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Striking trends in the incidence of health problems in the Netherlands (2002–05). Findings from a new strategy for surveillance in general practice

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ABSTRACT

Background: This study aimed to detect striking trends based on a new strategy for monitoring public health. **Methods:** We used data over 4 years from electronic medical records of a large, nationally representative network of general practices. Episodes were either directly recorded by general practitioners (GPs) or were constructed using a new record linkage method (EPICON). The episodes were used to estimate raw morbidity rates for all codes of the International Classification of Primary Care (ICPC). Multilevel Poisson regression models were used to analyse the trend over time for 15 health problems that showed an obvious change over time. Based on these models, we calculated adjusted incidence rates corrected for clustering, sex and age. **Results:** During 2002–05, both men and women increasingly consulted the GP because of concern about a drug reaction, a change in faeces/bowel movements and urination problems. Men showed an increase in consultations for prostate problems and venereal diseases. The incidence of chronic internal knee derangement decreased for both sexes. Women consulted their GP less frequently about sterilization and fear of being pregnant. **Conclusion:** The strategy developed proved to be useful to detect trends across a short period of time. Changes in the health care market, such as the increasing availability of over-the-counter drugs and various large advertising campaigns for medications may explain some of the findings. The increasing incidence of health problems in the urogenital area deserves attention as it could reflect increases in the incidence of sexually transmitted diseases (STDs) and urinary tract infections.

INTRODUCTION

Morbidity trends in general practice provide important information for public health agencies, because they reflect, to some extent, morbidity trends in the general population. In particular, this holds for countries that use a gatekeeping system, because these systems utilize general practices as the main pathway to medical care. In countries where patients have free access to specialist care, trends in general practice could still provide an indication of morbidity changes in the population, although there is a higher chance of morbidity 'leaking' to other health care providers.

Electronic medical records (EMRs) in general practice can be a valuable source for estimating these trends, because they can provide the large and longitudinal datasets that are needed to observe morbidity over time. In the past, this routine data has been widely used to estimate morbidity trends of specific diseases. However, using this data to signal striking and unusual changes in a large range of health problems, is only just emerging.[1] This can probably be attributed to the complexity of this type of research, which has various requirements.

For starters, it calls for a sufficiently large registration network of general practitioners (GPs) who accurately code diagnoses of their patients using a coding system. Next, morbidity rates (i.e. incidence and prevalence rates) over specific time periods have to be computed. In order to estimate the numerators of these rates, contact diagnoses have to be grouped into episodes of care. An episode of care includes 'all encounters for the management of a specific health problem'.[2] An episode could be either one diagnosis or a sequence of diagnoses that reflects the course of a disease over time. To be able to distinguish between incidence and prevalence, we also need an indication whether the presented health problem represents the start of a new episode or is part of an episode that started in the past.

Generally, two approaches for constructing episodes can be distinguished. The first approach involves the use of episode-oriented EMRs. In this new generation of EMRs, the GP records diagnoses directly into episodes.[3] In the second approach, diagnoses from contact-oriented EMRs are grouped afterwards, through manual review or use of a computerized method. In a previous paper, we presented EPICON, an application for automatically grouping diagnoses from contact-oriented EMRs into episodes of care. Both the development and the evaluation of EPICON have been described in detail elsewhere.[4–6]

In addition, the size of the population at risk in the denominator has to be determined. In countries where every patient is registered with a GP (so called list system), the denominator can easily be determined, while more complicated approaches are available for countries without a list system.[7] Finally, a method has to be developed to detect trends in morbidity rates over time that takes into account that count data are used which are clustered within patients and within practices.

In this study, we developed a strategy that met all these requirements, and involved the application of EPICON to yearly data from a very large, nationally representative computerized network of Dutch general practices,[8,9] and the use of multilevel Poisson regression models. The Netherlands has favourable conditions for monitoring public health based on data from EMRs in general practice, because it utilizes both a gatekeeping and a list system. The aim of our research is to detect striking trends in the incidence of health problems in the Netherlands during 2002–05.

METHODS

Dataset

We used data from practices participating in the Netherlands Information Network of General Practice (LINH).[8,9] This network consists of a large and dynamic pool of practices, which differs from year to year as some practices leave the network and others join up. The GPs within this network assign codes from the International Classification of Primary Care

(ICPC) to consultations, prescriptions and referrals.[10] Medical information about out of hours care is transferred to the GPs' offices, coded and included in the database as well. The majority of the practices uses contact-oriented EMRs and a minority uses episode-oriented EMRs. In a previous study, we compared morbidity rates between EPICON-grouped and GP-grouped diagnoses. The results of that study indicate that morbidity rates based on EPICON-grouped diagnoses from contact-oriented EMRs can be used in conjunction with morbidity rates based on GP-grouped diagnoses from episode-oriented EMRs provided that the same grouping rules are used.[6] The present study includes only health problems (15 in total) for which the rules used by EPICON for grouping diagnoses in the contact-oriented EMRs are similar to those utilized by the GPs in the episode-oriented EMRs.

In this study, we included data from 2002 (the first year in which EPICON could be applied) through 2005 (the last year for which data were available at the time of analyses). The total number of LINH-practices was 83 in 2002, 80 in 2003, 61 in 2004 and 71 in 2005, but only practices were included that met certain criteria for accuracy and completeness. This resulted in the following number of practices in the analyses: 69 in 2002, 66 in 2003, 43 in 2004 and 42 in 2005 (220 practice-years in total).

The included practices are representative of all Dutch practices in terms of urbanization level and practice type (i.e. solo or group practice), but practices in the northern part of the country are slightly overrepresented at the expense of practices in the western part.[11] For each year, the total patient population of these practices provides a representative sample of at least 1% of the Dutch population regarding age and gender.[12]

Raw morbidity rates

Several steps were taken to compute raw morbidity rates. For contact-oriented practices, episodes were constructed using EPICON. For episode-oriented practices, (six in 2002, six in 2003, six in 2004 and five in 2005), we used the episodes that were recorded by the GP. The episodes were weighted for the length of recording of a practice within 1 year, to account for vacation, sick leave, etc. (198 of the 220 included practice-years covered a complete year and 22 covered slightly less than a year).

Next, we estimated the yearly morbidity rates. For the numerators, we counted, per episode name, the number of patients with at least one episode (prevalence) and the number of new episodes (incidence). For the denominators, we used the mid-year population (i.e. the average of the population at the beginning and the end of a year). The total mid-year population varied from 174 138.5 in 2005 to 296 716.0 in 2002.

We then computed raw incidence rates for the total population, for men and women separately, and for various age groups (0, 1–4, 5–14, 15–24, 25–44, 45–64, 65–74, 75+). These raw morbidity rates are comparable with the rates in the second Dutch National Study of General Practice.[13,14]

Out of the raw incidence rates for all ICPC codes (n = 683), we selected 15 health problems that showed an obvious increase or decrease over time for further investigation.

Crude and adjusted incidence rates

We used multilevel Poisson regression models to analyse the trend over time for the selected health problems.[15,16] Because of the large number of dependent variables (15), we developed general models that could be applied to each outcome. For all models, the dependent variable is the number of new episodes of a health problem in a year for one patient.

These multilevel analyses were used, because the data is clustered within levels: repeated observations of a health problem are clustered within patients (level one) who are clustered within general practices (level two). We modelled (i.e. corrected for) the variance due to clustering within levels in the random part of all models. The fixed part of all models includes the 4 years which is necessary to test for a trend over time. For the total population, we used a crude and an adjusted model. The crude model, which corrects just for clustering, includes only the 4 years. The adjusted model includes the 4 years controlling for sex and age.

For each health problem, we stratified by sex, and used the adjusted model (without controlling for sex) to test for a linear trend over time. The adjusted model was also used for the total population to test whether the age effect differed between 2 years. Statistical significance was set at $P < 0.05$.

Based upon the crude and the adjusted model, we calculated incidence rates for the total population and for men and women separately.

RESULTS

Looking at the raw incidence rates, eight health problems increased and seven health problems decreased considerably over the 2002–05 period. Table 1 shows the results of the analyses over time. Nine of the 15 selected health problems show a significant increase (6) or decrease (3) over time.

[TABLE 1]

Figure 1 shows the adjusted incidence rates for all significantly changing health problems and for 'hypertrophy/chronic infection tonsils/adenoids (R90)'.

[FIGURE 1]

'Concern about drug reaction (A13)' is a common problem in general practice, especially among women and the elderly. Within the ICPC coding system, the symptom-diagnosis 'concern about drug reaction (A13)' is distinguished from the disease-diagnosis 'adverse effect medical agent proper dose (A85)'. Both men and women increasingly consulted the GP because of concern about a reaction to drugs, especially in 2005. The increase occurs mainly among patients of 45 years of age and older, which results in a highly significant change of the effect of age over time ($P = 0.0000$).

GPs use the uncommon diagnosis 'change in faeces/bowel movements (D18)' for a change in the pattern of defecation. Separate ICPC-codes exist for 'diarrhoea (D11)' and 'constipation (D12)'. In particular, infants and elderly patients are bothered by changes in faeces/bowel movements. The increase, however, did not occur among the youngest and oldest, but among people in the age range of 15 through 74.

'Chronic internal knee derangement (L97)' starts to occur at the age of five and is a frequent problem in the age group of 15 through 64. Chronic internal knee derangement decreased for men and women in the examined time period. The effect of age over time changed significantly ($P = 0.0002$) for this health problem due to a remarkable decrease among young people (15 through 24 years of age).

'Hypertrophy/chronic infection tonsils/adenoids (R90)' shows borderline significance for men, but not for women. This health problem, which occurs mainly in infants and children, decreased especially in male infants and young boys (the raw incidence decreased from 18.5 to 1.6 for male infants and from 27.0 to 21.1 per 1000 per year for boys from one through 4 years of age). For female infants and young girls, the trend also decreases, but it fluctuates more over time.

'Frequent/urgent (U02) and other urination problems (U05)' are common problems among the elderly. 'Other urination problems (U05)' refers to problems other than 'painful urination (U01)' and 'incontinence (U04)' for which separate ICPC-codes exist. Frequent, urgent, and other urination problems show an increase in various age groups, but in particular in people aged 75 and over.

Women who consult the GP for 'fear of being pregnant (W02)' are usually between 15 and 44 years of age. In the 2002–05 period, the number of consultations for fear of pregnancy decreased, especially among young women (15 through 24 years of age).

Consultations for 'family planning/sterilization (W13)' among women start at the age of 20, increase until the age of 40 and then decline to zero at 50 years of age. Starting in the year

2003, women decreasingly consulted their GP about sterilization, a decline which occurred especially among women in their thirties.

We found a considerable increase for 'symptoms/complaints prostate (Y06)', a health problem which commences among men at the age of 25 and is a common problem among elderly males. Prostate symptoms/complaints increased for both middle-aged and older men.

Starting at age 15, young men frequently consult their GP about 'fear of venereal disease (Y25)'. These consultations peak among men in their twenties, and then decline slowly to zero among the elderly. This health problem shows a considerable increase among men between 15 and 44 years of age.

To illustrate the effect of clustering on the incidence rates, we added both the raw rates (no corrections) and the crude rates (corrected for clustering only), to four health problems in figure 1. The differences between the raw rates and the crude rates clearly show that clustering may have considerable impact on incidence rates in general practice. The crude rates are generally lower than the raw rates, because part of the variance of the raw incidence is attributable to the fact that these data are clustered within patients and within practices. The adjusted rates (corrected for clustering and age) are usually higher than the crude rates because they show the incidence of a patient with a mean age (i.e. the age variables were centered).

DISCUSSION

In this study, we monitored trends in the incidence of health problems in general practice through the application of a new method for record linkage and the use of multilevel Poisson regression models for analysing trends in clustered data. The results show that the incidence of nine health problems changed significantly over the 2002–05 period in the Netherlands.

Dataset

Our results are based on data obtained from a large network of computerized general practices in the Netherlands, a dataset which has several advantages. First, the patient population of the included practices forms a representative sample of the Dutch population regarding age and gender. Second, the health of this patient population reflects the health status of the general population because the Netherlands uses a gate keeping system. Third, the dataset is large enough to find trends across time, and finally, the use of routine data is efficient and reduces the risk of information bias.

A limitation of the dataset is that some practices had to be excluded from the analyses because their record keeping was not sufficiently, which resulted in a considerable loss of practices for 2004 and 2005. Furthermore, the selected practices record not always 100% completely, which could mean that the calculated rates underestimate the true rates to a limited extent. Recently, the network developed an application to improve the quality of recording. The application uses a number of indicators to measure the quality of recording of a practice. These measurements are used to provide the practice with automatic feedback on its quality of recording.

Methods

We used EPICON, a new application to disclose data from EMRs in general practice for estimating morbidity rates. EPICON constructs episodes from ICPC-codes, which can be used to estimate the numerator of morbidity rates. Results from studies assessing the internal and external validity show that EPICON performs adequate for the purpose of estimating morbidity rates.[5,6]

In our analyses, we correct for clustering of observations within patients and within practices through the use of multilevel Poisson regression models. The results show that this clustering may have considerable impact on the incidence rates. It is therefore advisable to correct incidence rates for clustering when data is clustered within levels, for instance in incidence rates based on samples stratified by general practice, hospital or neighbourhood.

Interpretation of findings

To interpret the findings, the full range of factors that could affect the registration of patient data in EMRs in general practice has to be taken into account. In Box 1, we distinguish between four categories of possible causes of changing incidence rates. The first category falls within the domain of medical informatics, which comprises aspects of the validity of using EMRs in general practice for the purpose of estimating morbidity rates. In the previous paragraphs, we discussed our findings from this perspective. The second and third categories are related to the area of health policy; the fourth category is the area of epidemiologic research. Before considering a real change in the incidence of disease, possible causes that fall into the first three categories should be excluded.

[BOX 1]

We discussed the causes listed in Box 1 with three experts in the field of general practice registration networks (see Acknowledgements) in order to interpret the findings of our study. The most plausible explanations are described below. Note that we did not study these explanations; they are merely hypotheses. We also compared our findings to the annual incidence rates of a similar general practice network in England and Wales (Weekly Returns Service).[17] This comparison is limited to ICPC-codes that could be mapped to corresponding ICD-9 related Read codes from the Weekly Returns Service.

The increasing 'concern about drug reaction (A13)' might be due to a change in the availability of over-the-counter drugs. In 1999, a large number of drugs that was previously available on prescription only became available over-the-counter, although chronic users still received a reimbursement on presentation of a prescription. Subsequent legislation (starting from 1 January 2004) limited the reimbursement for chronic users considerably.[18] The use of over-the-counter drugs shows a steady increase in 2002–05 period.[19] The observed increase of 'concern about drug reaction (A13)' could thus be caused by patients who consulted their GP about possible adverse effects of over-the-counter drugs.

An explanation for the increase of 'change in faeces/bowel movements (D18)' might be a very successful, broad campaign on colon cancer in 2004 by a large non-profit organization. Among other things, the campaign explained that a change in faeces/bowel movements is one of the possible signs of colon cancer.[20,21]

We have no explanation for the observed decrease of 'chronic internal knee derangement (L97)'. In English and Welsh practices, the incidence of 'internal derangement of knee' (ICD-9 code 717) decreased also in the study period.[17]

The decrease of 'hypertrophy/chronic infection tonsils/adenoids (R90)' might be part of an ongoing decline that started decades ago. Another Dutch registry in general practice noticed a decrease in the incidence of this disease starting in the 1970s. This decline is possibly related to the simultaneous decreasing trend in tonsillectomy.[22] Furthermore, in 1993 the haemophilus influenza type b vaccine was added to the routine childhood immunization schedule, which could have caused a further decrease in this disease. In England and Wales, the incidence of 'chronic disease of tonsils and adenoids' (ICD-9 code 474) remained more or less the same between 2002 and 2005.[17]

We found a decrease in consultations for 'fear of being pregnant (W02)', especially among young women, a finding which could be partly explained by the increased use of contraceptives among young people. Results of a 2005 study on sexual health among young people show an increased use of contraceptives among sexually active school going youth compared to 1995.[23]

The decrease in consultations for sterilization among women (W13) is possibly related to the increase in childbearing age. Results of a study comparing different birth cohorts indicate that sterilizations are postponed (delay effect), whereas no catch-up effect is observed yet.[24] Furthermore, in 2004 new legislation excluded sterilization from the basic health insurance plan[25] and since then, only supplemental plans cover sterilization. This health policy measure

may have attributed to a decrease in consultations for sterilization in the period after 1 June 2004.

The increase in 'symptoms/complaints prostate (Y06)' might be due to the fact that new drugs for benign prostate hyperplasia became available in the period under study. This medical condition causes urination problems, and between 2002 and 2005, the pharmaceutical industry launched a broad advertising campaign focusing on urinary problems. The availability of these new drugs accompanied by the advertising campaign may have resulted in an increase in consultations for both prostate and urination problems in general practice.

The increased 'fear of venereal disease (Y25)' is not limited to men. We found an increased 'fear of venereal disease (X23)' among women as well, but this health problem was not selected for further investigation (the raw incidence increased from 10.0 to 19.6 among young women (15 through 24 years of age) and from 2.7 to 6.5 among women aged 25 through 44 years of age). The increased fear is probably explained by a considerable rise in the number of sexually transmitted diseases (STDs) in the examined period. In particular, Chlamydia, gonorrhoea and Lues showed an increase among both men and women. This trend is attributed to the availability of effective therapy for AIDS (Highly Active Antiretroviral Therapy) which resulted in an increase in unprotected sexual behaviour.[26,27]

We found an increase in 'frequent/urgent (U02)' and 'other urination problems (U05)' for both men and women. The availability of, and campaign for, new drugs for benign prostate hyperplasia as well as the increase in STDs provide a partial explanation for the observed increase in urination problems since both urinary tract infections and STDs may cause urination problems. Furthermore, these diseases share similar risk factors such as recent sexual activity.[28] The increase in urination problems among middle-aged and older women might be due to another, unknown cause of increasing urinary tract infections. Results of our study show an increase in 'urinary tract infections (U71)' among women of 25 years of age and older, but this health problem was not selected for further investigation (the raw incidence for all women increased from 69.0 in 2002 to 77.6 in 2005).

We could provide plausible explanations for most of our findings. These presumed causes, however, were not investigated in this study and no causal relationships were assessed. Therefore, these interpretations should be considered as hypotheses for further investigation.

Implications of findings

This study shows that data from EMRs can be a valuable source to monitor trends in the incidence of health problems in general practice over a relatively short time period. Extracting diagnoses from EMRs, provided that they are recorded accurately, is an efficient method to obtain a dataset that is large enough to pick up both usual and unusual changes over time. In this article, we provide an example of a strategy for processing, analysing and interpreting such data. This strategy is essentially applicable to all databases of routinely collected data in general practice. These new possibilities are relevant for future research, not only in the Netherlands, but in all countries with a high degree of Information Technology. Future research should aim to develop methods that disclose and use data from EMRs for research purposes, in particular methods for ensuring the quality of this data.

Results of this study regarding time trends in morbidity point at three important issues. First, attention should be paid to the increasing concern about reactions to drugs and the possible relation with the availability of over-the-counter drugs. Second, our findings indicate that advertising campaigns may have considerable impact on incidence rates in general practice. More research is needed to investigate the effect of advertising campaigns on the health care market. Third, the increasing incidence of urination problems and fear of venereal diseases is a cause for concern. Both health problems are probably related to an increase in the incidence of STDs and urinary tract infections.

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Conflicts of interest: None declared.

KEY POINTS

- Data from EMRs in general practice can be a valuable source for surveillance of public health, in particular for those countries using a gatekeeping system.
- This data can be used for monitoring health problems, provided that a strategy has been developed for processing, analysing and interpreting this information.
- This article provides an example of such a strategy. Development of methods that disclose and use data from EMRs is an important topic for future surveillance of public health.
- Attention should be paid to the increasing concern about reactions to drugs among middle-aged and elderly patients in the Netherlands.

The increasing incidence of health problems in the urogenital area in the Netherlands should be monitored closely as it could reflect increases in the incidence of STDs and urinary tract infections.

SUPPLEMENTARY MATERIAL

The supplementary material provides further details on the selection procedures, the analyses, and an overview of all adjusted rates with 95% confidence limits. Supplementary data are available at *Eurpub* online

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TABLES, FIGURES AND BOX

Table 1 Results of tests for a linear trend over time 2002–05 (*p*-values)

Health problems (ICPC code)[a]	Males	Females
Increasing based on raw incidence rates		
Concern about drug reaction (A13)	0.0008*	0.0039*
Change in faeces/bowel movements (D18)	0.0015*	0.0010*
Hypertension with involvement target organs (K87)	0.1797	0.1049
Frequent/urgent urination (U02)	0.0261*	0.0013*
Other urination problems (U05)	0.0004*	0.0005*
Family planning/other (W14)	NA	0.1573
Symptoms/complaints prostate (Y06)	0.0003*	NA
Fear of venereal disease (Y25)	0.0001*	NA
Decreasing based on raw incidence rates		
Sprains and strains of other joints (L79)	0.1821	0.1229
Chronic internal knee derangement (L97)	0.0028*	0.0547
Other head injury without skull fracture (N80)	0.1738	0.3482
Hypertrophy/chronic infection tonsils/adenoids (R90)	0.0719	0.4237
Diaper rash (S89)	0.6315	0.4708
Fear of being pregnant (W02)	NA	0.0113*
Family planning/sterilization (W13)	NA	0.0000*

a: International Classification of Primary Care
*Statistically significant at $P<0.05$

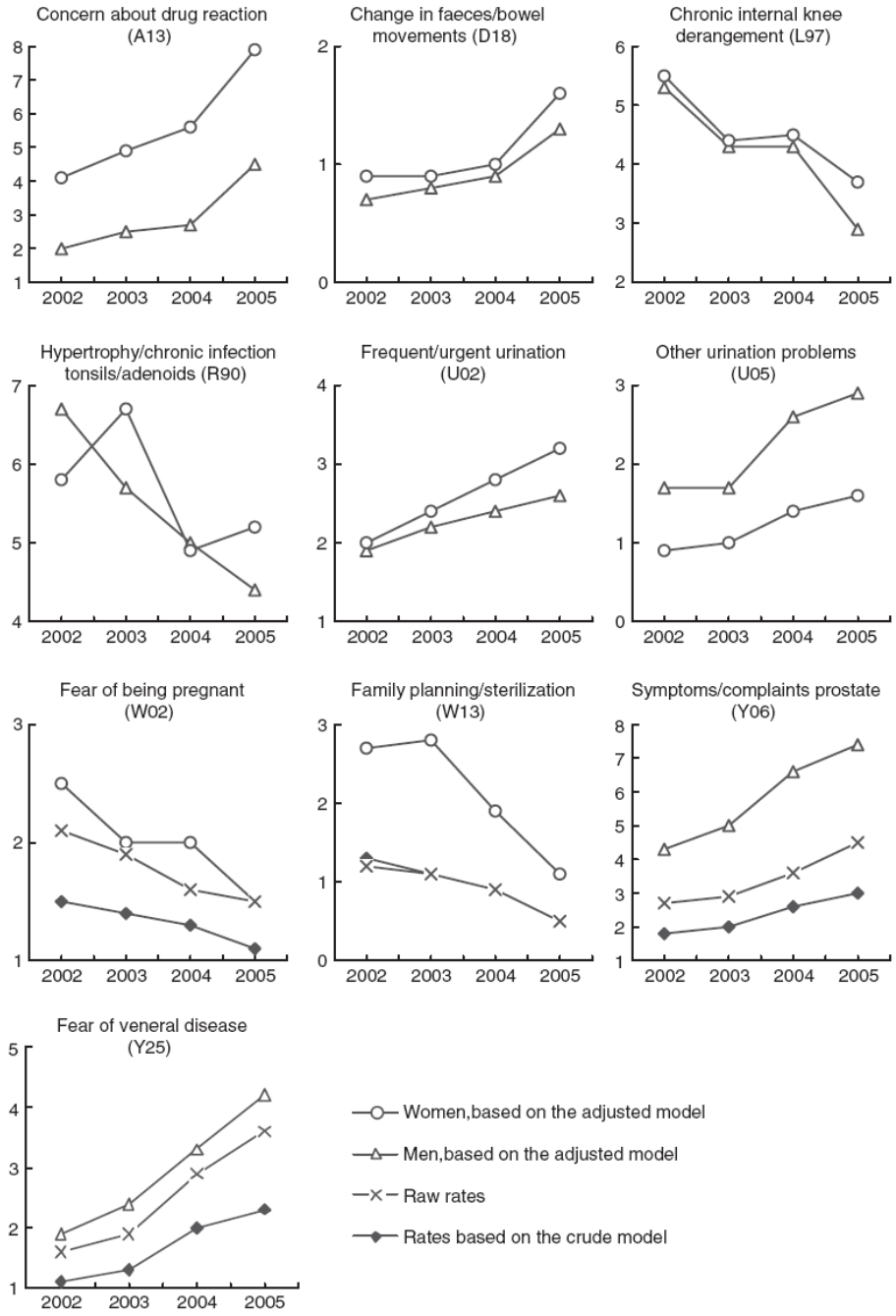

Figure 1 Incidence rates per 1000 per year, the Netherlands, 2002–05. All rates are corrected for clustering and age (adjusted model). Rates for men or women only (W02, W13, Y06, Y25) are compared with raw rates, and to rates corrected for clustering only (crude model).

BOX 1 POSSIBLE CAUSES OF CHANGING INCIDENCE RATES

Category 1: Changes in recording as a result of

a. change in GPs' perspective of disease;
b. change in rules for coding diagnoses;
c. change in rules for grouping diagnoses into episodes;
d. change in quality of recording;
e. change in general practice software;
f. unknown change in recording.

Category 2: Changes in supply of care as a result of

g. change in organization of care;
h. change in availability of drugs including

- introduction of a new drug;
- change in reimbursement of medication;
- change in availability of prescription versus over-the-counter drugs;

i. unknown change in supply of care.

Category 3: Changes in demand for care as a result of

j. media attention including advertising;
k. change in patients' perspective of disease;
l. change in patients' expectations of general practice;
m. unknown change in demand for care.

Category 4: Changes in incidence of disease as a result of

n. natural course of disease;
o. medical intervention;
p. change in lifestyle behaviour;
q. change in compilation of the patient population;
r. change in environment;
s. unknown cause that changes incidence of disease.