

The social and physical environment represent the elements of the client's and the health care system's society, culture, and environment (See Figure 1). These elements, according to Starfield, have impact on the structure, process, and outcome.

Application of Model to Study

The conceptual definitions utilized in this study were modeled after those of Ambrose (1995). The primary component from Starfield's model used in this study was outcome, as shown in Figure 2. Process, structure, and social and physical environment are elements which interact with and influence the outcome. These last three components, however, were not the focus of this study.

Structure. Structure is defined by Starfield as the characteristics needed by a health care system to provide services (Figure 2). The structural components utilized in this study were the immunization records from the selected subjects who obtained their vaccinations from the Muskegon County Health Department clinic. The population eligible for services at the health department immunization clinic are Muskegon County residents who choose to receive vaccinations at this site, regardless of insurance or socioeconomic

status. The immunization records are entered and maintained in the computer database at the health department. The printouts of the subjects' immunization records were used in this study instead of the individual immunization cards filed at the health department. The

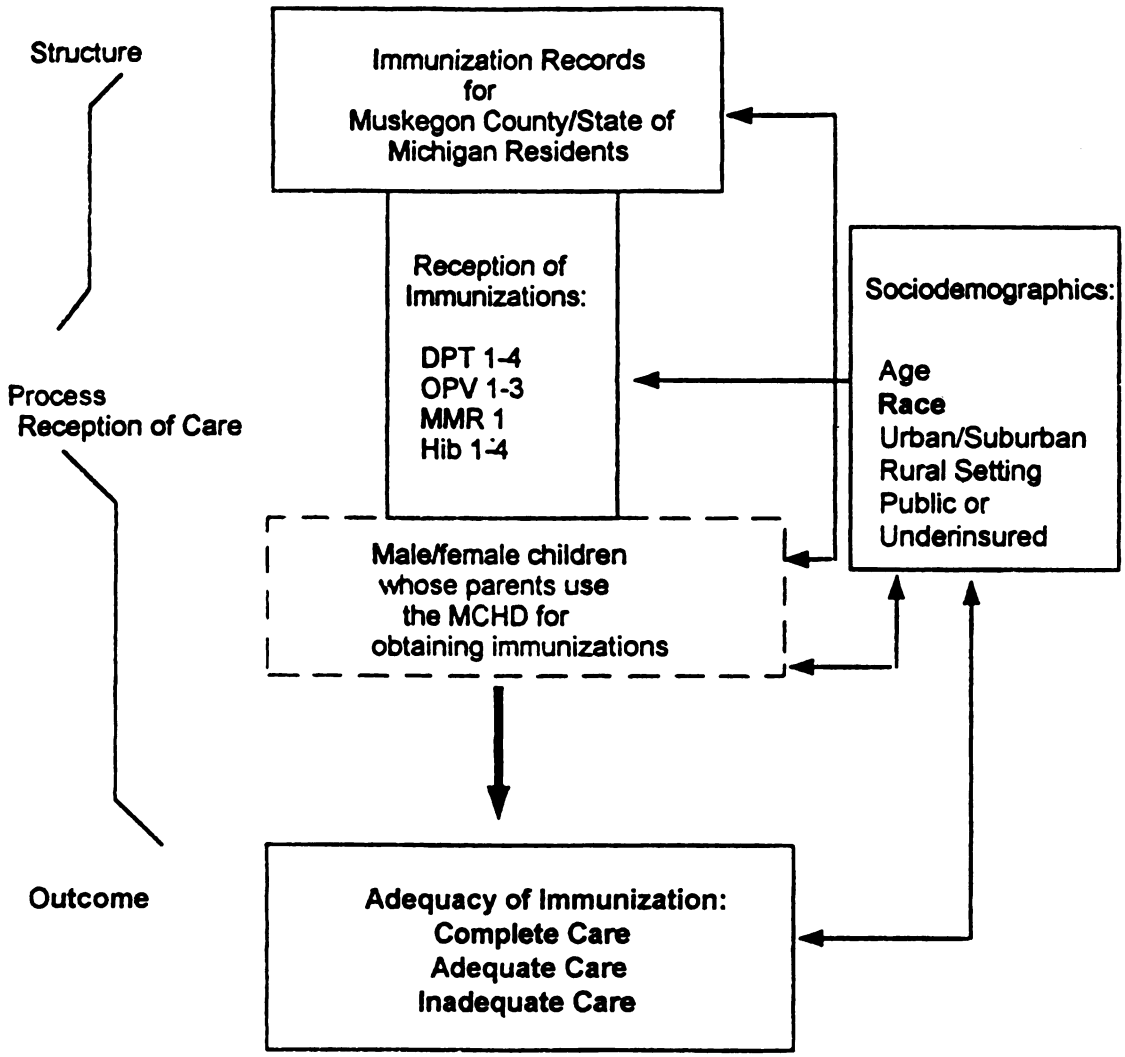

Figure 2. Adequacy of care through immunization for children age two years utilizing the public health system. Adapted from the Starfield Model (Ambrose, 1995; Starfield, 1992).

accuracy of this variable is dependent upon the computer program and the data input and retrieval by the health department staff.

Process. Process refers to the acquisition of vaccinations by the children (Figure 2). Parents, in addition to the children, are included in the process since it is the parent who decided when, and if, the child received the vaccines. Within this study, the process was limited to whether or not the immunizations were obtained. Other elements of the process to obtain immunizations which were not addressed in this study include barriers and facilitators to obtaining vaccinations, missed opportunities by providers, and the steps taken by parents and children to receive the immunizations.

Social and Physical Environment. Social and physical environment were defined in this study as race, sex, age, insurance status, and type of neighborhood (urban, suburban, rural) of the sample population (Figure 2). These components of the social and physical environment influence the structure, process, and outcome aspects of the model. The structure component is influenced through the delineation of the population which receives the services of the clinic. The health department must be able to define the community it serves and must know important demographic information of that community to maximize its service potential. Receipt of vaccinations, in the process component, can be influenced by the sociodemographic information of the community serviced. For example, if the majority of the community who are eligible for services in the clinic are underinsured for immunization coverage there will be a greater need for these services and result in increased use of the health department clinic (Bates, Fitzgerald, Dittus, & Wolinsky, 1994). Lastly, the outcome component of adequacy of immunization for children can also be influenced by sociodemographic information. Bates et al. (1994) reported poverty to be a predictor of decreased immunization coverage and Mustin, Holt, and Connell (1994) reported a lower percentage of adequate immunization for black infants than white infants. The overall description of the population is the defined service area of the health provider.

Race was conceptually defined, for the purpose of this study, as the combination of biological and cultural influences (Betancourt & Lopez, 1993). Within this study race was included as a social and physical environment variable which could impact the outcome of immunization status. Biological factors of race include observable physical characteristics such as skin color, hair type, and facial features. Cultural factors include social norms, learned behaviors, and self definition.

Outcome. Outcome was defined within this study as the measurable adequacy of immunization for the sample; complete care, adequate care, and inadequate care (Figure 2). *Complete care* was defined in this study as the reception and proper timing of all immunizations by age two according to the ACIP recommended schedule. *Adequate care* was defined as the reception of all immunizations by age two but not properly timed according to the recommended schedule. Lastly, *inadequate care* was defined as the reception of less than all the recommended immunizations by age two. The communicable childhood diseases of diphtheria, measles, mumps, rubella, poliomyelitis, pertussis, tetanus, and Haemophilus influenza were studied in this research.

Adequate health care for children has been identified as a major strategy in improving the health status of the Nation (OTA, 1988). Illness prevention and health promotion in early childhood can benefit a child for a lifetime. Health care interventions which result in the positive health status of a child are included in the adequacy of health for children. These interventions include health education and teaching about injury prevention, obtaining treatment when sick, routine evaluation of physical health and developmental status at well-child visits, establishing a health supervision relationship between child, parents, and health provider, and prevention of childhood illnesses through immunization.

Health is viewed as a state of well-being, although specific definitions are made subjectively by each individual. Generally, however, health is viewed as a positive goal, something which is of value to every individual. A state of health is maintained and

influenced by many factors including health care activities which are actively sought out by individuals. Immunization of infants and children is considered a health seeking behavior.

Children in the United States are vaccinated against the nine preventable childhood diseases mentioned previously in this paper. Vaccines were developed in response to the high numbers of morbidity and mortality associated with these childhood diseases. A schedule of childhood immunizations has been established in the United States based upon the efficacy of vaccines in preventing childhood illnesses. A series of immunizations is the sequence and number of vaccines recommended in the schedule for a specific disease.

Immunizations are viewed as an important factor in health promotion of children and their families. Also, vaccinations are a preventive intervention which has been researched and found to have a high benefit-to-cost ratio (MLHS, 1995; OTA, 1988). Childhood vaccination helps to reduce the incidence of disease, disability, and death and can lower medical costs in a Nation whose health care expenditures are growing out of control (Mitchell, 1986).

Since infant and child immunization is widely accepted as an indicator of the adequacy of health care and is a cost-effective approach to prevention, APNs, as health care providers, have a role in providing this preventive care. Multiple research has proven the effectiveness of immunization in promoting health and preventing morbidity and mortality of preventable diseases in children (CDC, 1995b). As shown by the many programs mentioned previously to increase immunization numbers, providing adequate care for the Nation's young through control and elimination of all preventable childhood diseases has been a goal in public health care for decades, continues on today and into the future (CDC, 1994a; U. S. Public Health Service, 1990).

Review of the Literature

Rates of preventable diseases in children are reported widely in the literature (Bouffard, 1995; CDC 1994a; Vetter & Johnson, 1995). In a report on the prevalence of Haemophilus influenza type b (Hib) in infants and children the CDC (1995a) states that the incidence of Hib declined rapidly among children between 1988 and 1992. Since 1992 however, the decline has slowed and they report that one barrier to eradication of this disease is the high percentage of under-vaccinated children. The incidence of measles was also on the decline until the period from 1989 to 1991 when there was a resurgence of measles which was attributed primarily to a failure to vaccinate pre-school children on time (CDC, 1994a).

It is important to combine the surveillance data of both disease numbers and rates of vaccination coverage to obtain a complete picture of the health status of children. Surveillance data on disease numbers alone only demonstrate problems after they occur. There must be monitoring of progress toward immunization coverage targets rather than only progress toward disease reduction targets.

The U.S. Public Health Service, as part of the Healthy People 2000 guidelines, have set the goal of 90% coverage of vaccinations for two year olds by the year 2000 (U.S. Public Health Service, 1990). This has been established in the literature as the goal for research on the topic of immunizations.

The National Immunization Survey (NIS) was established as one element of the objectives set by the CII to monitor the progress toward the CII goal of 90% coverage by the year 1996 (CDC, 1994c). This survey is done quarterly by the CDC through a random sample of telephone numbers and questionnaires which are sent to households with appropriately aged children ages 19 through 35 months. Parental recall of immunization dates and types received is verified with the health care provider named by the parent. This helps to improve the accuracy of the vaccination coverage estimates for the entire sample. Based on the NIS, among children who were born during May 1991 through

May 1993 and who were aged 19 to 35 months when surveyed, estimated coverage was 75% for the nation for receipt of the 4:3:1 series (four doses of diphtheria and tetanus toxoids and pertussis vaccine (DTP), three doses of poliovirus vaccine (OPV), and one dose of measles-mumps-rubella vaccine (MMR))(CDC, 1996). The coverage level fell to 72% when three doses of Hib were added (4:3:1:3 series). Specific information was given on each state with Michigan being the lowest with an estimated coverage of 63% for the 4:3:1 series and 59% for the 4:3:1:3 series. Detroit also had the lowest estimated coverage levels for the cities surveyed, with 52% and 49% for the 4:3:1 and 4:3:1:3 series, respectively.

Many studies of immunization coverage levels rely on parental recall, either from memory or household records, for data. Fielding, Cumberland, & Pettitt (1994) surveyed 1500 randomly selected employees of the Johnson & Johnson Company with children born between 1984 and 1991. Surveys were mailed to the employees home and telephone follow-up was done if the survey was not returned. Everyone in the sample had insurance coverage for immunizations with varying co-pays. Children were considered to be up to date with their immunizations if, by age two, they had received all the recommended shots, not necessarily on time. Results of the study included a 65.1% immunization coverage level for age two. The authors also showed that receiving the first set of immunizations as recommended at two months was a predictive factor for higher coverage. If children received their first DTP late, the coverage at two years was 50.6%, whereas the coverage level was 72.2% for children who had received their first DTP as recommended. A limitation to this study was the specific population utilized; only Johnson & Johnson employees with immunization insurance coverage were included in this study. This study was not generalizable to the greater population.

A second study which utilized parental recall for the data was by Salsberry, Nickel, and Mitch (1994). This study was conducted in a suburban community and included 299 children with birth dates in 1988 and 1989 whom were randomly selected

from birth certificates. The parents who responded in this study were mostly white (92%), married, and had household incomes greater than the county median. In this study, only 31% of children had received all their recommended immunizations by the age of two. Eighty percent of the children had received three doses of DTP, two OPV, and the MMR vaccines, suggesting that the basic deficiencies in immunization of the families surveyed were in obtaining the 18-month doses of DTP and OPV.

Several studies verified parental recall of vaccination records with provider records. This verification can help to increase the reliability of the data. In a study by Bobo, Gale, Thapa, and Wassilak (1993) immunization coverage levels were estimated for children six through 24 months of age. A sample of 1163 children were selected from Oregon and Washington; 601 were more than 24 months old. Copies of provider immunization records were obtained for 90% of the participants in the study. Results of the study included a coverage level of 69% and 60% for the 3:3:1 and 4:3:1 series, respectively, for both states combined. The authors of this study also addressed the question of coverage rates if the first series is at the recommended time. Children who were not up-to-date at 2 months of age were significantly less likely to be adequately immunized at 24 months of age. Delayed immunizations were associated with more than a twofold difference in rates at 24 months.

Two studies assessed vaccination levels based upon the timing of the immunizations received and the recommended schedule of immunizations for children under age two. Zell, Dietz, Stevenson, Cochi, and Bruce (1994) obtained retrospective data from 25 kindergarten and first grade classes in 35 schools. Random selection of the schools and children was done to increase the generalizability of the study. Data were collected and arranged for analysis by two categories: up-to-date (all vaccinations received by age two) and age-appropriate immunizations (all immunizations received within 30 days of the recommended schedule). School records were reviewed and dates of immunizations before age two were obtained retrospectively. The percentage of

children who were up-to-date for the recommended 4:3:1 series ranged from 11 to 58% (median, 43%) by age two. The percentage of children who were age-appropriately immunized for the 4:3:1 series ranged from 5 to 20% (median, 12%). The authors of this study also assessed coverage levels of each individual vaccine. The percentages for the individual vaccines were always higher than for the vaccination series.

Ambrose (1995) used the same variables to assess adequacy of immunizations by age two years as those mentioned in the previous study by Zell et al. (1994). In the Ambrose (1995) study, retrospective data from patient records were obtained from a health department immunization clinic. A sample of 96 children born between 1990 and 1992 who obtained vaccinations at the health department clinic were utilized to assess coverage rates for up-to-date and age-appropriate immunizations. No children in the study were age-appropriately immunized, 45% received all immunizations before age two but not by the recommended schedule, and 55% had not received all their immunizations before the age of two. This author also analyzed the percentages for each individual vaccine received as recommended. The percentage of children who received the individual vaccines as recommended decreased with each subsequent vaccine.

All of the studies mentioned in this section assessed immunization rates for two year old children. The immunization coverage rates reported ranged from a low of 31% in the Salsberry et al. (1994) study to a high of 75% in the NIS study (CDC, 1994c). It is notable, however, that none of these studies reached the 90% immunization coverage goal. Also, only the NIS study reported coverage rates for the immunization series which includes the Hib vaccine (CDC, 1994c). However, the majority of the studies reported data from time periods before the Hib vaccination series was added to the recommended schedule. Fielding et al. (1994) and Bobo et al. (1993) both reported in their studies that if immunizations were not started on time, according to the recommended immunization schedule at two months old, the likelihood of receiving all the vaccinations recommended by two years decreased.

The Zell et al. (1994) and Ambrose (1995) studies compared percent coverage of receiving all vaccinations before age two and receiving all vaccinations before age two according to the schedule recommended by the AAP. Zell et al. (1994) reported a median percent coverage of 43% for the first category whereas Ambrose (1995) reported a coverage of 45%. Results for the second category of properly timed immunizations in the Zell et al. (1994) study were a median of 12% and 0% in the Ambrose (1995) study.

Critique of the Literature

All of the reported studies fall well below the Healthy People 2000 goal of 90% coverage by the year 2000. Limitations to these research studies include the use of retrospective data with parental recall. Parents may have problems recalling the vaccine information accurately when some of the information is three to four years old. This problem is resolved in some studies with verifying immunization information with the provider records (Bobo et al., 1993). Also, most coverage levels were reported as percentage of children up-to-date on their immunizations, i.e. had received all of their immunizations recommended for that age (Bobo et al., 1993; CDC, 1996; Fielding et al., 1994; Salsberry et al., 1994). Within these studies no information was given on the percentage of children who were age-appropriately immunized i.e., within 30 days of the recommended schedule by the ACIP.

Future studies will be required to continually assess the progress toward the 90% immunization coverage goal for the year 2000. Progress toward this goal will help to reduce the morbidity and mortality of infants and children which is associated with totally preventable diseases.

As mentioned previously, it is important to continuously monitor the progress of the immunization coverage rates toward the 90% goal for two year old children. Without this continual assessment programs and interventions to increase vaccination rates cannot be evaluated. Investigation of adequacy of care for the young continues to be a need to better focus the resources necessary to decrease sickness and death for children at risk

(Ambrose, 1995). Specifically, this study was important to gain an understanding of the current coverage rates in a local county and to use this information to design interventions and implications for the APN in primary care.

Methods

Research Design

This study was a retrospective review of immunization records and was modeled after Ambrose (1995). This was a nonexperimental study utilizing descriptive research to investigate immunization rates for a local health department immunization clinic. Secondary analysis of vaccination records was done to obtain the data. Nominal and ordinal levels of measurement were applied to the data to attain results for this study.

Sample

This investigation utilized a randomly selected sample which was requested from the Muskegon County Health Department (MCHD) immunization records database. The population of Muskegon County is a mixture of urban, suburban, and rural residents whose household median household income is below the median household income for the state (MLHS, 1995). In Muskegon County, 24% of all children are minority children.

The sample size utilized in this study was 101 randomly sampled records of children who received their vaccinations at the MCHD immunization clinic. These sample cases were drawn from a population of 551 eligible immunization records which met the inclusion criteria. The following were the criteria for record selection:

1) Birth dates from 1-1-93 through 5-1-94. These dates were selected based upon the beginning date of the addition of the Hib vaccination series to the recommended schedule by the ACIP (CDC, 1994b).
2) All records of children immunized at the MCHD were eligible regardless of the child's status as a MCHD client.

The random sampling of the population was done by the MCHD computer. The total number of eligible subjects (551) were identified and the 101 subjects were then randomly selected from this population.

Setting

The setting used was the Muskegon County Health Department immunization clinic located in Muskegon Township, Michigan. Outreach clinics managed by the health department to access rural sites within the county were also included in the setting since the data is maintained centrally at the health department in Muskegon Township. This site was selected because it immunizes a significant portion of children in the county and is a central site for immunizations in Muskegon County.

Operational Definition of Variables

The operational definitions utilized in this study were the definitions developed by Ambrose (1995) with the addition of the Hib vaccine.

Adequacy of Care. Adequacy of care was defined as the number of immunizations the child has received and the timing in which they received them in relation to the recommended immunization schedule. The childhood immunization schedule approved by the Advisory Committee on Immunization Practices (ACIP), the American Academy of Pediatrics (AAP), and the American Academy of Family Practice (AAFP) (CDC, 1995b) was used as the standard for care for this study because this schedule was inclusive for the many variations in the recommended schedule during 1993, 1994, 1995, and 1996 which was the time identified as the study period (Figure 3). The shaded bars on Figure 3 indicate that the specific vaccination is recommended within that time period. For example, the fourth DTP (DTP4) is recommended between ages 12 and 18 months. Hepatitis B was not studied because it was not considered to be a standard of care for this time period and because of the many variations in the recommended schedule (CDC, 1995b).

AGE > VACCINE V	2 months	4 months	6 months	12 months	15 months	18 months
Diphtheria, Tetanus, Pertussis	DTP1	DTP2	DTP3	DTP4		
H. influenza type b	Hib1	Hib2	Hib3	Hib4		
Polio	OPV1	OPV2	OPV3			
Measles, Mumps, Rubella				MMR		

Figure 3. Recommended immunization schedule by the ACIP, AAP, and AAFP. Adapted from CDC (1995b).

The variable, adequacy of care, was operationalized with three levels:

1) *Complete Care*--4 DTP immunizations, 3 OPV immunizations, 1 MMR, and 4 Hib immunizations received before age two and correctly spaced within 30 days of the ACIP recommended schedule;
2) *Adequate Care*-- All immunizations received by age two years, but not properly spaced or outside 30 days of the recommended ACIP schedule; and
3) *Inadequate Care*-- Less than all of the recommended immunizations within 30 days of age two years or all immunizations not completed by two years of age.

Parameters for each immunization variable were defined using three levels: 1) obtained on time, properly spaced; 2) obtained by age two years, but not properly spaced; 3) not obtained by age two years. This was done to allow analysis of each series of immunization to determine if any differences exist between immunizations.

Proper Spacing of Doses. Criteria for properly spaced doses, according to the ACIP and AAP, were defined as follows: the first DTP dose must be given on or after 42 days (six weeks) of age; the second and third doses given after a minimal interval of 28days. The fourth dose must be given at least 184 days after the third dose. A child who

received the fourth DTP at 12 to 18 months (plus or minus 30 days) will be categorized as correct spacing. For OPV, the first dose must be given on or after 42 days (six weeks) of age; the second and third doses each given after a minimum of 42 days from the last dose. The third OPV was considered to be correctly spaced if it is 42 days after the second and received at six to 18 months (plus or minus 30 days). Any MMR given on or after the first birthday but before, or at 15 months (plus 30 days), was defined as being properly spaced (Ambrose, 1995). The first Hib must be given on or after 42 days (six weeks) of age; the second and third doses each given after a minimum interval of 42 days from the last dose. The fourth Hib must be given 42 days after the third dose and between 12 and 15 months (plus or minus 30 days) to be properly spaced (CDC, 1995a). When information on the month and year were available but not the date, the 15th was designated as the date (Zell et al., 1994).

Immunization records at the MCHD are updated with immunization dates of series given at other facilities if the information can be verified by the provider over the phone or in writing. However, if immunization records contained information on the fourth DTP, third OPV, first MMR, and fourth Hib, but did not have data on preceding immunizations, it was classified as either adequate or inadequate care based on the date the immunization was obtained relative to the date of birth. Any other immunization for which there was no date was deemed not obtained and reflected as inadequate care. This assumed the later immunizations would not have been given without evidence of prior immunization; however, they may not have been obtained at the MCHD and MCHD records had not been updated. No conclusions were able to be drawn in these cases regarding the spacing of prior immunizations.

Race. Race was operationally defined in this study by the Muskegon County Health Department policy for entering information into the computer database. The classification of race accepted by the computer database was broken into eight categories: white, black, Asian/Pacific Islands, American Indian/Alaskan Native, Hispanic, no

response, unknown, and other. The selection of which category to place clients was done by the desk clerk who entered the information into the computer. There was no paper work for the client's parent to fill out in this clinic so there was no self-selection of categories.

Data Collection Procedure

Immunization data sheets of the children who received immunizations through the clinic at the MCHD with birth dates between 1/1/93 through 5/1/94 and whose immunization records were entered into the MCHD database were requested. In addition to the immunization data, date of birth, sex, race, and insurance information were requested. The computer program which was used to obtain the data from the health department records was not available to this researcher.

The immunization records themselves were used as the collection instrument. Each record was assigned a case number in sequential order starting with one.

Statistical Analysis of Data

Data analysis was done with the SPSS statistical software package. Frequency, percentage, mean, and cross tabulation with chi square statistics were used, as appropriate, to describe the study results. The sample was described using demographic information including date of birth, gender, race, and type of insurance.

Analysis of the data included the following:

1. Percent of records sampled which indicated complete care, adequate care, and inadequate care for children by age two for all immunizations.
2. Percent of records sampled which indicated complete care, adequate care, and inadequate care for children by age two for each series of immunization.
3. Percent of records which indicated complete care, adequate care, and inadequate care for the subsequent series of immunization if the first series was complete.

4. Mean number of days from date of birth to date of starting immunizations and between subsequent immunizations for those children receiving adequate and inadequate care.
5. Percent of records sampled which indicated adequate care and inadequate care in the proper spacing for all immunizations.
6. Percent of sample receiving complete, adequate, and inadequate care for all immunizations by race.

Cross tabulation with chi-square analysis for question six was performed to determine any statistically significant differences. The level of significance was established at 0.05.

Missing immunization data were reported as inadequate care for all series combined and each individual series at age two years. This was done because if a record was missing immunization data, it resulted in the incomplete receipt of all recommended immunizations before age two years. In assessing the adequacy level for individual immunizations, percent missing data was included to avoid inflating values.

Study Limitations

Three limitations can be found in this study. First, the sample used was from a public health care clinic in an urban/suburban/rural setting which may not be representative of the population of the county and state. Also, data were limited to records of children who received their immunizations at the public health clinic. The immunization status of the sample of records of children who receive their immunizations at the MCHD may be different from the immunization status of the state and county population. Therefore, discussion of the results of this study must be limited to the specific sample and may not be generalizable to the county and state populations as a whole. Second, the parental and provider barriers to immunizing these children as recommended were not available. Thus, conclusions about the reasons behind the immunization coverage levels are beyond the scope of this study. Finally, data were

obtained from the Health Department computer records only; no attempt was made to fill in the missing data or verify records of the immunizations received by other providers which were entered by the health department staff. This was also beyond the scope of this study.

Study Assumptions

The assumptions identified by Ambrose (1995) were also utilized for the purpose of this study:

1. Immunizations against childhood disease are reasonably safe and effective.
2. The immunization schedule recommended by the Advisory Committee on Immunization Practices, the American Academy of Pediatrics, and the American Academy of Family practice is a valid standard for prevention of some childhood illnesses.
3. High vaccination coverage levels in the general population benefit the children immunized and the population in the United States as a whole by decreasing the risk of morbidity and mortality associated with these preventable diseases.
4. The data that was recorded at the MCHD was accurate.
5. Those seeking immunizations at a public health clinic are primarily people with public health insurance, those without insurance, or those who have insurance that does not cover the cost of immunizations.

Protection of Human Rights

The rights of the individuals from whom immunization records were utilized in this study were protected in accordance with the guidelines developed by the University Committee on Research Involving Human Subjects (UCRIHS) at Michigan State University. Approval was obtained from this committee before gathering the data (See Appendix A).

Verbal permission was obtained from the Health Director and Deputy Health Director at the Muskegon County Health Department to collect data. Written permission

was obtained before initiating data collection (See Appendix B). No data was used which could identify individuals in the study. Once the immunizations records were obtained they were assigned an arbitrary number beginning with one. No names, addresses, or other identifying information were removed from the health department. All data were entered into the SPSS database by this investigator. Confidentiality of the information was maintained.

Results

Description of Sample

The sample consisted of 101 records of immunization from the Muskegon County Health Department (MCHD) clinic. As illustrated in Table 1, the majority of the sample consistent with gender distribution for Muskegon County and the State of Michigan but not with racial distribution due to the high missing/unknown data in this category (MLHS, 1995).

The years of birth included in the study were 1993 and 1994 with the majority of the sample (73.2%) from 1993 due to the limitation of the inclusion criteria of birth dates through 5-1-94. The sample was fairly evenly distributed between the months with April, 1993 containing the highest number of records (10%, $\underline{n} = 10$). Insurance information was listed on only three of the records and this information was missing in the remainder of the sample ($\underline{n} = 98$). Physician Health Plan and Blue Care Network were the only insurance companies identified in the sample.

Answers to Research Questions

The five research questions presented in this study were based upon the concern that children under two years of age are at highest risk for morbidity and mortality of preventable diseases if they do not receive their vaccinations. The outcome in this study was measured by level of care received with respect to the immunizations obtained by two years of age: complete, adequate, or inadequate care.

Table 1

Sociodemographic Characteristics of Sample (n = 101)

Characteristic	Frequency	Percent
Gender:		
Female	56	55.4
Male	44	43.6
Missing data	1	1.0
Race:		
White	53	52.5
Unknown	22	21.8
Black	19	18.8
Hispanic	2	2.0
Other	2	2.0
American Indian	1	1.0
Missing data	2	2.0
Insurance:		
Physician Health Plan	2	2.0
Blue Care Network	1	1.0
Missing data	98	97.0

Question 1. What percentage of children from the Muskegon County Health Department obtained complete care, adequate care, or inadequate care with respect to all immunizations by age two years as recommended by the ACIP, AAP, and AAFP?

The percentage of children receiving complete care was 6.9% (n = 7); adequate care, 28.7% (n = 29); and inadequate care, 64.4% (n = 65) (Not listed in a table). This sample obtained an adequate coverage level by age two of only 28.7% and when combined with the complete care results, coverage of receiving all immunizations by age two for the entire sample was only 35.6%.

A notable result for the percentage of subjects with complete care was that four of the seven children (57%) who received all their immunizations as recommended had dates of birth in 1994. As stated earlier, the percentage of birth dates in 1994 was only 26.7% of the entire sample.

Question 2. For each series of immunizations, what percentage of children received complete care, adequate care, and inadequate care?

For each series of immunizations, the percentage of children who received complete, adequate, or inadequate care is listed in Table 2. The percentages of complete care ranged from 8.9% (n = 9) for the DTP series to 34.7% (n = 35) for the MMR series. The level of adequate care ranged from 27.7% (n = 28) for the MMR series to 38.6% (n = 39) for the OPV series.

Table 2

Frequency and Percent of Adequacy of Care for Each Immunization Series (n = 101)

Immunization Series	Adequacy of Care	Frequency	Percent
DTP	Complete	9	8.9
	Adequate	31	30.7
	Inadequate	61	60.4
Hib	Complete	11	10.9
	Adequate	32	31.7
	Inadequate	58	57.4
MMR	Complete	35	34.7
	Adequate	28	27.7
	Inadequate	38	37.6
OPV	Complete	26	25.7
	Adequate	39	38.6
	Inadequate	36	35.6

Sixty-four percent of the sample received the OPV series as either complete care (25.7%) or adequate care (38.6%). The majority of subjects received the recommended number of OPV and MMR vaccines by age two (64.3% and 62.4%, respectively). The DTP and Hib series percentages, however, were only 39.6% and 42.6%, respectively, for children having received all immunizations within each series by age two.

Question 3. What patterns of immunization are evident for those children receiving adequate or inadequate care with respect to initiation of immunizations and the spacing of those immunizations by age two years?

Table 3 reports the findings for each individual immunization. Several patterns were noted for the DTP, Hib, and OPV vaccinations, where more than one immunization is recommended. First, the coverage rates of subjects in this study ranged from 60% to 66% for the first DTP, Hib, and OPV vaccinations received according to the recommended schedule. Secondly, with each subsequent immunization, coverage rates dropped, especially between the third and fourth DTP and Hib immunizations. The decreasing rates paralleled the other immunizations, particularly the first three DTP and Hib, and the OPV series. The decline was the greatest between the third and fourth DTP immunizations where the rate of immunizations received before age two dropped 37 percentage points between DTP3 and DTP4. Also, the number of missing data, indicating a missed vaccination, increased with each subsequent immunization. The number of missing data ranged from 25 to 48 for OPV3, DTP4, and Hib4. The percent of missing data was incorporated in the evaluation of percents to avoid misinterpretation of inflated values due to the decrease in frequency of receipt of vaccinations.

A surprising result was the increase of 32.8 percentage points in the rate of complete care between OPV2 and OPV3. However, the percentage of adequate care dropped dramatically and overall, the rate of all immunizations received before age two (complete and adequate care percentages combined) decreased between OPV2 and OPV3 by 12 percentage points.

Table 3

Frequency and Percent of Adequacy Level for Individual Immunizations (n = 101)

Immunization	Adequacy Level	Frequency	Percent
DTP1	By ACIP	66	65.3
	By 2 years	32	31.7
	> 2 years	2	2.0
	Missing	1	1.0
DTP2	By ACIP	37	36.6
	By 2 years	51	50.5
	> 2 years	3	3.0
	Missing	10	9.9
DTP3	By ACIP	27	26.7
	By 2 years	50	49.5
	> 2 years	5	5.0
	Missing	19	18.8
DTP4	By ACIP	25	24.8
	By 2 years	15	14.9
	> 2 years	17	16.8
	Missing	44	43.6
Hib1	By ACIP	61	60.4
	By 2 years	34	33.7
	> 2 years	3	3.0
	Missing	3	3.0
Hib2	By ACIP	35	34.7
	By 2 years	51	50.5
	> 2 years	1	1.0
	Missing	14	13.9
Hib3	By ACIP	25	24.8
	By 2 years	46	45.5
	> 2 years	4	4.0
	Missing	26	25.7

Table 3 (cont'd).

Hib4	By ACIP	25	24.8
	By 2 years	19	18.8
	> 2 years	9	8.9
	Missing	48	47.5
MMR	By ACIP	35	34.7
	By 2 years	28	27.7
	> 2 years	15	14.8
	Missing	23	22.8
OPV1	By ACIP	67	66.3
	By 2 years	31	30.7
	> 2 years	2	2.0
	Missing	1	1.0
OPV2	By ACIP	38	37.6
	By 2 years	51	50.5
	> 2 years	2	2.0
	Missing	10	9.9
OPV3	By ACIP	60	59.4
	By 2 years	5	5.0
	> 2 years	11	10.9
	Missing	25	24.8

These results support that the continued morbidity and mortality of preventable diseases is due, in part, to a failure to adequately immunize children at an early age. Also, a low percentage of children begin their immunizations on schedule with a decreasing number accomplishing even adequate coverage for any of the subsequent individual immunizations.

Question 4. For the subset of children who received complete care for the first set of immunizations, what is the percentage of complete, adequate, and inadequate care for subsequent immunizations?

Sixty children (59.4%) in the sample received complete care for the first DTP, Hib and OPV given at two months of age. Table 4 reports the findings for the percentages of

level of adequacy for the each series and all immunizations by age two for the subsets of subjects having received the first set of immunizations at two months of age according to the recommended schedule and those who received the first set after two months of age.

The 59.4% of infants who received their first immunizations on-time were two to three times as likely to have received each series before age two and two-and-a-half times as likely to be up to date (48.4% versus 17.1%) at 24 months than the 40.6% of infants who were delayed in receiving their first set of immunizations at two months of age. The

Table 4

Frequency and Percent of Adequacy Level for the Subset of Subjects who Received Complete Care for the First Set of Immunizations

Immunization Series	Adequacy Level	First Set at 2 months (n = 60)		First Set > 2 months (n = 41)	
		n	%	n	%
All Series	Complete	7	11.7	0	0
	Adequate	22	36.7	7	17.1
	Inadequate	31	51.7	34	82.9
DTP	Complete	9	15.0	0	0
	Adequate	22	36.7	9	22.0
	Inadequate	29	48.3	32	78.0
Hib	Complete	11	18.3	0	0
	Adequate	25	41.7	7	17.1
	Inadequate	24	40.0	34	82.9
MMR	Complete	25	41.7	10	24.4
	Adequate	14	23.3	14	34.1
	Inadequate	21	35.0	17	41.5
OPV	Complete	23	38.3	3	7.3
	Adequate	21	35.0	18	43.9
	Inadequate	16	26.7	20	48.8

one exception was the MMR series which had a difference of 17.3 percentage points for complete care between the two subsets and a higher adequate level for children who did not begin their immunizations on time. The overall coverage for immunizations before age two was about equal with inadequate care levels of 35% and 41.5% for the MMR series. Overall, starting immunizations on time yielded an increased percentage of children having received complete and adequate care at two years of age.

Question 5. What are the differences by race in the percentage of complete, adequate, and inadequate care for all immunizations?

The cross tabulation and chi-square analysis of the adequacy of care for all series of immunizations by race is illustrated in Table 5. As reflected in the overall sample, only a small percent of subjects received complete care. When separated by race, five of the 53 white subjects (9.5%) received all immunizations according to the recommended schedule, as compared with one of the 24 non-white subjects (4.2%). The percentage of

Table 5

Cross Tabulation of Adequacy of Care for All Immunization Series by Race (n = 77)

Care Level	Race	
	White	Non-white
Complete		
Frequency	5	1
Percent	9.5	4.2
Adequate		
Frequency	18	8
Percent	33.8	33.3
Inadequate		
Frequency	30	15
Percent	56.7	62.5

χ^2 (df 2, n = 77) = 0.688, $p > 0.05$

adequate care was essentially even for the white and non-white subjects (33.8% and 33.3%, respectively). The level of inadequate care, however, was unequal with 62.5% of the non-white sample and 56.7% of the white sample not having received all their immunizations by age two. The differences in the levels of care were not statistically significant. This could be due to the small numbers for the non-white subjects.

Discussion

The major findings of this study were that immunization levels in this population of MCHD clinic patients were low overall with only about one-third (35.6%) of the children up-to-date by their second birthday, far below the national goal of 90% immunized by age two. Even worse, only 7% of the children received all of the immunizations at the age appropriate periods. The results of this study are consistent with other documented studies in that the immunization coverage rates of the studies in the literature review did not meet the 90% goal.

The percentage of adequate care in this study was lower than what was reported by the CDC (1996) in the National Immunization Survey (NIS) for the 4:3:1:3 series within the state of Michigan (59%). The NIS did not report county data but did report the coverage rate of 49% for the city of Detroit (CDC, 1996); this percentage for the city of Detroit falls closest to the level of coverage found in the current study. Further, the rates for complete and adequate care in this study fall within the ranges found by Zell et al. (1994) of 11 to 58% coverage for adequate care and 5 to 20% coverage for complete care. Salsberry et al. (1994) also found a low rate of adequate care (31%). It is difficult to compare results of the current study with those found in the literature because of the many differences in the population sampled. The only study found with similar sociodemographic information was the NIS which was done for the state of Michigan (CDC, 1996).

The Ambrose (1995) study was similar to the current research since it was done with health department records. The Ambrose study found no cases with complete care

but had an overall higher rate of adequate care (45%) than this study (28.7%). This difference in rates of complete and adequate care may have been due to a computation error found in the Ambrose study when the current study data analysis was completed. The limitation of assessment of the sociodemographic information due to missing data and small race numbers was consistent in both studies.

There are many reasons for the results obtained in this study. One main limitation to this study which could be reflected in the results is the lack of ability to track the children. A number of the cases which received inadequate care had missing data which could have been due to parents taking their children to another provider for the completion of the immunization series. Thus, these children would have received all their immunizations but within this study there was no means of tracking them to validate this possibility without direct contact of the child's parent. There was no system in which this researcher could have determined which records were incomplete for this reason and so all eligible records were included in the study.

Data records provide no insight into the barriers for childhood immunizations. Problems with inadequate and inaccurate data entry creates an inherent weakness in a records audit such as in this study. Also, according to Murphy et al. (1995), "clinic audits are most reliable when the population is stable and attends a single clinic (p.565)." The MCHD has recognized the inadequacies in their computer data system and are currently setting up a county-wide database to track the immunization records of children even if they receive vaccinations at an alternate provider. This new database should improve the accuracy of the records and improve the ability to assess this level of care for the children in Muskegon County.

The barriers for children not receiving immunizations have been well documented in the literature and include cost, lack of insurance coverage for preventive care such as immunizations, missed opportunities, and limited access to health care such as transportation or restricted clinic hours (CDC, 1994b; Salsberry, Nickel, & Mitch, 1993,

1995).Barriers specific to parental attitudes, cultural beliefs, knowledge, and misunderstandings regarding immunizations can affect receipt of vaccinations for children. Parental attitudes and misunderstandings of the prevalence and severity of the communicable diseases for which children can be immunized can play a large role in the receipt of immunizations. For instance, if parents believe that their children will not catch these diseases, or that they will not be very ill if they do contract the disease, parents are more likely not to obtain their children's recommended immunizations. Also, cultural beliefs regarding religious and health promotion practices of health care can positively or negatively affect immunization rates. Barriers to adequate care can also be due to the provider and include missed opportunities, lack of knowledge regarding true contraindications of administering the vaccination, and not keeping up with current changes in the recommended schedule (Kefelas, 1993; Lyznicki & Rinaldi, 1994).

Within Muskegon County, the community from which the data for this study was obtained, some barriers can be addressed which are specific to this urban/suburban/rural population. Muskegon County has large inner-city and rural populations which are, in general, economically depressed. This low socioeconomic status creates unique problems in accessing health care including immunizations. Parental barriers which can be identified as the most relevant to this community include lack of insurance which leads to out-of-pocket costs for health care and limited access to health care, especially transportation to primary care clinics.

All the previously listed barriers could apply to clients seeking immunizations at the MCHD. Additional barriers specific to a public health clinic could affect the level of adequate care found at the MCHD immunization clinic. The first of these is the necessity of two visits for the parents and children; one to obtain well-child care at the primary care provider's office and the second to receive immunizations at the health department. In addition to limited access problems, forcing families to make two health care appointments four or five times in the first two years of life could decrease the rate of

immunization coverage (Bobo et al., 1993; Salsberry et al., 1994). Secondly, the facility is located in Muskegon township, making it less accessible to the city and rural residents of the county. As mentioned previously, outreach clinics are organized to minimize this limitation. Lastly, there are often long waiting periods to receive immunizations at the clinic and a stigma attributed to families who obtain services at the health department and, therefore, parents are often hesitant to seek out services at a health department.

Media coverage and the increase in government programs and money toward increasing immunization rates for two year olds in the past three years could be a reason for the result of a greater percentage of children having received complete care with birth dates in 1994 over 1993 (CDC, 1994a; Osguthorpe & Morgan, 1995; Robinson et al., 1994). Perhaps parents are becoming more aware of the recommendations and benefits regarding immunizations. The recent findings of low coverage rates by the NIS (CDC, 1996) have instigated a flurry of campaigns and media coverage to increase public awareness of this problem. It will be interesting to observe if the immunization coverage rates for two-year-old children in 1998 increase due to this national attention.

The rates for complete and adequate care vary widely for the individual series of immunizations. The DTP and Hib series reflect the same coverage rates for complete, adequate, and inadequate care. This may be due to similar recommended schedules for each series. The OPV series has the highest level of adequate care (38.6%) and immunizations received before age two (62.3%). This series has the greatest amount of flexibility in the recommended schedule, especially for OPV3 which has a recommended range of six to 18 months. This wide range for complete care is a reason the OPV series had the highest level of adequate care. Also notable is that each series has a higher rate of adequate care than complete care except the MMR series. The MMR is a single vaccination before age two, has a range of three months (12 to 15 months of age) to be considered on-time, and is usually given at 12 months of age which is also a common age

to have a well-child visit. These three factors could result in the high level of complete care for this series.

The low rates of complete care found in this study are of particular concern since the greatest benefit from the DTP and Hib vaccines is achieved when each series is completed in the first six months of life as recommended (Mustin et al., 1994). These low numbers are reflected in the rapidly decreasing rates of adequate care shown for each individual vaccination. The drop in immunization coverage starts early in infancy with 40% not starting their vaccinations on time and less than 30% having received complete care by their third DTP and Hib. This decrease in the proportion of infants who receive immunizations on time may reflect a combination of parental and provider barriers discussed earlier and restrictions of the recommended schedule such as that the first three immunizations are scheduled close together and may be difficult to catch up a child who has started their immunizations late (Guyer et al., 1994).

The largest decrease in the rate of adequate care is between the third and fourth doses of DTP and Hib vaccines. This is consistent with other studies which found that when the fourth dose of DTP was excluded from the analyses, coverage levels improved (Bobo et al., 1993; Zell et al., 1994). This decrease in coverage levels can be attributed to difficulties in administering the fourth DTP and Hib, misconceptions regarding approved simultaneous administration of MMR, DTP, and Hib vaccinations at 12 months of age (CDC, 1995b), and large amount of time in the recommended schedule between the third doses at six months and the fourth at 12 months which could cause the parents to forget that the children are due at this time.

As noted earlier, timely receipt of the initial doses of DTP, Hib, and OPV were associated with a higher appropriate vaccination rate at 2 years. This finding is consistent with other studies although the percentage of impact varied with each study. Fielding et al. (1994) found that of 50.6% of children who received their first DTP late were fully immunized at 2 years compared with 72.2% of those who received the first DTP dose as

recommended at 2 months. Bobo et al. (1993) found that a delay in the receipt of the first set of immunizations was associated with more than a twofold difference in rates (30% versus 70%) for receiving all immunizations by age two. This association could be due to many factors. Perhaps parents who obtain their children's first set of vaccinations on time are less likely to have barriers to immunizations or limited access to the health care system which would also affect subsequent receipt of immunizations. Also, parental knowledge of the importance of vaccinations and immunization schedules could affect timely initiation and proper scheduling of vaccinations (Fielding et al., 1994). Thus, initial immunization delay provides an important predictor of lower immunization status at two years of age.

Race has been shown in the literature to be a predictor of immunization status with non-white children having lower rates of immunization coverage at two years of age (Fielding et al., 1994; Lieu et al., 1994; Mustin et al., 1994). This research study found no statistically significant difference in the rates of complete, adequate, and inadequate care for the white versus non-white subjects. These findings do not follow the results of the majority of the literature but this may be due to the small numbers of non-white subjects ($\underline{n} = 24$) and the number of missing or 'race unknown' data ($\underline{n} = 24$). Race is not a totally definable demographic statistic such as gender or age and thus increases the difficulty in interpretation of the results. This is a limitation within this study due to the responsibility of the health department employees in classifying the clients into a race category. These employees must be inserviced on the importance of filling in this information on each record and inquiring of the parents the appropriate category for their child.

Discussion of Results with the Theoretical Framework

The results from this study support the adapted theoretical framework from Starfield (1974, 1992) of evaluation of primary care through measurement of adequacy of care. The immunization status of two year old children is the outcome in the Starfield

model when applied to this study. This desired outcome of adequacy of care related to immunization status was shown to be an accurate predictor in a primary care setting of the health status of a child. The findings of low immunization status within this study reflects that the health status of two year old children is compromised due to risk of contracting preventable communicable diseases. The interaction of the structural components of immunization records from the MCHD, the process or receipt of immunizations, and the social and physical environment of race, gender, age, and insurance status of the subjects helped to determine the outcome of low immunization status at two years of age.

The reasons behind these findings, as discussed in the previous section, can be applied to the Starfield Model through classification within the components of structure, process, and social and physical environment which influence the outcome of immunization status. Examples of this include limited access to the public health clinic due to restricted hours and location which, in the Starfield Model, are characteristics of the structure component. Also, missed opportunities by parents and providers can negatively impact a child's immunization status and is classified in Starfield as a characteristic of the process component.

Implications for Advanced Practice Nursing in Primary Care

This study was designed to discover the level of adequacy of care through analysis of immunization rates for two year old children who received their immunizations at a public health clinic. The major findings of this study include: 1) low immunization rates for this sample which fell well below the national expected goal of 90% and 2) higher rates of complete and adequate care associated with starting immunizations on time per the recommended schedule.

Many implications for the advanced practice nurse (APN) arise from these major study findings. Specifically these include educational, research, and clinical measures to increase immunization status for two year old children. Preschool children remain at high

risk for preventable diseases when they are underimmunized as shown in this study. The APN in primary care has the opportunity to impact this inadequate state of care through education, research, and practice.

Lack of education has been cited many times in the literature as reasons for the low rates of immunization coverage found throughout the country (Bobo et al., 1994; Salsberry et al., 1994). This lack of education encompasses parents, providers, communities, and the national government. The APN in primary care can impact this aspect of underimmunization because if education can be identified as a problem, then education can also be a solution.

Education of parents can begin prenatally with the introduction of immunization practices and benefits at meetings between expectant parents who are interviewing potential APN providers for care of their newborn. Collaboration between prenatal care providers and the APN in primary care can enhance the learning experience of the parents through the dissemination of consistent and reliable information to every family. The importance of immunizations for children age two and under can also be addressed after birth with a postpartum visit from the APN in the hospital during maternal discharge or infant assessments for discharge, to discuss early care of the infant including the timing of immunizations and well-child care visits. At this time, two week and two month well-child visits can be scheduled with the APN to increase the rate of children receiving their first immunizations on time at two months which, as shown in the findings of this study, can increase the chance of receiving all immunizations by age two.

After birth the APN must involve parents in health promotion and illness prevention interventions for their child(ren). Immunization of children under the age of two is one of these interventions. Involvement in the child's care includes educating the parents on the risks, benefits, and side effects of each immunization. Discussions would also include dissemination of current research, the importance of beginning immunizations on time to increase the rate of receiving all immunizations by age two and decrease the

morbidity associated with these diseases, and a copy of the current recommended schedule. All together, this information allows the parents to make knowledgeable decisions regarding illness prevention health practices for their child. The APN can use the opportunity of each contact with the families to continuously reinforce and educate parents regarding proper timing of immunizations and their importance in preventing disease in young children.

In addition to education of parents regarding the cost-effectiveness of on-time vaccinations and the risks of morbidity and mortality associated with undervaccination, the APN must assess parental beliefs and attitudes toward immunization to specifically address individual parents' concerns. The unique relationship established between the APN in primary care and the child and his/her family can support communication of these parental concerns and help to dispel incorrect attitudes or beliefs regarding immunizations. Also, concrete approaches to education could be used by the APN to impress upon parents the severity of the problem of undervaccination. One example of a concrete application of education is a monetary incentive program when a child obtains all recommended immunizations before age two. The APN could locate local sources for these incentives from area businesses or non-profit organizations such as March of Dimes or United Way.

In addition to education of parents to increase immunization rates, education of primary care practice staff and providers can also help to increase vaccination coverage rates for the health care system. Dissemination of current immunization research by the APN to other providers and the office or clinic staff will keep everyone involved in the child's care aware of the most recent information. This education would include inservices on the current changes in the recommended immunization schedule, true contraindications for administration of immunizations to decrease missed opportunities, and current standards of immunization practices. Also, since installation of a reminder system for upcoming immunization appointments and recall messages to families after

missed appointments has been shown to have positive results on immunization coverage rates (Grabowsky & Marcuse, 1996), this information could be utilized by the primary care practice to increase the rate of children who receive their vaccinations by age two.

Discussion and education regarding the implications of this study on managed care environments must be addressed by the APN since immunization status of clients is included as a component of provider evaluation in the 'report card' distributed by managed care companies. As clients are assigned primary care providers within the managed care environment, it will be the responsibility of this provider to ensure that clients are properly immunized. Managed care environments can decrease fragmentation of care, increase use of case management, and promote use of a tracking system with reminder cards. These three aspects of managed care can help to increase immunization status through identification of 'at risk' client such as those who do not begin their immunizations on time.

Communities can be educated by the APN on the benefits to society of high immunization rates. These benefits include lower health care costs and a decrease in the morbidity and mortality associated with totally preventable diseases. The APN can access community educational programs of church groups, school health education programs, parenting classes, and prenatal classes to disseminate this information. Also, it has been well documented that high risk groups for inadequate immunization coverage include low income, underinsured, and single parent families (Bates et al., 1994; Bobo et al., 1993). These findings would encourage the APN to access community programs which are designed for low income families and teenage mothers such as Women, Infant, and Children (WIC) supplemental food program centers and teenage prenatal classes.

Local publicity programs can be instituted with funding from area businesses to increase the awareness in the APN's community. Recently in Muskegon, the MCHD cooperated with area McDonalds restaurants to disseminate information regarding the dangers of lead poisoning by creating placemats on the food trays which had pictures and

facts about lead hazards. This same idea of teaching through local businesses could be applied to immunization education which would increase the community's awareness of the need for vaccinations and the dangers of underimmunizing their children. A concern regarding this approach is the need for continuity of care. The education should focus on the importance of receiving all immunizations by age two to increase immunization rates and decrease the morbidity and mortality for this at-risk age group.

A last area for education by the APN is the national government. It is important for the APN in primary care to inform local, state, and national governments of research findings regarding factors which have been found to positively or negatively impact immunization coverage rates such as beginning immunizations on time to increase coverage rates at two years of age. This information will help to increase government awareness of the risks of the current low immunization status of two year old children and to also increase funding and programs which can improve these numbers.

One program which has been proven to increase immunization rates in other countries is a national tracking system for health care (Preventive Health Care, 1992). These systems enter the child's information from the birth certificate into a database and are designed to assure continuing participation of the infant in one or more systems of health care throughout childhood. Nearly all infants in the United States are registered with official agencies after birth when birth certificates are filed (Preventive Health Care, 1992). However, there is no system of tracking these children for appropriate health care till they enter the educational system unless they are associated with a primary care provider who assumes this case managing responsibility. The APN can educate government officials on the benefits of this system and assist in development of legislation which supports policies and programs such as this which increase immunization coverage rates.

A second measure which the APN can utilize to increase the level of adequate care for children under age two is that of research. As mentioned previously, through

dissemination of research findings of current immunization coverage rates and reasons behind these numbers the APN will help to increase personal and public awareness of the importance of maintaining adequate care for children under age two. Also, the APN can use research findings to guide his/her practices in the primary care setting regarding immunizations. Many research findings, such as the drastic decrease in level of adequate care of individual vaccines over the first 18 months of life or recent changes in the recommended immunization schedule, can alert the APN to the importance of following children through tracking and reminder systems to increase coverage rates.

The importance of following the coverage rates for two year old children at state or local levels has been shown throughout the literature (Bobo et al., 1993; Zell et al., 1994). However, assessment at city and individual practice levels is also important because coverage levels found for large geographic areas can hide local areas and populations which are underimmunized and at high risk for outbreaks of vaccine-preventable diseases (Zell et al., 1994). APNs in primary practice can calculate their own clinic's childhood immunization rate to obtain an awareness of immunization barriers which are specific to the clinic and to potentially increase the level of care. One example of potential barriers to increasing immunization rates is a study which evaluated missed opportunities and found that high rates of well-child visits in a practice are not always associated with high rates of immunization coverage (Grabowsky & Marcuse, 1996). This finding in a clinic setting could impact the APNs policy toward assessment of immunization status at each visit and administration of vaccinations to increase coverage rates. Chapman and Hacker (1995) report on a family practice office which evaluated the coverage levels of two year old children who attend the clinic. These authors report the immunization rates found and state that calculation of a clinic's immunization rate can be easy and have modest costs.

Clinical measures is the final area through which the APN can impact the level of care for two year old children. As providers of pediatric primary care, APNs assess the

need for immunization; plan the schedule for the child's vaccinations and, if needed, utilize the minimum spacing of immunizations to 'catch up' a child who is not on time; directly or indirectly administer the vaccine; and document administration. APNs can raise immunization coverage levels among their patients through utilization of all appropriate opportunities for vaccination, giving patients all vaccines for which they are eligible, and awareness and use of only valid contraindication for administration. Assessment of a child's immunization status at each visit, regardless of the reason the parent is seeking care, can increase level of care. Also, the APN can increase the rates of immunization coverage for his/her patients through institution of a tracking system to identify children at higher risk for underimmunization such as children who begin their immunizations late. Lastly, use of appropriate standards for immunization practices can assure that the APN will continue to provide adequate levels of care for two year old children.

Recommendations for Further Research

This investigation revealed several possibilities for future research. First is the need to find an adequate system of assessment to measure two year old immunization rates. As identified in the literature review, parental recall is a frequently used assessment technique which is often inaccurate or incomplete and clinic audits, such as the current study, assess only a small segment of the community. This limitation of assessment techniques encourages a need to develop an accurate system to monitor trends in immunization coverage. In addition, continued analysis of immunization status of two year old children is needed to track movement toward the year 2000 goal of 90% immunization coverage.

A second recommendation for future research is the assessment of not only the coverage rates but also concurrent assessment of perceived parental and provider barriers. This research could help the APN understand how and why children receive their immunizations late and off schedule. For example, for the children who received their first

immunization on time, what was the reason for delayed receipt of the subsequent immunizations?

The addition of several steps to the current research could have revealed more information for the MCHD immunization clinic data. First, follow-up of records with missing information would increase the reliability of the results of this study. Determination of whether the missing data was due to receipt of the vaccine at another site could be done by contacting the parents to verify this data and also access any other immunization records. Verification of missing data could also be done through other providers to confirm immunization status. The implementation of a county wide immunization database as discussed previously will also help to increase the reliability of the data since, eventually, all pediatric providers in the county will have access to this computer system to update immunization records. Secondly, additional information, such as coverage rates divided by race and percent coverage for 2, 4, 6, 12, 15, and 18 months of age could reveal new implications and interventions for the APN.

Lastly, use of a larger, more diverse sample could improve the reliability and generalizability of this study. A larger sample would help to more accurately determine any statistical differences in immunization rates for race, insurance status, and economic status as found in other studies.

Summary

This study assessed the adequacy of care for children under two years of age through immunization coverage rates. The levels of complete, adequate, and inadequate care were evaluated for a sample of records of children from the Muskegon County Health Department immunization clinic. The level of complete care within this study was only 6.9%; adequate care, 28.7%; and inadequate care, 64.4%. The findings of this study support other studies that current immunization rates fall well below the Healthy People 2000 goal of 90% coverage. Specifically, this study identified that the subset of children who received their first immunizations at two months were twice as likely to receive all

immunizations by age two. There was no significant difference in level of adequate care for white and non-white groups.

The findings of this study will assist the APN in improving the immunization coverage rates for children under age two through education of parents, communities, and government; dissemination of research and periodic assessment of coverage levels; and clinical application of the research findings in practice. Increasing the coverage rates of immunization for two year old children is important to decrease the morbidity and mortality associated with totally preventable diseases. Prevention of health care problems in early childhood can benefit a child for a lifetime, and failure to prevent such problems can be costly to the child, the child's family, and the Nation.

APPENDICES

APPENDIX A

UCRIHS Approval

APPENDIX A

UCRIHS Approval

MICHIGAN STATE
UNIVERSITY

May 17, 1996

TO: Patricia Jurcich
105 Harmony Lane
Muskegon, MI 49445

RE:

IRB#:	96-354
TITLE:	ADEQUACY OF IMMUNIZATION FOR CHILDREN BY AGE TWO YEARS
REVISION REQUESTED:	N/A
CATEGORY:	1-E
APPROVAL DATE:	05/17/96

The University Committee on Research Involving Human Subjects'(UCRIHS) review of this project is complete. I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the UCRIHS approved this project and any revisions listed above.

RENEWAL: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Investigators planning to continue a project beyond one year must use the green renewal form (enclosed with the original approval letter or when a project is renewed) to seek updated certification. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for complete review.

REVISIONS: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB # and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

PROBLEMS/ CHANGES: Should either of the following arise during the course of the work, investigators must notify UCRIHS promptly: (1) problems (unexpected side effects, complaints, etc.) involving human subjects or (2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of any future help, please do not hesitate to contact us at (517)355-2180 or FAX (517)432-1171.

Sincerely,

David E. Wright, Ph.D.
UCRIHS Chair

DEW:bed

cc: Rachel F. Schiffman

OFFICE OF
RESEARCH
AND
GRADUATE
STUDIES

University Committee on Research Involving Human Subjects (UCRIHS)
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APPENDIX B

Muskegon County Health Department Approval

APPENDIX B

Muskegon County Health Department Approval

MUSKEGON COUNTY
MICHIGAN

1611 E. OAK AVENUE, MUSKEGON, MICHIGAN 49442 • 616-724-6311
FAX 616-724-6674
HEALTH DEPARTMENT

June 10, 1996

Patricia Jurcich, RN
105 Harmony Lane
Muskegon, MI 49445

Dear Patricia:

This letter confirms approval of your request to use Muskegon County Health Department immunization record data in your graduate research project. Please submit your request for data to Pat Burke, Microcomputer Analyst.

If you have any questions, please contact me at 724-1212.

Sincerely,

Kenneth A. Kraus, M.P.A.
Deputy Health Officer

pf

c: Pat Burke

REFERENCES

REFERENCES

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