Pediatr Nephrol (1999) 13:45–49

ORIGINAL ARTICLE

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Clinical guidelines and hospital discharges of children with acute urinary tract infections

Received: 1 September 1997 / Revised: 29 April 1998 / Accepted: 29 April 1998

Abstract In order to evaluate the effect of the introduction of recent similar guidelines on the treatment of acute urinary tract infection (UTI) in children, and possible changes in its epidemiology, we analyzed the records of hospital discharge for acute UTI under the age of 15 years in England and Wales between 1979 and 1993 and in Finland between 1978 and 1994. Cases were defined by the ICD9 diagnostic codes 590.1 (acute pyelonephritis) and 599.0 (UTI, site not specified) for males and females according to three age groups (0–4, 5–9, and 10–14 years). We also compared the registry data on kidney transplants due to end-stage renal disease caused by recurrent pyelonephritis in the United Kingdom and Finland. In England the rate of attack of symptomatic UTI per 1,000 girls under 15 years increased from 0.74 (95% confidence interval 0.71–0.76) in 1987 to 1.32 (1.29–1.35) in 1993 ($P<0.001$, test for trend). The respective figures for Finnish girls were 1.74 (1.62–1.86) in 1987 and 1.62 (1.51–1.74) in 1993 ($P=0.72$). In English boys, the increase in the attack rate was from 0.38 (0.36–0.40) in 1987 to 0.70 (0.68–0.73) in 1993 ($P<0.001$). In Finnish boys the respective figures were 0.74 (0.66–0.82) in 1987 and 0.88 (0.80–0.97) in 1993 ($P<0.02$). The observed increases in the attack rates of UTI most probably relate to increased referral of acute UTI patients to hospitals for the recommended imaging studies rather than changing occurrence. Publication of guidelines for treatment of UTI in children, consolidating more-general awareness, may have contributed to this. The mean annual numbers of kidney transplants in the United Kingdom and Finland during 1989–1995 due to end-stage renal disease caused by pyelonephritis were of similar magnitude, i.e., 1.9 (1.6–2.3) transplants per million inhabitants in the United Kingdom and 2.8 (1.5–4.7) transplants per million inhabitants in Finland. The decreasing trend in these figures in both countries, although statistically significant only in the United Kingdom ($P<0.05$, test for trend), suggests improved long-term outcome of these patients induced by better diagnosis and treatment of pyelonephritis and the diseases related to it, such as congenital malformations. According to our data, valid clinical guidelines are effective in changing clinical practice.

Key words End-stage renal disease · Epidemiology · Renal transplantation

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Introduction

Renal scarring, hypertension, and even renal failure can develop after recurrent pyelonephritis [1–3], which is the most-common preventable cause of end-stage renal disease (ESRD). Recent guidelines in England and Wales (1991) [4] and Finland (1992) [5] recommend that all children, regardless of age and gender, should have renal tract imaging after the first episode of confirmed acute urinary tract infection (UTI). Failure to diagnose UTI could be reflected in subsequent increased occurrence of ESRD and a large number of kidney transplants due to recurrent pyelonephritis. Overdiagnosis of UTI, on the other hand, causes considerable extra cost for the health-care system, mainly due to unnecessary imaging examinations and follow-up. A knowledge of the changing occurrence of acute UTI in children will help us to monitor awareness and treatment of acute UTI and may give valuable clues to possible etiological factors. Earlier data from Finland showed that occurrence of acute UTI in children decreased significantly during 1978–1984, which was ascribed to changes in the care of infants[6].

The most-recent guidelines on treatment of acute UTI in children are remarkably similar in England and Wales (1991) [4] and Finland (1992) [5]. In order to evaluate

the effect of these guidelines on treatment and possible changes in the epidemiology of acute UTI in children, we decided to reanalyze the hospital record data on the treatment of acute UTI in Finland and England and Wales. In order to evaluate long-term outcome amongst these types of patients, we also compared the registry data on kidney transplants due to recurrent pyelonephritis in the United Kingdom and Finland.

Patients and methods

Both the English and Finnish hospital discharge data are based on the two ICD9 diagnostic codes 590.1 (acute pyelonephritis) and 599.0 (UTI, site not specified), which have been identified separately for males and females according to three age groups (0–4, 5–9, and 10–14 years). In Finland the coding system for diagnoses changed in 1987 and thereafter the respective codes (5901A, 5990B) were included in the analyses. The hospital discharge statistics are based on the nationwide collection of diagnoses determined by physicians on patients treated and discharged from all hospitals.

England and Wales data

The data for years 1979–1985 were obtained from the Hospital Inpatient Enquiry based on a 10% sample of hospital discharges and deaths in England and Wales (1979–1981) and England only from 1982 to 1985. English data for the years 1987–1993 were also obtained from the Office for National Statistics (ONS), which was responsible at the time for the processing of hospital episode statistics, covering financial (April to March) years in England only as a complete 100% count of hospital inpatient activity. These data are collected as "finished consultant episodes (FCEs)", but were converted to "discharges and deaths" (DDs) by ONS before they were supplied to us to minimize any discontinuity in the trends. The conversion factor for FCEs to DDs (for all hospital activity, at all ages) leads to about a 10% reduction in numbers of calculated "admissions" [7]. Statistics for renal transplants were provided by the United Kingdom Transplant Support Service Authority covering the United Kingdom and Republic of Ireland also for the years 1989–1995.

Finnish data

As in our earlier study [6], the source of Finnish data for the attack rate of acute UTI was the hospital discharge registry of The Finnish Board of Health. In addition we obtained the number of children receiving free medication for prophylactic treatment of recurrent UTI from the registry of the Finnish Social Insurance Institution. Data on kidney transplants due to pyelonephritis were obtained from the Finnish Registry of Kidney Diseases.

Statistical methods

The numbers of children at risk were determined from the censuses and annual population estimates. The discharge figures represent the annual rate of attack of UTI, since first and recurrent infections cannot be differentiated. The numbers of children receiving preventive treatment for recurrent UTI in Finland represent the period prevalence. All rates were assumed to follow a Poisson distribution, and the 95% confidence intervals were calculated on this assumption [8]. Changes in the attack rates were assessed by regression analysis.

Results

In England from 1979 to 1985, the attack rates for both boys and girls at ages other than 0–4 years were broadly stable. But from 1987 the trend in the attack rate of acute UTIs per 1,000 children at risk increased in each age group studied, especially after the publication of the most-recent guidelines on treatment of acute UTI (1991) [4]. A statistically significant increase in the attack rate occurred in each age group, both in girls and boys, in

Table 1 Rate of attacks (number having infection/ 1,000 at risk/ year; 95% confidence intervals in parentheses) of symptomatic urinary tract infections in children under 15 years of age discharged from hospitals in England (UK) 1979–1993 and in Finland (FIN) 1978–1994

Year	Girls 0–14 years		Boys 0–14 years	
	UK[a]	FIN[b]	UK[a]	FIN[b]
1978	–	2.67 (2.52–2.82)	–	0.85 (0.77–0.93)
1979	0.65 (0.58–0.72)	2.60 (2.46–2.75)	0.27 (0.23–0.32)	0.82 (0.75–0.91)
1980	0.68 (0.61–0.75)	2.48 (2.34–2.63)	0.31 (0.27–0.36)	0.78 (0.70–0.86)
1981	0.70 (0.63–0.78)	2.27 (2.14–2.41)	0.33 (0.28–0.38)	0.70 (0.72–0.88)
1982	0.65 (0.57–0.72)	2.26 (2.12–2.40)	0.37 (0.31–0.37)	0.68 (0.61–0.75)
1983	0.83 (0.74–0.91)	1.87 (1.75–2.00)	0.31 (0.26–0.37)	0.72 (0.64–0.80)
1984	0.72 (0.64–0.80)	1.88 (1.76–2.01)	0.32 (0.27–0.37)	0.59 (0.52–0.66)
1985	0.72 (0.64–0.80)	1.90 (1.78–2.03)	0.35 (0.30–0.41)	0.58 (0.43–0.65)
1986	–	1.71 (1.59–1.83)	–	0.62 (0.55–0.69)
1987	0.74 (0.71–0.76)	1.74 (1.62–1.86)	0.38 (0.36–0.40)	0.74 (0.66–0.82)
1988	0.74 (0.71–0.76)	1.75 (1.63–1.87)	0.40 (0.38–0.42)	0.77 (0.70–0.85)
1989	0.90 (0.87–0.92)	1.74 (1.62–1.86)	0.48 (0.46–0.50)	0.87 (0.79–1.04)
1990	0.95 (0.92–0.98)	1.79 (1.67–1.91)	0.52 (0.50–0.55)	0.80 (0.73–0.88)
1991	1.07 (1.04–1.10)	1.83 (1.71–1.96)	0.58 (0.56–0.60)	0.87 (0.79–0.95)
1992	1.18 (1.15–1.21)	1.81 (1.69–1.93)	0.63 (0.61–0.65)	0.90 (0.82–0.99)
1993	1.32 (1.29–1.35)	1.62 (1.51–1.74)	0.70 (0.68–0.73)	0.88 (0.80–0.97)
1994	–	1.69 (1.57–1.81)	–	0.94 (0.86–1.03)

[a] Data sources in UK: Hospital Inpatient Enquiry 1979–1985, a 10% sample of hospital discharges and deaths in England and Wales (1979–1981) and England only from 1982 to 1985. Hospital episode statistics covering financial (April to March) years in England only from 1987 onwards as a complete 100% count

[b] Data source in Finland: the hospital discharge statistics kept by the Finnish National Board of Health. ICD classification changed from 1987 onwards for Finnish data. Figures for Finland for years 1978–1984 published earlier [6]

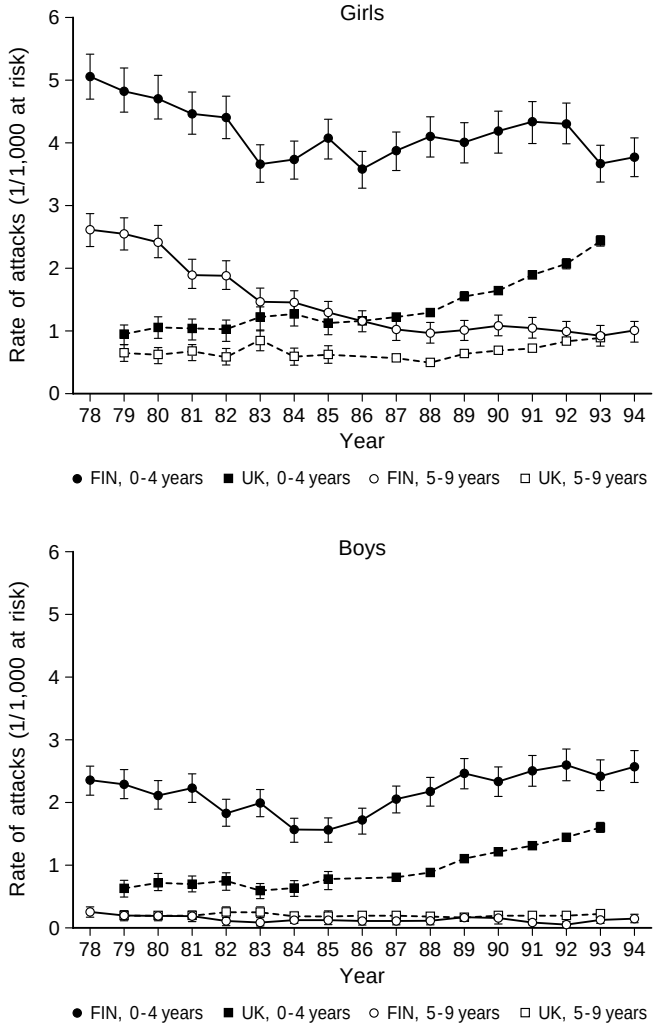

Fig. 1 Annual rate of attacks (number having infection/1,000 at risk per year) of symptomatic urinary tract infections (UTI) in 0- to 4-year-old and 5- to 9-year-old girls and boys in England (*UK*) 1979–1993 and in Finland (*FIN*) 1978–1994. *Vertical bars* represent 95% confidence intervals. *Data sources in UK*: Hospital Inpatient Enquiry 1979–1985, a 10% sample of hospital discharges and deaths in England and Wales (1979–1981) and England only from 1982 to 1985. Hospital episode statistics covering financial (April to March) years in England only from 1987 onwards as a complete 100% count. *Data source in Finland*: the hospital discharge statistics kept by The Finnish National Board of Health. ICD classification changed from 1987 onwards for Finnish data. Figures for Finland for years 1978–1984 published earlier [6]

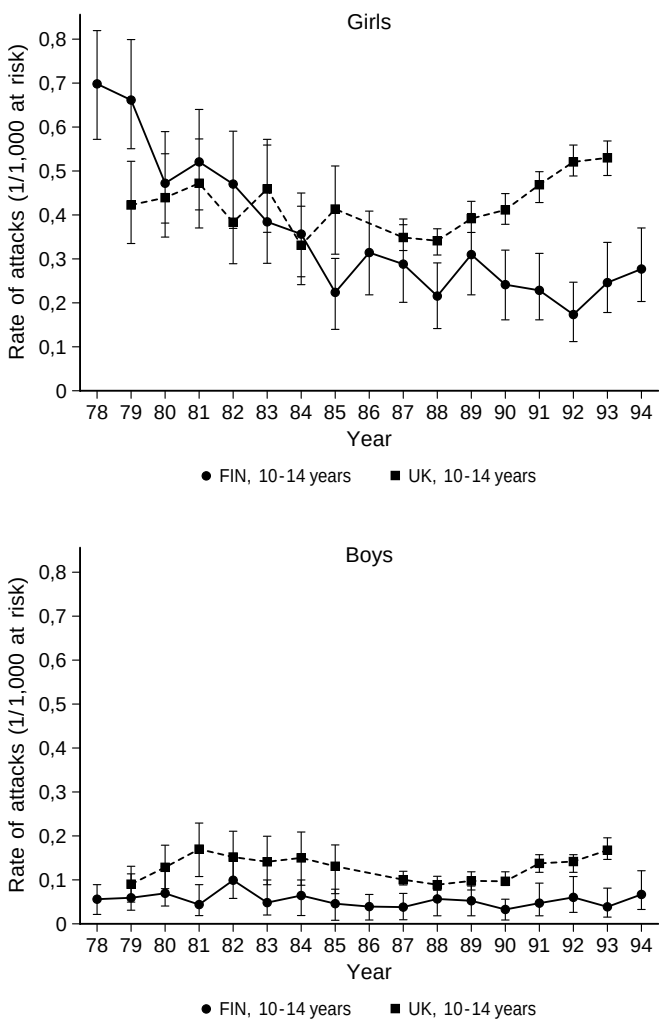

Fig. 2 Annual rate of attacks (number having infection/1,000 at risk per year) of symptomatic UTI in 10- to 14-year-old girls and boys in England (*UK*) 1979–1993 and in Finland (*FIN*) 1978–1994. *Vertical bars* represent 95% confidence intervals. Data sources as in Fig. 1

England between the years 1987 and 1993 (Figs. 1 and 2, numerical data available upon request to authors). The greatest increase in the attack rate of symptomatic UTI per 1,000 occurred in girls in the age group 0–4 years, where the rate almost doubled from 1.24 (1.18–1.30) to 2.44 (2.37–2.52) between 1987 and 1993 ($P<0.001$, test for trend). The respective increase in boys was from 0.83 (0.79–0.88) to 1.62 (1.56–1.68) ($P<0.001$). In England the rate of attack of symptomatic UTI per 1,000 girls under 15 years (Table 1) increased from 0.74 (0.71–0.76) in 1987 to 1.32 (1.29–1.35) in 1993 ($P<0.001$). In boys the increase in the attack rate was from 0.38 (0.36–0.40) in 1987 to 0.70 (0.68–0.73) in 1993 ($P<0.001$).

The general trend in the attack rate of UTI in Finland decreased from 1978 to 1984 (Figs. 1 and 2) [6]. Thereafter, during the following 10 years the attack rate generally remained relatively stable or declined, except for boys in the youngest age group (0–4 years) where the attack rate per 1,000 increased from 2.05 (1.84–2.27) in 1987 to 2.58 (2.34–2.84) in 1994 ($P=0.02$, test for trend). This increasing trend is reflected also as a statistically significant increase ($P<0.02$) in the combined attack rate figures of 0- to 14-year-old Finnish boys (Table 1). In Finnish girls the attack rate of UTI continued the earlier decreasing trend in 5- to 9-year-olds, being 1.45/1,000 (1.37–1.77) in 1984 and 0.99/1,000 (0.84–1.16) in 1994 ($P=0.005$).

In Finland the same trend is also seen in the period prevalence of free medication (Fig. 3) and also in the

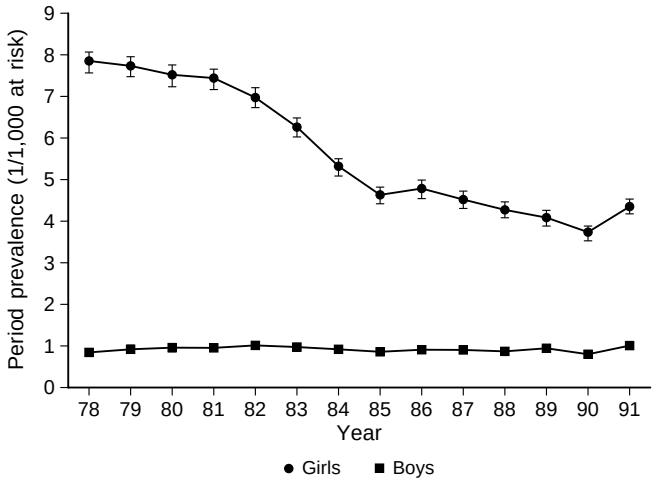

Fig. 3 Period prevalence of free medication (number of children receiving continuous treatment/1,000 at risk per year) in 0- to 14-year-old girls and boys in Finland 1978–1994. *Vertical bars* represent 95% confidence intervals

Table 2 Number of all new renal transplants and those due to pyelonephritis (% of all transplants given in parentheses) in England, Wales, Scotland, Northern Ireland and the Republic of Ireland (UK) and Finland (FIN) per million inhabitants during 1989–1995. All ages included

Year	Kidney transplants			
	All new transplants/ million inhabitants		Transplants due to pyelonephritis/ million inhabitants (%)	
	UK	FIN	UK	FIN
1989	32.2	33.5	2.4 (7.4)	3.3 (9.8)
1990	32.4	25.0	2.0 (6.2)	1.6 (6.4)
1991	30.4	27.2	2.0 (6.6)	3.6 (13.2)
1992	30.1	31.8	1.8 (6.1)	2.8 (8.8)
1993	29.8	34.6	1.6 (5.3)	3.0 (8.7)
1994	31.3	35.1	1.9 (5.9)	2.7 (7.8)
1995	31.9	32.5	1.7 (5.3)	2.4 (7.2)
Mean	31.2	31.4	1.9 (6.0)	2.8 (8.8)

number of new awards of free medication, which decreased in girls (aged 0–14 years) from 1.63/1,000 at risk (1.52–1.75) in 1986 to 1.25 (1.15–1.35) in 1991 (P=0.02, test for trend), and remained constant in boys being 0.27 (0.23–0.32) in 1986 and 0.31 (0.26–0.36) in 1991 (P=0.23).

Even though the attack rates of UTI in English and Finnish children have become closer during the last few years, differences are still found. In 1993 in the youngest age group (0–4 years), Finnish attack rate figures were 1.5 times greater than those in England, i.e., 3.67 (3.38–3.98) versus 2.44 (2.37–2.52) in girls and 2.44 (2.21–2.69) versus 1.62 (1.56–1.68) in boys. Opposite trends in the attack rate in 5- to 9-year-old girls in England and Finland during the last few years have led to similar attack rates in 1993. In 5- to 9-year-old English boys the attack rates are consistently higher than in Finnish boys during the entire time period studied. Also, in the age group 10–14 years, the English figures are several times higher in both girls and boys (Fig. 2). The combined attack rates of UTI in children under 15 years have remained consistently higher in Finland than in England, although they have become closer to each other during the last few years (Table 1).

The mean annual number of kidney transplants performed in the United Kingdom and the Republic of Ireland (not just England and/or Wales) and Finland during 1989–1995 was similar, i.e., 31.2 and 31.4 transplants per million inhabitants, respectively (Table 2). The transplant rate due to ESRD caused by pyelonephritis was 1.9 (1.6–2.3) per million inhabitants in the United Kingdom and 2.8 (1.5–4.7) per million in Finland, representing 6.0% and 8.8% of all transplants, respectively (Table 2). The rate of transplants due to pyelonephritis was decreasing in both countries during 1989–1995, although statistically significant only in the United Kingdom (P<0.05, test for trend).

Discussion

In England the most-recent guidelines for the management of acute UTI in childhood were published in 1991 [4]. It was recommended that all children, regardless of gender, should have renal tract imaging after the first episode of confirmed acute UTI [4]. According to the present results, superimposed upon slower prior increases, after this recommendation there occurred a greater than 20% increase in the attack rate of UTI in 0- to 4-year-old and (consequently) 0- to 14-year-old girls and boys during 1991–1993. Since the imaging studies are performed in hospitals, the steadily increasing attack rates of UTI in children calculated from hospital statistics for England most probably reflect improved detection through the better awareness and diagnosis of the disease and, especially, increased referral rate to hospital for the recommended imaging examinations.

The problems concerning investigations and management of UTI in children have been repeatedly discussed in the United Kingdom [9–12]. Two recent reports from England suggest that UTI is underdiagnosed [9, 10]. Our data suggest that the discussion of the topic [9–12] as well as the recent guidelines [4] have helped to improve diagnosis of UTI in England. This is in accordance with the data showing valid guidelines to be effective in changing clinical practice [13].

In 1987 an important article was published in Finland on the management and treatment of UTI in children, stressing the importance of imaging of the urinary tracts of children under 5 years of age, and especially in boys [14]. Thereafter, there was a significant increase in the attack rate of acute UTI in 0- to 4-year-old Finnish boys (but not in girls or other age groups). This suggests that diagnosis of UTI and the necessary imaging studies in young boys may have been previously neglected in Finland. This interpretation of the trends may also be sup-

ported by the fact that the prevalence of free medication and the number of new awards of free medication have been steadily decreasing in girls but have slightly increased in boys. In the most-recent Finnish guidelines (1992), urinary tract imaging is now recommended for all children with UTI [5].

In the youngest age group, Finnish attack rates are still higher in both girls and boys than in England. However, the figures are similar in the 5- to 9-year age-group, and English figures are clearly higher in the pubertal age group (10–14 years). Older children may more often be treated on an outpatient basis, and therefore the attack rates calculated from hospital discharges in these age groups may underestimate the true occurrence. In the oldest age group, the recommended imaging studies may have been more easily neglected, which may also decrease the figures. However how much of these differences is due to the ways in which national statistical systems differ in their data collection and coding practices is difficult to define.

In 1988 we reported a significant decrease in the attack rate of acute UTI in Finland between 1978 and 1984 and suggested that changes in nursing habits of children could explain this decrease rather than guideline dissemination or the lack of it leading to underdiagnosis [6]. We found in a recent case-control study a change from disposable and cotton nappies to superabsorbent nappies during 1987–1994 in Finland, but the type of nappy was not shown to be a risk factor for UTI [15]. So although environmental factors may affect occurrence of UTI, we are inclined to believe that present trends are due to diagnosis/ascertainment rather than changing incidence [6, 15].

The aim of the clinical guidelines on management of acute UTI in childhood is to improve diagnosis and treatment of pyelonephritis and the diseases increasing the risk of acute UTI, such as congenital malformations. The total kidney transplant rate as well as the proportion of renal transplants due to ESRD caused by pyelonephritis was of the same magnitude in the United Kingdom and in Finland, suggesting that the final outcome in pyelonephritis patients does not differ. The transplants due to ESRD caused by pyelonephritis seemed to slightly decrease during 1989–1995 in both the United Kingdom and Finland. This decrease cannot be due to the latest guidelines, since a follow-up period of some 25 years or more would be required in order to show a change in the incidence of ESRD due to improved diagnosis and management of acute UTI in early childhood pyelonephritis [1, 2]. Therefore, the most-significant possible beneficial effects of the guidelines for the management of acute UTI in childhood in Finland and the United Kingdom on the occurrence of ESRD should be evaluated after several decades.

Acknowledgements The present results were presented at the 31st Annual Meeting of the European Society for Paediatric Nephrology (ESPN congress), Athens, Greece, 27–30 September 1997 and at the Nordic Pediatric Congress, Trondheim, 11–14 June 1997. The authors wish to thank Jenny Fairweather of the Unit of Health Care Epidemiology, Institute of Health Sciences, Oxford for technical assistance; the Office for National Statistics for supplying the hospital inpatient enquiry and hospital episode statistics data for England and Wales; United Kingdom Transplant Support Service Authority for the data on kidney transplants in the United Kingdom and Republic of Ireland; the Finnish Board of Health for the data from the hospital discharge registry of Finland; Finnish Social Insurance Institution for data on free medication due to prophylactic treatment of recurrent UTI and Finnish Registry of Kidney Diseases for data on kidney transplants in Finland.

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