Measurement of Physiologic Health for Children

Urinary Tract Infection

Betsy Foxman, John V. Zielske, Caren J. Kamberg, Kathleen N. Lohr, George A. Goldberg, Robert H. Brook
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Volume 6: Urinary Tract Infection

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September 1986

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PREFACE

The Rand Health Insurance Experiment (HIE), funded by a grant from the U.S. Department of Health and Human Services, is a large-scale social experiment designed to assess how varying a patient's cost of health services affects his or her use of services, quality of care, patient satisfaction, and health status. It is also designed to study how the provision of services in either the fee-for-service system or a prepaid group practice affects those same variables. This monograph describes the health status measurement methods and the enrollment results of the child health portion of the experiment with respect to urinary tract infection. The final outcomes of the study will be reported in separate publications.

A total of 7706 people in 2756 families were enrolled in the experiment in six sites across the United States: Dayton, Ohio; Seattle, Washington; Fitchburg, Massachusetts; Franklin County, Massachusetts; Charleston, South Carolina; and Georgetown County, South Carolina. The sites were chosen to represent the four census regions of the country and an urban-rural mix, and to reflect variation in the amount of stress on the ambulatory medical care system (in terms of long or short delay for new and return appointments).

Families were enrolled in the HIE for either three or five years (approximately 70 and 30 percent, respectively). Low-income families were oversampled. Eligibility for participation in the HIE was broad; ineligible persons were mainly heads of households 61 years of age and older at the time of enrollment, members of the military, people confined to various institutions, and people eligible for Medicare. When families were enrolled, they agreed to assign their own health insurance benefits (if they were previously covered) to the HIE for the duration of their enrollment. Their policies were kept in force so that the families could return to them at the end of their participation. For persons who had not been previously insured, a policy was purchased during the HIE; it was assumable by the family at the end of the experiment.

The families were assigned to one of several health insurance plans that differed either in the amount of cost sharing required each year or in the system from which medical services were obtained. For this

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1 The experimental design for estimating the effects of insurance on the demand for medical or dental care was first described by Newhouse (1974a, b) and most recently by Newhouse et al. (1981). The structure of the experiment as it relates to covered services and rules of operation can be found in Clasquin and Brown (1977).
purpose, an unbiased allocation model (described in Morris, 1979) was used to ensure that the assortment of families in each plan closely resembled that in every other plan in terms of 24 different demographic and socioeconomic variables. The 16 experimental plans were as follows:

- One plan in which care was free to the family (i.e., 0-percent coinsurance).
- Three plans with 25-percent coinsurance on all services (i.e., the family paid 25 percent of its medical bills).
- Three plans with 50-percent coinsurance for dental and outpatient mental health services and 25-percent coinsurance for all other services (the “25/50” plans).
- Three plans with 50-percent coinsurance on all services.
- Three plans with 95-percent coinsurance on all services (which approximates an income-related catastrophic insurance plan).
- One plan with 95-percent coinsurance on outpatient medical or dental expenditures up to a maximum out-of-pocket expenditure of $150 per individual ($450 per family) per year and no coinsurance above that; all inpatient care was free on this plan, which is referred to as the “individual deductible” plan.
- One plan that assigned some Seattle participants to a prepaid medical group practice, Group Health Cooperative of Puget Sound, or GHC. Families were reimbursed 5 percent (95-percent coinsurance) for services acquired outside the GHC that were available (with no cost sharing) at the GHC.
- An additional plan (a control group) that consisted of a random sample of people who were already members of the GHC at the time the HIE began in Seattle and who also met HIE eligibility requirements.

All plans except the first one and the last three had a ceiling on annual out-of-pocket expenditures by the family amounting to 5, 10, or 15 percent of annual family income. This maximum dollar expenditure (MDE) per year per family was $1000 for the 50- and 95-percent coinsurance plans ($750 for the 25-percent plans in some sites and years). All plans had an identical, very comprehensive benefits package that covered all ambulatory and inpatient medical care, preventive services, all dental restorative and preventive services except orthodontia, prescription drugs, certain over-the-counter drugs, most supplies and durable medical equipment, psychiatric and psychological services, and almost all other personal medical services, including those delivered by chiropractors and Christian Science healers.
During the HIE, data were collected on demographic and socioeconomic variables, health status, use of health services, satisfaction with and attitudes toward health care, and types of providers seen. The sources of data included baseline interviews before enrollment, parent-completed Medical History Questionnaires, medical screening examinations, and claims submitted (chiefly by providers) for reimbursement for services rendered.

Comprehensive assessment of each child’s health status occurred upon enrolling and leaving the experiment. In addition, certain health data were collected annually during the enrollment period. As noted, a major HIE objective is to assess the effects of varying the cost of health services on the health status of individuals sampled from a general population. To this end, reliable, valid, and understandable measures were specially developed or adapted to enable us to detect small but meaningful changes in the health status of enrollees.

HIE enrollment began in 1974, and the enrollment period ended for the last site in 1982. Enrollment data concerning health status in all six sites are available and reported herein. Complete longitudinal (experimental) data have not been published as of this writing.

This report series (R-2898-HHS) accompanies Rand report R-2262-HHS, which has the series title Conceptualization and Measurement of Physiologic Health for Adults. The volumes that constitute R-2262-HHS cover a wide variety of diseases and organ system defects, such as eyesight and hearing problems, cardiovascular and bronchopulmonary diseases (e.g., hypertension, chronic obstructive pulmonary disease), and surgery-related conditions (e.g., hernia, varicose veins). The R-2898-HHS series includes diverse conditions as well, such as middle ear disease, convulsive disorders, and anemia. These and other disorders (see the list at the end of the Preface) are all used to measure physiologic health, one of several conceptually distinct dimensions of health status defined for the HIE.

These disease-specific volumes detail the suitability of these conditions as health status measures for the HIE, discuss important measurement issues, describe HIE techniques for determining the prevalence and personal impact of the conditions, give HIE enrollment results, and outline the disease-specific criteria for quality-of-care analyses for the HIE. The present volumes report on enrollees aged 13 years and younger. They follow the general outline of the adult health status series (R-2262-HHS).

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2Smith et al. (1978) give a detailed description of all aspects of tests and procedures carried out in the enrollment and exit screening examination.
Three other dimensions of health status—physical, mental, and social health—have been defined for the HIE, as has an integrative measure—general health perceptions. These measures were initially described in the eight volumes of R-1987-HEW, which has the series title *Conceptualization and Measurement of Health for Adults in the Health Insurance Study*. More recent treatments of these health concepts can be found in R-2551-HHS, *Construction and Scoring of Aggregate Functional Status Indexes* (Vols. I and II); R-2737-HHS, *Refinements in the Measurement of Mental Health for Adults in the Health Insurance Study*; R-2937-HHS, *The Quantification of Social Contacts and Resources*; and R-2711-HHS, *Measuring Health Perceptions in the Health Insurance Experiment*. Measurement of these same health status dimensions for children and youths (i.e., enrollees under age 14) was discussed in R-2313-HEW, *Conceptualization and Measurement of Health for Children in the Health Insurance Study*.

### DISEASES AND CONDITIONS FOR HEALTH STATUS AND QUALITY-OF-CARE MEASUREMENT

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SUMMARY

INTRODUCTION AND DEFINITION

The Rand Health Insurance Experiment (HIE) will use data on the presence and adverse impact of urinary tract infection (UTI) to investigate the effects of differing levels of health insurance on the health status of and quality of care for children. UTI was selected as an appropriate indicator for several reasons: (1) It is a relatively common condition, especially among girls; (2) it is easy to diagnose and responds to treatment in most cases; and (3) it has potentially serious complications.

A urinary tract infection is characterized by the presence and growth of bacteria anywhere in the kidneys, their collecting systems, or the bladder. Infection is most commonly confined to the bladder (cystitis), but sometimes it may spread to the kidneys, resulting in the far more serious condition of pyelonephritis. In defining the disease, researchers and clinicians often make other distinctions, such as whether the disease is symptomatic or asymptomatic, whether it is recurrent or an isolated episode, and whether the condition is complicated by a mechanical obstruction to urinary drainage (stone, tumor, or stricture of the ureters).

Most authorities consider one laboratory culture with 100,000 organisms per ml or greater in the presence of symptoms to be diagnostic for UTI, and two or three consecutive cultures showing greater than 100,000 organisms (of the same species and strain of bacteria) in the absence of symptoms to be indicative of infection. Neither of these definitional criteria is easily met within the HIE context. Moreover, UTI is primarily an acute disease. It appears and disappears, often regardless of treatment and often without overt symptoms. Whereas it is relatively easy to find evidence of the presence of a chronic disease such as hypertension once the disease has been diagnosed, there are no practical tests to confirm the existence of UTIs that have occurred in the past.
PREVALENCE AND EFFECT OF THE DISEASE

Urinary tract infection is a common condition in the infant and pediatric age groups. After infancy, UTI is much more common among girls than boys. Population surveys have found the point prevalence of UTI among school-age girls to be between 1 and 2 percent; among boys the figure is about 0.03 percent.

The immediate symptoms of UTI are quite distressing to the patient and interfere with social and educational activities. Infection may also have the more serious sequelae of scarring and growth retardation of the kidneys. UTI is fairly easy to diagnose and treat, however, making it an appropriate condition for evaluating the effects on health status of different levels of health insurance.

HEALTH INSURANCE EXPERIMENT METHODS

At enrollment, the HIE used two data sources to estimate the prevalence of urinary tract infection and related conditions among children under 14 years of age. First, we used a self-administered questionnaire to gather information on whether the child had ever had a urinary tract infection, how many times, and if infection was currently present; on visits to a physician for UTI; and on treatments prescribed and used. This Medical History Questionnaire (MHQ) was completed by a parent (usually the mother) about any child 13 years of age or younger.

Second, we administered a medical screening examination at enrollment to all children from a random sample of families. A midstream urine specimen was collected from all girls six years of age and older. Urine specimens were cultured at the screening examination site with the Isocult (R) system (a dipslide culturing system). This report concerns only enrollment results.

A child is defined as having a UTI during the HIE if at least one of the following conditions is met: (1) a positive response to the MHQ question, “Does this child currently have a kidney, bladder, or urinary infection?”, (2) a urine culture of at least 100,000 colonies bacteria per ml urine at the enrollment or exit screening examination, or (3) a diagnosis of UTI on at least two insurance claim forms. Because these categories are not mutually exclusive, the prevalence of UTI is reported separately for each definition.

Adverse effects of UTI are measured by three questions on the MHQ about recent worry on the part of the parent about the child’s UTI and about the child’s pain, activity restriction, and days in bed attributed to UTI. Generally, the hypotheses are that if more generous health insurance results in more or higher-quality medical care, then
the various adverse effects of infection should be lower for persons with such insurance than for those with less generous insurance.

HEALTH INSURANCE EXPERIMENT RESULTS

Among the 2663 children who had a completed enrollment MHQ, 27 (3 percent) of the boys and 104 (13 percent) of the girls ages 5–13 reported a history of UTI. Most of the UTIs had occurred more than a year before the questionnaire: only two boys and 14 girls reported experiencing an infection within the past six months.

Of the 479 urine cultures performed among girls 6–13, 14 (2.9 percent) had a positive urine culture.1 An additional five girls claimed to have a current infection or to be taking prescription pills for UTI; their cultures, however, were negative. If these five are considered cases under treatment, then the point prevalence of UTI based on one positive culture or a claim of current therapy is 4.0 percent (19/479).

Disease impact from UTIs was minimal. Most of the children who had ever had a UTI reported no pain (87 percent), worry (85 percent), or restricted activity (92 percent) during the past three months; most did not report any days in bed during the past 30 days (95 percent).

QUALITY OF CARE

Quality of care for urinary tract infection will be assessed in a later publication by criteria that outline good medical outcomes and processes. The data used to evaluate quality are from the MHQ and the screening examination administered at enrollment and exit and from insurance claim forms submitted during the experiment. Good processes of care include the use of appropriate antibiotics, urine cultures, microscopic urinalysis, and appropriate followup care. Good outcomes of care include none or only a little morbidity or disability (pain, worry, activity restriction, or days in bed) attributed to the condition.

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1It was administratively impossible to recall the 14 girls with positive cultures for repeat culturing; thus, there is no way to know how many would have been confirmed on a second or third culture.
ACKNOWLEDGMENTS

The authors thank Calvin M. Kunin of Ohio State University for a thoughtful and constructive review of this monograph. Appreciation is also expressed to Joseph Newhouse for advice and useful contributions to the work reported here. Finally, we thank Barbara Eubank-Thurston for her efforts in bringing this manuscript into final form.
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Chapter 1

INTRODUCTION

The Rand Health Insurance Experiment (HIE) will use data on the prevalence and adverse impact of urinary tract infection (UTI) to investigate the effects of differing levels of health insurance on the health status of and quality of care for children. UTI was selected as an appropriate indicator for several reasons: (1) It is a relatively common condition, especially among girls; (2) it is easy to diagnose and responds to treatment in most cases; and (3) it has potentially serious complications.

Chapter 2 presents the HIE conceptualization of UTI in children and reviews pertinent measurement and diagnostic issues. Chapter 3 discusses the suitability of UTI as a measure of the health status of and quality of care for children in terms of its prevalence, associated morbidity, and response to medical care. Chapter 4 describes the HIE methods for determining the presence of UTI and for assessing the effect of this disorder for HIE participants. The experiment's results from enrollment procedures only are presented in Chapter 5 for all six HIE sites (Dayton, Ohio; Seattle, Washington; Fitchburg and Franklin County, Massachusetts; Charleston and Georgetown County, South Carolina). Finally, Chapter 6 introduces the quality-of-care criteria for UTI in children.

Readers are referred to the Preface for more information regarding the design of the HIE and the overall strategy to measure disease-specific effects on health as a function of the level of health insurance. The companion series (R-2262-HHS) includes a volume on UTI in adults (Zielske et al., 1981).
Chapter 2

DEFINITION AND MEASUREMENT ISSUES

Urinary tract infection is a general term describing the presence of significant numbers of bacteria somewhere in the urinary tract. The infection can be confined to the bladder, as in the case of uncomplicated cystitis, but retrograde spread of the infection up the ureters to the kidneys is not uncommon. Infections of the kidney itself (pyelonephritis) are sometimes referred to as upper urinary tract infections to distinguish them from lower urinary tract (bladder) infections. Relapses (defined as infections with the same strain as initially isolated) are distinguished from reinfections (defined as new infections with different strains). Urinary tract infection is also sometimes referred to as bacteriuria.

The offending organisms in childhood urinary tract infections are the same as those in adults, namely, bacteria found in the normal gastrointestinal tract. The Enterobacteriaceae are the most frequent, especially Eschericia Coli. Although the large number of strains of E. Coli responsible for urinary tract infections can be typed, serotyping is not available except in special reference laboratories.

Although the classic symptoms of UTI are frequent urination, an urgent need to urinate, painful urination, and flank pain, these symptoms are often not present when infants and young children are affected. For example, infants may have only unexplained fever, irritability, or failure to thrive, and fewer than half of older children presenting with pyelonephritis may have specific symptoms (McCoy, 1982; Todd, 1982; Turner, 1982).

Because of the nonspecificity of UTI symptoms, an accurate urine culture is necessary to diagnose UTI in a child. This, in turn necessitates an uncontaminated urine specimen (bacteria from the perineum and vagina often contaminate the specimen). However, even among adults, a clean catch midstream urine specimen is difficult to obtain. Suprapubic aspiration of the bladder (removal of urine from the bladder by inserting a hypodermic needle in the bladder through the abdominal wall) or catheterization (insertion of a tube into the bladder from the urethra) eliminate external complications, but they are less acceptable to the patient, especially children.

1In this method, the area around the urethra is cleaned and the initial part of urine flow is discarded. The “midstream” portion of urine is collected for examination.
Classically, the laboratory diagnosis of urinary tract infection is accomplished by culturing the specimen by either the pour plate method or the calibrated loop streak method (Kunin, 1979). (The pour plate method is used primarily by research laboratories.) In either case, the specimen is diluted and grown on two types of media—one nonselective and the other favoring the growth of gram negative organisms, the most common offenders. Most contaminating organisms will grow only on the nonselective media, whereas the pathogenic organisms will grow on both media. This method allows the technician to assess the degree of contamination of the culture. The culture plates are incubated for 24–48 hours and the number of bacterial colonies are counted to determine the approximate number of bacteria per ml in the original specimen. Zielske et al. (1981) describe other commercial methods for examining urine (e.g., dip slides, dip spoons).

When screening for UTI, a colony count indicating greater than 100,000 organisms per ml is considered evidence of infection (Kunin, 1979). When urinary symptoms are present counts greater than 100 per ml have been shown to be a sensitive and specific diagnostic criterion (Stamm et al., 1982).

The danger of making a false diagnosis on the basis of just one positive culture, especially in the absence of clearcut symptoms, was demonstrated by Kunin et al. (1964), who used the stringent criterion of three cultures. In Kunin’s first survey (1960–1961), there was a 7.1 percent rate of positive urine cultures on the first test; only 1.1 percent of the sample was confirmed as having urinary tract infection by three consecutive positive cultures. In the 1962–1963 survey, 2.4 percent of the girls were positive on the first test and 0.9 percent were confirmed by three consecutive positive cultures. Similarly, another study of five-year-old girls (Savage et al., 1973) found that although 3.9 to 6.3 percent of the girls had a positive culture on the first specimen, this reduced to a prevalence of 1.2 to 2.1 percent using the criterion of three consecutive positive cultures. Some authorities accept two consecutive or two out of three positive cultures as evidence of “covert bacteriuria,” the preferred terminology for bacteriuria uncovered in the screening of presumably healthy populations (Medical Research Council, 1979).
Chapter 3

JUSTIFICATION FOR SELECTING URINARY TRACT INFECTION FOR HEALTH INSURANCE EXPERIMENT ANALYSES

GENERAL CONSIDERATIONS

As noted in Chapter 1, we selected UTI for intensive investigation of the health status of children in the HIE for several reasons. First, UTI is fairly common among children, especially among girls. Moreover, it has potentially serious complications. Finally, it is easy to diagnose and responds to treatment in most cases. These topics are taken up in turn in the remainder of this chapter.

PREVALENCE

The incidence of UTI is greater in male (vs. female) infants in the few weeks immediately after birth. These are primarily cases of blood-borne pyelonephritis (infection by the blood to the kidneys by the blood from other parts of the body) (Marks, 1981). The higher male-to-female incidence accords with the greater morbidity and mortality from all infectious diseases and the higher number of congenital anomalies in males (Fox, 1981). Readers are referred to the specialized literature on neonatology (Marks, 1981; Schaffer and Avery, 1977) for a detailed discussion of UTIs in the newborn.

Beyond the neonatal period, a striking reversal of the sex-specific incidence of urinary tract infections occurs. In one prospective study, the ratio of infections among girls compared to boys was 0.4 in the first month of life but 1.5 in the second to sixth months (Winberg et al, 1975). By age two, girls were ten times as likely as boys to have a UTI.

Kunin, in his widely reported long-term study of bacteriuria in schoolage children, found an initial point prevalence of 0.03 percent in boys and 0.97 percent in girls in the first through third grades. (No further study was performed in boys because of the extremely low prevalence.) In girls, repeated studies over a ten-year period disclosed a
cumulative prevalence of 4.8 percent (Kunin, 1971). In a later article
drawing on his own further investigations, Kunin claims that 1 to 2
percent of schoolage girls have a urinary tract infection at any one
point in time (Kunin, 1976). Savage et al. (1973) found a similar point
prevalence of bacteriuria in five-year-old schoolgirls (ranging from 1.2
to 2.1 percent) in a study carried out in 1967 to 1970 in Dundee, Scot-
land. By rescreening one cohort for two consecutive years, they found
an annual incidence of 0.9 percent.

The cumulative probability of a girl's acquiring bacteriuria, either
covered or symptomatic, during her school years is between 5 and 10
percent (Rapkin, 1977). Some studies show a markedly increased
chance of acquiring bacteriuria after menarche, but this may reflect a
greater contamination rate of the specimens rather than a higher rate
of infection (Savage et al., 1975).

Data available from the National Center for Health Statistics
(NCHS) indicate the magnitude of the problem of urinary tract infec-
tions and their impact on the population. For example, in the 1975
National Ambulatory Medical Care Survey (NCHS, 1978), diseases of
the genitourinary system (ICDA codes 580–629) accounted for nearly
1.8 million out of a total of 99 million visits (1.8 percent) made by per-
sons under the age of 15. Many of these were undoubtedly for urinary
tract infection.

Cystitis, if uncomplicated, is rarely an indication for hospital ad-
mission. Therefore, figures on hospital discharges are considered indicative of complicated or unusual cases of this disease. In a survey of
inpatient utilization of short-stay hospitals, patients under 15 years of
age with a principal diagnosis of kidney infection accounted for 6000
discharges (0.2 percent of all discharges for patients of that age group);
the corresponding figures for cystitis are 10,000 discharges (0.3 percent)
(NCHS, 1982). This is equivalent to a rate of inpatient discharges for
the population ages 15 years or under of 1.2 and 2.0 per 10,000, respec-
tively. The average hospital lengths of stay for patients under 15 years
of age were 5.7 days for kidney infection and 3.0 days for cystitis
(NCHS, 1982). These figures exclude newborn infants and therefore
do not address the incidence of neonatal pyelonephritis.

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As noted above, in diagnosing urinary tract infection, Kunin used the quite stringent
criterion of three or more consecutive positive cultures containing greater than 100,000
organisms per ml of the same species and serotype.
MORBIDITY AND MORTALITY

Urinary tract infections in children are prognostically quite different from those in adults and demand close medical scrutiny. A significant percentage of children experiencing UTIs have underlying congenital abnormalities of the urinary tract that predispose them to repeated infections and quite possibly to serious kidney damage. Even short of these problems, UTIs can interfere with educational and social activities.

Although the immediate symptoms of urinary tract infection may be quite distressing to the patient or his or her family and may interfere considerably with daily activities, clinicians are far more concerned about the long-term prognosis. In the past, experts feared that repeated UTIs in children could lead to endstage renal disease requiring transplantation or maintenance dialysis. These fears were fueled in part by observations that an alarmingly large percentage of children presenting with UTIs have radiographically demonstrable abnormalities of the urinary tract including ureteral reflux,\(^2\) scarring, and growth retardation of the kidneys. From 30 to 70 percent of girls being evaluated for recurrent, symptomatic urinary tract infections, and 19 to 35 percent of schoolage girls with asymptomatic bacteriuria, have ureteral reflux; smaller percentages have evidence of scarring and damage to the kidney (Kunin, 1971; Savage et al., 1973; Retik, 1974). Such abnormalities are rare in children with no history of urinary tract infection.

EFFECTS OF MEDICAL CARE

General Considerations

Medical intervention in childhood urinary tract infection has two aims: first, to reduce or eliminate the pain, worry, and restriction of activity that interfere with social and educational development; second, to prevent the occurrence of permanent, irreversible renal damage. Although prompt treatment of uncomplicated infections minimizes those immediate effects such as pain, inconvenience, and restriction of activity and can prevent possible complications such as pyelonephritis, it is to the approximately 5 percent of the girls presenting with urinary tract infections who have a significant underlying abnormality that medical care has the most to offer.

\(^2\)An abnormality that is due to a malfunction of the closing mechanism of the ureter as it enters the bladder (Kunin, 1979).
For the purposes of evaluating the effects of medical care, children with urinary tract infections can be divided into three categories. First, the group of girls presenting with urinary tract infections who have no radiographically demonstrable abnormalities of the urinary tract is easily treated with the usual 7–14 days course of antibiotic therapy. Among young girls with recurrent or chronic bacteriuria, a single successful course of short-term antibiotic therapy may move 20 percent into permanent long-term remission (Fair et al., 1974; Kunin, 1971; Kunin, 1976). The second group includes girls presenting with urinary tract infections and minimal-to-moderate radiographic abnormalities of the urinary tract. Evidence indicates that these abnormalities usually disappear spontaneously and will not result in decreased renal function. This group deserves close medical followup, but surgery to correct the abnormalities is usually not indicated. The third group presents with urinary tract infections and moderate-to-severe abnormalities on radiographic examination. Most authorities agree with a decision for surgical intervention for this group (Fair et al., 1974; Kunin, 1971; Kunin, 1976; Govan, 1974).

**Short-Term Antibiotic Therapy**

As in adults, childhood urinary tract infections are easily treated with a short course of antibiotics. Sulfa drugs are a common choice because of their effectiveness against gram-negative organisms, the most common offenders. A few antibiotics such as tetracycline should not be used in young children because of a high likelihood of adverse effects—in this case, dental discoloration.

After the first infection in a young boy and after the first or second in a young girl (depending upon which authority is consulted), a full radiologic study of the urinary tract, including both an intravenous pyelogram (IVP) and a voiding cystourethrogram is justified. (Some authorities argue that because a girl with urinary tract infection has a high likelihood of acquiring further infections, a full evaluation should be done after the first occurrence (Asscher, 1977; Abramowicz, 1977; Kunin, 1976); others (e.g., King, 1984) maintain that infants of either sex should have a cystogram and an IVP after the first infection, but that radiologic studies can be deferred in older girls in whom an uncomplicated first infection responds promptly to therapy.) If the radiologic study is normal, repeat studies are almost never indicated inasmuch as they will almost certainly fail to disclose any abnormality.
Prophylactic Antibiotic Therapy

Long-term prophylactic antibiotic\(^3\) therapy has been recommended by some authorities for those girls suffering repeated, closely spaced infections but for whom surgical intervention is not indicated. However, there are a number of theoretical and practical problems with this approach.

First, the most common source of urinary pathogens is the bowel flora. Long-term antibiotic prophylaxis may alter the antibiotic sensitivity pattern of the bowel flora, selecting for resistant bacterial strains before a reinfection actually occurs. When a reinfection does occur, a more potent antibiotic may be required to treat it. Asscher (1977) makes this point and recommends the use of drugs that are absorbed high up in the small bowel such as nitrofurantoin or drugs such as cephalixin that can be used in such low dosage that no alteration of the gastrointestinal bacteria will result. Treatment with organic acids such as hexamine mandelate may also be instituted because bacterial resistance to these agents is unknown.

In addition, investigators do not always agree on the benefits of long-term prophylactic antibiotic therapy. Some (e.g., Savage et al., 1975) have found it a failure, whereas others report successful reduction in the number of reinfections (Smellie et al., 1978; Stamm et al., 1980). Asscher and Lindberg report that antibiotic therapy of covert infection is frequently followed by symptomatic reinfection by a different organism (Asscher et al., 1969; Lindberg et al., 1975; Lindberg, 1975).

Part of the controversy surrounding the efficacy of prophylactic antibiotic therapy stems, no doubt, from the much-neglected problem of parental cooperation. A study by Daschner and Marget (1975) demonstrated a dismal level of compliance by parents and children with the antibiotic regimen prescribed. Only 32 percent of the study group took the prescribed drug at regular intervals, 19 percent did not take the antibiotic at all, and the remainder took the drug irregularly. Not surprisingly, the group of children taking the drug irregularly had a significantly lower rate of infections per year during the two-year followup than those who did not take them at all, and the children taking the drug regularly experienced the lowest rate of infections, significantly lower than among the group taking the drug irregularly.

Much of the enthusiasm for prophylactic antibiotic therapy, radiologic evaluation, and surgical correction of radiographically diagnosed abnormalities stems from the now-discredited notion that children who

\(^3\) In the context of this report, antibiotic is used to refer to any antimicrobial drug, whether of natural, semisynthetic, or totally synthetic origin.
suffer repeated episodes of urinary tract infection are likely to end up with serious renal disease. One study claimed that 40 percent of children with endstage renal failure presented with chronic pyelonephritis (Asscher, 1974). More recent and thorough studies place the figures in the range of 12 to 14 percent and in most of these patients the endstage renal disease developed not from the effect of repeated urinary tract infections alone, but rather from the effect of infections superimposed upon severe obstructive, congenital, or neurologic lesions (Kunin, 1974). It is now generally accepted that girls with recurrent urinary tract infections per se do not end up with endstage renal disease and that renal damage, unless it is very severe, does not cause hypertension (Kunin, 1974; Gillenwater et al., 1979).

Surgical Therapy for Those with Urinary Tract Reflux

The presence of severe reflux predisposes the young girl with urinary tract infection to renal scarring and damage. In the past, surgical repair of all grades of reflux was advocated; however, more recent investigations indicate that surgery can be avoided in many nonsevere cases for at least two reasons (Govan, 1974). First, mild-to-moderate reflux tends to disappear spontaneously; second, treatment with antibiotics coupled with close medical supervision results in an outcome as good as could be achieved by surgical intervention.

SUMMARY

Urinary tract infection is a common condition in the infant and pediatric age groups. After infancy, UTI is much more common among girls than boys. The immediate symptoms of UTI are quite distressing to the patient and interfere with social and educational activities. Infection may also have the more serious sequelae of scarring and growth retardation of the kidneys. UTI is fairly easy to diagnose and treat, making it an appropriate condition for evaluating the effects of different levels of health insurance on health status.
Chapter 4

HEALTH INSURANCE EXPERIMENT METHODS

For study design purposes in the HIE, we classified the nonadult population into two age groups: 0–4 years of age (i.e., infants and small children) and 5–13 years of age (i.e., older children and adolescents). Diseases and symptom complexes selected for intensive study in the HIE differed somewhat for the two age groups. Some problems were studied in both age groups and others in only one or the other, depending chiefly on whether the problem was likely to be observed (or measurable) in either or both groups.

Although including many conditions of infancy and childhood in the HIE analyses would have been desirable, several constraints limited our analyses. First, children typically are healthy individuals, and the HIE sample is by design representative of a general population. Thus, for conditions that are not widespread in a pediatric age group, our sample sizes might have been too small for reliable or valid analyses. Second, considerations of respondent burden dictated that questionnaires about children not be too lengthy. This factor arose because self-administered questionnaires about health and health-related topics for children were completed by parents (or other responsible adult proxies). Generally, this respondent was the child’s mother, and for families with more than one child, multiple questionnaires might begin to pose a substantial burden on her.¹ (Moreover, parents had their own questionnaires to complete.) Third, overall time and other resource constraints limited the extensiveness of the disease studied for the pediatric age groups. UTI was not considered sufficiently frequent and important among children younger than five to be measured in that age group. Further, because UTI is very uncommon among boys (outside of infancy), urine cultures to diagnose UTI were performed only among girls six years of age and older.

¹Because the mother was the person who most often completed the children’s Medical History Questionnaire (MHQ), we will use "she" or "her" to refer to any proxy respondent in the remainder of this monograph. Because answers to MHQ questions reflect a parent’s perception of the presence and harmful effects of illness on the child, the proxy approach unavoidably introduces some degree of error into the data and analysis. It does not necessarily introduce a systematic bias, however, because parents in different families may well differ in their assessments of symptoms or sequelae of illness. We have not tried in this monograph to evaluate the validity of parental responses relative to some definition of "truth" from the child’s point of view—that task was beyond the experiment’s means.
Two sources were used by the HIE to measure the prevalence of UTI at enrollment among its participating children under 14 years of age: the MHQ and a medical screening examination. The MHQ for each age group contained several diagnosis-specific batteries through which information was obtained about the child’s history of the particular condition, use of physician care for it, forms of treatment prescribed or used, and the adverse effects on the child’s life brought about by or attributed to the specific condition. To reduce respondent burden, these batteries were introduced by a “skip” question. If the mother answered the skip question negatively, she skipped out to the next battery in the child’s questionnaire; if she gave a positive answer, she continued on to complete the battery.

At enrollment the medical screening examination was given to a random sample of children, generally between 50 and 75 percent of all participants depending on the site.\textsuperscript{2} During the examination, a midstream urine sample was collected from all girls six years of age and older.

The remainder of the chapter describes our methods for detecting UTI by questionnaire and laboratory test, gives our definition of UTI, and discusses our ways of evaluating the deleterious effects of this ailment.

PREVALENCE

Medical History Questionnaire

Two versions of the MHQ battery are reproduced in Appendix A. One was used at enrollment in Dayton; the other was used at enrollment at all other HIE sites and at exit at all sites. Differences in the two forms are the result of minor changes in the non-Dayton form to provide better information on the timing of medical care for UTI.

The battery is introduced by the question, “Has a doctor ever said that this child had a kidney, bladder, or urine infection?” Mothers who responded “yes” continued on to complete the battery and those who responded “no” skipped out to the next disease-specific battery.
Medical Screening Examination

The second source of information used to measure the prevalence of UTI at enrollment was the urine test from the medical screening examination. A midstream urine specimen was collected from all girls six years of age and older. Smith et al. (1978) describe screening examination procedures in detail.

Urine specimens were cultured at the screening examination site with the Isocult (R) system (a dipslide culturing system); positive Isocult tubes and their corresponding preserved urines for microanalysis were then delivered to the laboratory. Growth was reported as negative (less than 100,000 organisms per ml), or positive (greater than 100,000). If growth indicated more than 100,000 organisms per ml in the sample, the organisms were identified using standard laboratory methods.

Urine specimens were also tested at the laboratory for blood, protein, and glucose using Ames Labstix (R). After centrifugation, the urinary sediment was examined microscopically for the presence of red cells, white cells, bacteria, casts, crystals, and epithelial cells.

At exit, the same general procedures were followed, except that microurinalysis was done only if the urine culture was positive. Formed elements in the urine were preserved with Stabular Tablets (R) (Cargille Laboratories) until cultures had been interpreted and the need for microanalysis had been determined.

At the screening examination the parent or guardian completed a questionnaire about the child. Included on this questionnaire were a set of questions used to identify girls who were menstruating or taking birth control pills or hormones at the time of enrollment. At the exit screening examination, this group of questions was expanded to include an item related to symptoms such as burning or pain while urinating. The questions are referred to as the exit Screening Examination Confidential Questionnaire, or SECQ.

Insurance Claim Forms

The final source of data for both incidence and prevalence of urinary tract infection in the HIE is insurance claim forms. These contain diagnoses recorded by the doctor and reasons for visit completed by the patient. The following HICDA-II (Hospital International Classification of Diseases: Adapted for Use in the United States) diagnostic codes are relevant to urinary tract infection: 590.0–590.9, especially 590.9 (kidney infection); 595.0–595.9 (cystitis); 599.5 (urinary tract infection, unspecified); 783.0–783.9 (symptoms referable to urinary
systems); and Y76.1 (positive urine culture). Reasons for visit are
coded according to the Rand symptom classification code, which is
based on the National Ambulatory Medical Care Survey code (NCHS,
1974). Procedures are coded according to the California Relative Value
Study (CMA, 1975).

No assessment of the reliability of the microscopic urinalysis,
Labstix test, or urine culture was done for enrollment screening exami-
nations. For exit examinations, split sample analysis is performed for
a randomly selected subsample of urine specimens to estimate the reli-
ability of urine cultures and of microscopic urinalysis.

Criteria for Classification

A child (5–13 years of age) is defined as having a urinary tract infec-
tion during the HIE if at least one of the following conditions is met:

1. Enrollment: A positive response to the MHQ question, “Does
this child currently have a kidney, bladder, or urinary infec-
tion?”

2. Enrollment: A urine culture of at least 100,000 colonies bacte-
ria per ml urine at the enrollment screening examination
(this test was administered only to females six years of age
and older).

3. During the HIE: Diagnosis of urinary tract infection on at
least two insurance claim forms.

4. Exit: The same definitions as were used at enrollment were
used to define persons as having a UTI at exit.

Because the criteria used to define UTI are not mutually exclusive, the
prevalence of UTI will be reported separately for each definition.

DISEASE IMPACT

The adverse effects of urinary tract infection were assessed by
several MHQ questions dealing with the amount of worry and concern
that the illness has caused the mother or other MHQ respondent, the
level of pain the child felt, the amount of time the child restricted his
or her activities owing to illness, and the number of days the child
spent most or all of the day in bed because of the condition. The first
three questions referred to the previous three months and the last to
the past 30 days.

Responses to these disease impact questions ranged from “none” to
“a great deal” or “all of the time” (or equivalent wording, depending on
the item). The question about days in bed required the mother to write either zero or the specific number of days. These questions were asked for all children whose mother had responded affirmatively to a history of UTI.

**POTENTIAL EFFECTS OF HEALTH INSURANCE**

The HIE will investigate the effects of various levels of health insurance on the incidence, prevalence, and treatment of symptomatic cystitis and pyelonephritis. Plan-specific differences in the quality of care provided to patients with *symptomatic* infections may well be observed, although the directions of those differences may be unpredictable. Compared with persons having generous health insurance, for example, those having less generous insurance may receive less care or care from less well trained physicians. Under such circumstances, they might be given a potent, dangerous antibiotic (even despite its possible greater expense) without good reason for using it in place of less risky antibiotics. Similarly, their physicians might devote less time and effort to allaying their worries about the condition.

More frequent medical care, stimulated by having generous insurance, might be associated with less frequent use of antibiotics in patients with vague complaints referable to the urinary tract if the patients' physicians perform more diagnostic tests to rule out bacterial causes and thus eliminate the need to prescribe antibiotics. Better insurance might also be associated with more appropriate selection of drugs. Finally, such insurance might be associated with lower levels of parental worry or concern, if physicians take more time to explain the condition, its probable causes, purposes of therapy, and other factors to them.

Conversely, generous health insurance, by prompting more care, may expose the patient to unnecessary (or overly powerful) antibiotics, may be excessively costly, may expose the patient to risks of unnecessary invasive diagnostic tests, or may lead to undue worry. Such outcomes could arise, for example, if the patient visits a physician more frequently, has more frequent routine urine cultures, and is treated unnecessarily for nonspecific urethritis or other conditions that might be expected to resolve spontaneously. This would be a particular problem if the patient were exhibiting no relevant symptoms. That is, generous health insurance may stimulate more frequent treatment of asymptomatic bacteriuria, which is considered a questionable practice by many experts.
As discussed in the following chapter, many of these aspects of care can be evaluated in the HIE. Data will be available, for example, on drugs prescribed and filled, on laboratory tests performed, on numbers of physician visits, and on the physician-recorded diagnoses. For parents who are aware of their child's condition at the end of the study, data will be available on how much they perceived that urinary tract infection caused pain, worry, or disability to their child or themselves.
Chapter 5

HEALTH INSURANCE EXPERIMENT
ENROLLMENT RESULTS

ANALYTIC SAMPLE

The HIE administered enrollment procedures to a total of 2712 children (0–13 years of age) in six sites. Just over 50 percent were girls, and about 15 percent were nonwhite. The average family income (in 1973–74 dollars) was about $13,000. (See the Preface for additional information about the HIE sample and enrollment population.)

As noted in Chapter 4, the pediatric MHQ was filled out for the child by a parent, typically the mother. To simplify the presentation of our results, however, we will at times in this chapter write as if the child himself or herself had completed the MHQ.

Of the 2712 children participating in the enrollment process, 2663 (98 percent) had a completed Form A of the MHQ. They included youngsters in any of the experimental HIE plans, in the Dayton control group, and in a “pre-enrollment group” in South Carolina. Of the 2712, 2523 were given Form B; in Dayton, a random sample of 184 children did not receive it. The completion rate for Form B was also 98 percent (2474 of 2523 children).

The screening examination was administered to 1651 children at the six sites. Those who received the examination represented a random sample of about 60 percent of the entire sample. Nine additional children were examined without completing Form B of the MHQ. As mentioned above, not everyone was examined at enrollment; this was deliberate, to study how participation in the screening examination affected later use of medical services.

PREVALENCE OF URINARY TRACT INFECTION

Medical History Questionnaire Results

A history of urinary tract infection was reported in 27 of the boys (3 percent) and 104 of the girls (13 percent) 5–13 years of age (see Table 1). The majority of both boys and girls with a history of UTI reported having only one episode of urinary tract infection (boys, 74 percent; girls, 50 percent). However, 14 of the girls (13 percent) reported five or more infections.
Table 1

DISTRIBUTION OF RESPONSES TO MHQ QUESTIONS ABOUT KIDNEY DISEASE AND URINARY TRACT INFECTION IN CHILDREN: PRESENCE OF CONDITION

<table>
<thead>
<tr>
<th>Question and Response</th>
<th>Boys</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
<td>Percent</td>
<td></td>
</tr>
<tr>
<td>Has a doctor ever said that this child has a kidney, bladder, or urine infection?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>27</td>
<td>3</td>
<td>104</td>
<td>13</td>
<td>131</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>836</td>
<td>96</td>
<td>714</td>
<td>86</td>
<td>1550</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>13</td>
<td>1</td>
<td>9</td>
<td>1</td>
<td>22</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>876</td>
<td>99</td>
<td>827</td>
<td>100</td>
<td>1703</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>How many times altogether?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once</td>
<td>20</td>
<td>74</td>
<td>52</td>
<td>50</td>
<td>72</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Twice</td>
<td>5</td>
<td>18</td>
<td>21</td>
<td>20</td>
<td>26</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>3 times</td>
<td>1</td>
<td>4</td>
<td>10</td>
<td>10</td>
<td>11</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>4 times</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5 or more times</td>
<td>1</td>
<td>4</td>
<td>14</td>
<td>13</td>
<td>15</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>100</td>
<td>104</td>
<td>100</td>
<td>131</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Does this child currently have a kidney, bladder, or urine infection?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>27</td>
<td>100</td>
<td>101</td>
<td>97</td>
<td>128</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>100</td>
<td>104</td>
<td>100</td>
<td>131</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

*Percentages may not sum to 100 because of rounding.

1If the respondent answered “no” to this question, he/she was instructed to skip the rest of the battery. Data are reported for the remainder of the battery only for those 27 boys and 104 girls with a “yes” response to this question.

*At Dayton, if the respondent said “no” to this question, he/she was instructed to skip the next three questions.

None of the boys and only three of the girls reported currently having a urinary tract infection at the time of enrollment (Table 1). Thus, the prevalence of UTI at enrollment as measured by the MHQ was 0.0 percent among boys and 0.4 percent among girls.

In the non-Dayton sites two boys (8 percent) and 23 girls (26 percent) with a history of infection had been prescribed pills or medicines
for a UTI in the past 12 months (Table 2). (In Dayton, questions regarding medical treatment were asked only of those reporting current infection. Because no respondents had a current UTI, all responses were missing.) Only eight children, all girls, were currently taking pills

Table 2

DISTRIBUTION OF RESPONSES TO MHQ QUESTIONS ABOUT URINARY TRACT INFECTION: USE OF MEDICAL CARE OR DRUGS

(Non-Dayton sites)*

<table>
<thead>
<tr>
<th>Question and Response</th>
<th>Boys</th>
<th></th>
<th>Girls</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>In the past 12 months, has a doctor prescribed any pills or medicines for this kind of infection?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2</td>
<td>8</td>
<td>23</td>
<td>26</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>No</td>
<td>24</td>
<td>92</td>
<td>66</td>
<td>74</td>
<td>90</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>100</td>
<td>89</td>
<td>100</td>
<td>115</td>
<td>101</td>
</tr>
<tr>
<td>Does this child currently take any pills or medicines for the infection, whether or not a doctor prescribed them?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, prescribed by doctor</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>9</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Yes, but not prescribed</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No, not taking anything</td>
<td>26</td>
<td>100</td>
<td>61</td>
<td>91</td>
<td>107</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>100</td>
<td>89</td>
<td>100</td>
<td>115</td>
<td>100</td>
</tr>
<tr>
<td>When was the last time this child saw a doctor about a kidney, bladder, or urine infection?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within past 3 months</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>10</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>3-6 months ago</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>7-12 months ago</td>
<td>2</td>
<td>8</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>More than 1 year ago</td>
<td>22</td>
<td>85</td>
<td>62</td>
<td>70</td>
<td>84</td>
<td>73</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>101</td>
<td>89</td>
<td>100</td>
<td>115</td>
<td>100</td>
</tr>
</tbody>
</table>

*A slightly different version of these questions was asked in Dayton—but only to those reporting current infection (see Appendix A). There were no nonmissing responses.

*Percentages may not sum to 100 because of rounding.
or medicines for their infection. All these drugs were doctor-prescribed.

Most of the urinary tract infections had occurred more than a year before the questionnaire (boys, 85 percent; girls, 70 percent). Only two boys (8 percent) and 14 girls (16 percent) had experienced an infection within the past six months.

In summary, only ten children had experienced a urinary tract infection during the past three months (non-Dayton) and only three currently had infection (all sites). Given the acute nature of the condition and relatively short duration of symptoms when properly treated, it is not surprising that disease impact was minimal (see Table 3). Most of the children reported no pain (87 percent), worry (85 percent), or restricted activity (92 percent) during the past three months; most did not report any days in bed during the past 30 days (95 percent).

The number of enrollees in each age group claiming a history of urinary tract infection is shown in Table 4. For the girls, the percentage reporting a previous urinary tract infection varied from a high of 16.0 percent for the six-year-olds to a low of 9.9 percent for the 13-year-olds. For the boys, the corresponding figures ranged between a high of 5.2 percent for the 13-year-olds to a low of 1.1 percent for the seven-year-olds. Although the preponderance of females is in accord with the results of other investigators, the cumulative history of urinary tract infection does not rise with age. This may be due to the respondents’ tendency to forget information about events occurring long before they filled out the MHQ.

Screening Examination Findings

Of children ages 5-13 enrolled in the HIE, 1141 attended the screening examination (594 boys and 547 girls). Only 491 girls ages six and above were scheduled to receive a urine culture. The results of 479 cultures were reported by the laboratory (the remaining 12 were lost, not done, or not reported).

Of the 479 urine cultures successfully performed, 198 showed some growth, but only 14 of this group had growth indicative of more than 100,000 organisms per ml. The species of the infecting organism was identified in these 14 cases. Five of them were *E. Coli*, the most common offender in urinary tract infections. Seven cultures showed *Staphylococcus epidermidis* when the organisms were identified, and the remaining two cultures showed *Entrobacter agglomerans* in one, and *Proteus mirabilis* in the other. All of the 14 girls with a positive urine culture had denied a previous history of urinary tract infection on the MHQ and thus skipped out of the UTI battery. It was
Table 3
DISTRIBUTION OF RESPONSES TO MHQ QUESTIONS ABOUT DISEASE IMPACT

<table>
<thead>
<tr>
<th>Question and Response</th>
<th>Boys</th>
<th></th>
<th>Girls</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>During the past 3 months, how much pain or distress has this child's kidney, bladder, or urine infection caused him or her?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>27</td>
<td>100</td>
<td>87</td>
<td>84</td>
<td>114</td>
<td>87</td>
</tr>
<tr>
<td>A little</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Some</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>A great deal</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>100</td>
<td>104</td>
<td>101</td>
<td>131</td>
<td>100</td>
</tr>
<tr>
<td>During the past 3 months, how much has this child's kidney, bladder, or urine infection worried or concerned you?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>26</td>
<td>96</td>
<td>85</td>
<td>82</td>
<td>111</td>
<td>85</td>
</tr>
<tr>
<td>A little</td>
<td>1</td>
<td>4</td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Somewhat</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>A great deal</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>100</td>
<td>104</td>
<td>101</td>
<td>131</td>
<td>100</td>
</tr>
<tr>
<td>During the past 3 months, how much of the time has a kidney or urine infection kept this child from doing the kinds of things that other children that age do?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None of the time</td>
<td>27</td>
<td>100</td>
<td>94</td>
<td>90</td>
<td>121</td>
<td>92</td>
</tr>
<tr>
<td>A little of the time</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Some of the time</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Most of the time</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>All of the time</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>100</td>
<td>104</td>
<td>100</td>
<td>131</td>
<td>101</td>
</tr>
<tr>
<td>During the past 30 days, how many days has a kidney, bladder, or urine infection kept this child in bed all of most of the day?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>27</td>
<td>100</td>
<td>98</td>
<td>94</td>
<td>125</td>
<td>95</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>100</td>
<td>104</td>
<td>100</td>
<td>131</td>
<td>101</td>
</tr>
</tbody>
</table>

*Percentages may not sum to 100 because of rounding.
Table 4

NUMBER AND PERCENTAGE OF ENROLLEES REPORTING A HISTORY OF URINARY TRACT INFECTION ON THE MHQ*, PER 100 PERSONS, BY AGE AND SEX, FOR CHILDREN AGES 5–13

<table>
<thead>
<tr>
<th>Age (in years)</th>
<th>Boys</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases per Sample</td>
<td>Rate</td>
<td>Cases per Sample</td>
<td>Rate</td>
<td>Cases per Sample</td>
<td>Rate</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3/88</td>
<td>3.4</td>
<td>11/79</td>
<td>13.9</td>
<td>14/167</td>
<td>8.4</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>3/101</td>
<td>3.0</td>
<td>15/94</td>
<td>16.0</td>
<td>18/195</td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1/93</td>
<td>1.1</td>
<td>11/95</td>
<td>11.6</td>
<td>12/188</td>
<td>6.4</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>4/90</td>
<td>4.4</td>
<td>11/89</td>
<td>12.4</td>
<td>15/179</td>
<td>8.4</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>3/89</td>
<td>3.4</td>
<td>12/91</td>
<td>13.2</td>
<td>15/180</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3/91</td>
<td>3.3</td>
<td>11/77</td>
<td>14.3</td>
<td>14/168</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>2/102</td>
<td>2.0</td>
<td>11/109</td>
<td>10.1</td>
<td>13/211</td>
<td>6.2</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>3/112</td>
<td>2.7</td>
<td>13/93</td>
<td>14.0</td>
<td>16/206</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>5/97</td>
<td>5.2</td>
<td>9/91</td>
<td>9.9</td>
<td>14/188</td>
<td>7.4</td>
<td></td>
</tr>
<tr>
<td>5–13</td>
<td>27/863</td>
<td>3.1</td>
<td>104/818</td>
<td>12.7</td>
<td>131/1681</td>
<td>7.8</td>
<td></td>
</tr>
</tbody>
</table>

*Based on the response to the question, "Has this child ever had a kidney, bladder, or urine infection?" (Dayton site), or, "Has a doctor ever said this child had a kidney, bladder, or urine infection?" (non-Dayton sites).

Administratively impossible to recall the 14 enrollees with positive cultures for repeat culturing, and there is thus no way to know how many of them would have been confirmed on a second or third culture. The sample of 479 girls who had a urine culture performed included five of the eight girls claiming to have a current infection on the MHQ Form B or to be taking prescription pills for urinary tract infection. (All of the five cultures were negative.) If these five enrollees are considered cases under treatment, then the estimate of the point prevalences of urinary tract infection at the time of enrollment in the HIE based on one positive culture or a claim of current therapy is 19/479, or 4.0 percent.
HISTORY OF URINARY TRACT INFECTION BY HIE INSURANCE PLAN

Table 5 shows the distribution of children with a history of urinary tract infection among the HIE experimental insurance plans. The 16 plans, described in more detail in the Preface, have been grouped into four fee-for-service plans in the six sites, based on the levels of coinsurance or maximum deductible expenditure, and two prepaid group practice plans (Group Health Cooperative of Puget Sound, or GHC, in Seattle, Washington). Only the 1477 children assigned to one of the HIE plans and who could be classified as to the presence or absence of history of infection (i.e., those who answered the initial question in the MHQ battery) are included in the analysis.1

Table 5

<table>
<thead>
<tr>
<th>HIE Experimental Insurance Plan</th>
<th>Number of Children Classifiable</th>
<th>Number of Children with Disease</th>
<th>Percent with Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fee-for-service (all sites)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free care</td>
<td>363</td>
<td>25</td>
<td>6.9</td>
</tr>
<tr>
<td>25- or 50-percent coinsurance</td>
<td>292</td>
<td>23</td>
<td>7.9</td>
</tr>
<tr>
<td>95-percent coinsurance</td>
<td>211</td>
<td>14</td>
<td>6.6</td>
</tr>
<tr>
<td>Individual/family deductible</td>
<td>236</td>
<td>14</td>
<td>5.9</td>
</tr>
<tr>
<td>Prepaid group practice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Seattle only)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>237</td>
<td>25</td>
<td>10.5</td>
</tr>
<tr>
<td>Control</td>
<td>138</td>
<td>10</td>
<td>7.2</td>
</tr>
<tr>
<td>Total assigned to plan</td>
<td>1477</td>
<td>111</td>
<td>7.5</td>
</tr>
</tbody>
</table>

1See the Preface for definitions and details of insurance coverage.

2Includes only those who answered the “trigger” questions, “Has this child ever had a urinary tract infection?” or, alternatively, “Has a doctor ever said this child had a kidney, bladder, or urine infection?”

3Those who said “yes” to the trigger question.

4Of those classifiable (see the text).

1Of the entire HIE sample of children ages 5–13 who received the MHQ Form B, 206 children were never assigned to an experimental HIE insurance plan; they were left over from a large pool of possible HIE participants from which the unbiased assignments were made. For more information on the assignment of families to plan, see Morris (1979). In addition, 20 children were assigned to a plan but had no response recorded on the MHQ Form B for the UTI trigger question.
Differences in the prevalence among the four types of fee-for-service plans were not statistically significant. This is as expected, because all HIE participants were assigned to these plans in an unbiased way at the time of enrollment in the HIE, before data from the MHQ or the medical screening examination were collected. Prevalence in the fee-for-service plans (taken together) in Seattle was 9.1 percent (20 of 219 children classifiable), a rate that was also not significantly different from the 10.5 percent prevalence rate in the prepaid group practice (GHC) experimental plan in Seattle. The GHC control plan is not strictly comparable to any other HIE plan, even in Seattle, because it comprised people who were already members of the GHC when the HIE began in that site. The difference in prevalence of urinary tract infection between the experimental and control GHC plans (10.5 and 7.2 percent, respectively) was also not significant, however. These findings demonstrate that assignment of families to the HIE plans was not biased at enrollment with respect to the history of urinary tract infection.
Chapter 6

QUALITY OF CARE

Several sets of criteria exist for good quality of care of symptomatic, acute, bacterial urinary tract infections. They typically stress initial and followup laboratory testing and use of appropriate antibiotics. They tend to disagree on the practicality of, and hence the absolute need for, confirming the diagnosis by culture and for performing a followup culture to assure that the infection is cured. Various studies show that fewer than 50 percent of patients with a diagnosis of urinary tract infection receive any kind of followup, and as few as 1 percent receive a followup urine culture (Morrow et al., 1976; LoGerfo et al., 1978). Also, there is some disagreement on when an intravenous pyelogram should be performed and whether a voiding cystourethrogram should be performed at the same time. Still more controversy exists over the questions posed by surgical therapy.

The assessment of quality of care in the HIE is limited by the unavailability of office medical records, which would probably show, for example, results of laboratory tests such as urine cultures or microurinalysis. Information is available in the HIE from insurance claim forms for outpatient and inpatient care and for prescription drugs (which are submitted throughout the HIE), from screening examination results such as urine cultures, and from the MHQ.

The quality of care criteria compiled for the HIE, which are listed in Appendix B, will be used to test various hypotheses relating the quality of care received to the generosity and type of insurance provided. The criteria are expressed in a form that assumes that a high level of quality of care has been delivered.

The outcome criteria specify that a urinary tract infection is not present at exit screening, that the patient is experiencing no pain, activity restrictions, or days in bed as a result of a UTI, and that the parent reports no more than a little worry about her child's condition. Process criteria specify what should be done by the health care provider. The source of information related to processes is the claim forms. Such criteria focus on laboratory tests ordered, prescriptions written for antibiotics, appropriate types of antibiotics, and timing of care following the first appearance of a diagnosis of urinary tract infection.
Appendix A

URINARY TRACT INFECTION BATTERIES FROM THE MEDICAL HISTORY QUESTIONNAIRES

ENROLLMENT MEDICAL HISTORY QUESTIONNAIRE
Non-Dayton Sites, Ages 5–13 Years

**KIDNEY, BLADDER, URINE INFECTION**

76. HAS A DOCTOR EVER SAID THAT THIS CHILD HAD A KIDNEY, BLADDER OR URINE INFECTION?

Yes .......................................................... 1 —Answer 76-A
No ............................................................ 2 —Go to 85,

76-A. HOW MANY TIMES ALTOGETHER?

(Circle one)
Once ........................................................ 1
Twice .......................................................... 2
3 times ....................................................... 3
4 times ....................................................... 4
5 or more times ......................................... 5

77. DOES THIS CHILD CURRENTLY HAVE A KIDNEY, BLADDER OR URINE INFECTION? (FOR EXAMPLE: CYSTITIS (sis-TIE-iz), PYELONEPHRITIS (pie-lo-neh-FRY-itis), ETC.)

Yes .......................................................... 1
No ............................................................ 2

78. IN THE PAST 12 MONTHS, HAS A DOCTOR PRESCRIBED ANY PILLS OR MEDICINES FOR THIS KIND OF INFECTION?

Yes .......................................................... 1
No ............................................................ 2

79. DOES THIS CHILD CURRENTLY TAKE ANY PILLS OR MEDICINES FOR THE INFECTION, WHETHER OR NOT A DOCTOR PRESCRIBED THEM?

(Circle one)
Yes, prescribed by doctor ................................ 1
Yes, but not prescribed .................................. 2
No, is not taking anything ................................ 3

1Used at all HIE sites except Dayton at enrollment and in all sites upon exit. Revisions incorporated in this version were based on experience with the initial Dayton battery.
80. WHEN WAS THE LAST TIME THIS CHILD SAW A DOCTOR ABOUT A KIDNEY, BLADDER OR URINE INFECTION? (Circle one)
   Within the past 3 months ........................................ 1
   3 - 6 months ago .................................................. 2
   7 - 12 months ago .................................................. 3
   More than 1 year ago .............................................. 4

81. DURING THE PAST 3 MONTHS, HOW MUCH PAIN OR DISTRESS HAS THIS CHILD'S KIDNEY, BLADDER OR URINE INFECTION CAUSED HIM OR HER? (Circle one)
   A great deal ......................................................... 1
   Some ........................................................................ 2
   A little ....................................................................... 3
   None .......................................................................... 4

82. DURING THE PAST 3 MONTHS, HOW MUCH HAS THIS CHILD'S KIDNEY, BLADDER OR URINE INFECTION WORRIED OR CONCERNED YOU? (Circle one)
   A great deal ......................................................... 1
   Somewhat .............................................................. 2
   A little .................................................................... 3
   Not at all ............................................................... 4

83. DURING THE PAST 3 MONTHS, HOW MUCH OF THE TIME HAS A KIDNEY, BLADDER OR URINE INFECTION KEPT THIS CHILD FROM DOING THE KINDS OF THINGS THAT OTHER CHILDREN THAT AGE DO? (Circle one)
   All of the time ......................................................... 1
   Most of the time ..................................................... 2
   Some of the time ..................................................... 3
   A little of the time .................................................. 4
   None of the time ..................................................... 5

84. DURING THE PAST 30 DAYS, HOW MANY DAYS HAS A KIDNEY, BLADDER OR URINE INFECTION KEPT THIS CHILD IN BED ALL OR MOST OF THE DAY? (Write in number. If none, write "0")

   _________ days in bed last month
ENROLLMENT MEDICAL HISTORY QUESTIONNAIRE
Dayton, Ages 5–13 Years

KIDNEY, BLADDER, URINE INFECTION

30. HAS THIS CHILD EVER HAD A KIDNEY, BLADDER, OR URINE INFECTION?
NO ........................................... 2 — (GO to q. 40, page 9)
YES ......................................... 1 — (GO to q. 31)

31. How many times altogether?
(Circle one.)
1 ........................................... 1
2 ........................................... 2
3 ........................................... 3
4 ........................................... 4
5 or more .................................. 5

32. Does this child currently have a kidney, bladder, or urine infection? (For example, cystitis, pyelonephritis)
("Cystitis" pronounced "Sis-TY-itis")
("Pyelonephritis" pronounced "Pi-loh-nih-PREY-itis")
No ........................................... 2 — (GO to q. 36)
Yes .......................................... 1 — (GO to q. 33)

33. In the last 12 months, has a doctor prescribed any pills or medicine for it?
Yes ........................................... 1
No ........................................... 2

34. Does this child currently take any pills or medicine for it, whether or not a doctor prescribed it?
(Circle one.)
Yes, those prescribed ..................... 1
Yes, but not those prescribed ............ 2
No ........................................... 3

35. Is this child currently under a doctor's care or supervision for kidney, bladder, or urine infection?
Yes ........................................... 1
No ........................................... 2

36. During the past 3 months, how much pain has this child's kidney, bladder or urine infection caused him or her?
(Circle one.)
A lot ......................................... 1
Some ....................................... 2
A little .................................... 3
None at all .................................. 4
37. During the past 3 months, how much has this child’s kidney, bladder, or urine infection worried or concerned you?
   (Circle one.)
   A lot ..................................... 1
   Somewhat .................................. 2
   A little ...................................... 3
   Not at all ................................... 4

38. During the past 3 months, how often has a kidney, bladder, or urine infection kept this child from doing the kinds of activities other children the same age do?
   (Circle one.)
   All of the time ............................. 1
   Most of the time ........................... 2
   Some of the time .......................... 3
   A little of the time ....................... 4
   None of the time .......................... 5

39. During the past 30 days, how many days has a kidney, bladder, or urine infection kept this child in bed all or most of the day? (If NO DAYS IN BED, WRITE IN “0.”)

   ______ Days in bed
Appendix B

URINARY TRACT INFECTION
QUALITY-OF-CARE CRITERIA

All criteria listed below, unless otherwise specified, refer only to enrollees who have urinary tract infection or, when specified, chronic kidney disease, according to the definitions used by the HIE at the time of exit screening (see Chapter 4). Criteria that, because of their more general applicability, appear on several different HIE criteria lists are designated as “recurrent criterion.” “Alternative criteria” may be tested to see if the insurance plan effects differ for slight variations in the criterion. “She” refers to both boys and girls.

PATIENT OUTCOMES

1. The enrollee who reports ever having had a UTI
   a. Denies symptoms of urinary tract infection at exit screening.
   b. Has no blood or only 1+ protein (detectable by dipstick) in the urine at exit screening.
   c. Does not have a positive urine culture at exit screening.

2. The enrollee’s mother reports “no pain at all” or “a little pain” when asked about pain caused by UTI on the MHQ. Alternatively, the mother reports “no pain at all” when asked about pain caused by UTI on the exit MHQ.

3. The mother reports “not at all” or “a little” when asked about worry or concern related to the child’s UTI on the exit MHQ.

4. The mother reports “none of the time” when asked about activity restrictions caused by the child’s UTI on the exit MHQ.

5. The mother reports “zero” days in bed during the past month attributable to the child’s UTI on the exit MHQ.
PROCESS

1. If the child is diagnosed as having an initial visit for an acute or unspecified (i.e., not chronic) UTI, then her physician performs or orders both a urinalysis (including microanalysis) and a urine culture; or, alternatively, either a urinalysis (including microurinalysis) or a urine culture.

2. If the child is diagnosed as having an initial visit for a definite UTI that is either acute or unspecified (i.e., not chronic), then antibacterial therapy was prescribed; or, alternatively, appropriate antibacterial therapy was prescribed, defined as one of the following drugs: a sulfonamide, nitrofurantoin, or trimethoprim-sulfadiazine (co-trimoxazole).

3. If the child received antibacterial therapy for an acute episode of UTI, and the diagnosis indicated an acute or unspecified (i.e., not chronic) UTI, then the initial antibacterial selected was one of the following drugs: a sulfonamide, ampicillin or amoxicillin, cephalaxin, nitrofurantoin, or trimethoprim-sulfadiazine (co-trimoxazole).

4. If the physician prescribed antibacterial therapy for an acute episode of UTI, then enough medicine was prescribed for at least a three-day course.

5. If the child is diagnosed as having an initial visit for an acute or unspecified (i.e., not chronic) UTI, and has received antibacterial therapy during the episode, then a followup urinalysis (including microurinalysis) or urine culture is performed within six weeks after antibacterial therapy was prescribed; or, alternatively, a followup urine culture is performed within six weeks after antibacterial therapy was prescribed.

6. If the physician has prescribed long-term prophylaxis therapy for chronic recurrent UTI, and the prescription has been filled at least twice, then refills have been made sufficiently often to allow continuous use of the medication, given the dosage prescribed.

7. If the child has received long-term prophylaxis therapy for chronic recurrent UTI, then the therapy selected is one of the following: mandelamine, nitrofurantoin, or trimethoprim-sulfadiazine (co-trimoxazole), but not a sulfa drug alone.

8. Urologic evaluation, including at least intravenous pyelography and a voiding cystourethrogram, was obtained for any child with at least one definite UTI diagnosed during the HIE if the child had no history of UTI before the HIE started.
Alternatively, for girls, the evaluation occurred after two definite UTIs were diagnosed during the HIE, if she had no history of UTI before the HIE started.

9. No urethral dilations were performed on girls presenting with acute UTI.

10. If the child had a positive urine culture at the enrollment screening examination, then a repeat urine culture was ordered within six months after the enrollment screening examination.
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