What factors explain the differences in morbidity estimations among general practice registration networks in the Netherlands? A first analysis

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ABSTRACT

Background: Information on the incidence and prevalence of diseases is a core indicator for public health. There are several ways to estimate morbidity in a population (e.g., surveys, healthcare registers). In this paper, we focus on one particular source: general practice based registers. Dutch general practice is a potentially valid source because nearly all non-institutionalized inhabitants are registered with a general practitioner (GP), and the GP fulfils the role as "gatekeeper". However, there are some unexplained differences among morbidity estimations calculated from the data of various general practice registration networks (GPRNs). Objective: To describe and categorize factors that may explain the differences in morbidity rates from different GPRNs, and to provide an overview of these factors in Dutch GPRNs. Results: Four categories of factors are distinguished: "healthcare system", "methodological characteristics", "general practitioner", and "patient". The overview of 11 Dutch GPRNs reveals considerable differences in factors.

Conclusion: Differences in morbidity estimation depend on factors in the four categories. Most attention is dedicated to the factors in the "methodology characteristics" category, mainly because these factors can be directly influenced by the GPRN.

INTRODUCTION

Morbidity rates are core indicators of public health and the healthcare needs of a population; therefore, valid information on incidence and prevalence rates of diseases is important [1]. There are several ways to estimate morbidity rates in a population, such as health interview surveys, health examination surveys, and healthcare registers, of which general practice based registers are an example [1]. Compared to morbidity rates estimated from health interviews, an important advantage of morbidity rates estimated from care-based data is that health problems are diagnosed by a physician.

In the Netherlands, and other countries such as the UK, nearly all non-institutionalized inhabitants are registered with a general practitioner (GP) [2-4]. Additionally, Dutch GPs fulfil the role as "gatekeeper": when patients seek medical care from a medical specialist, they have to be referred by their GP and, after consultation, the medical specialist reports back to the patient's GP [5]. GPs have contact with patients suffering from diseases in various stages of their disease and with all patient groups without selection regarding age, gender, socio-economic status, or ethnicity [6-9]. This makes Dutch general practice a potentially valid source of information on morbidity.

Many GPs keep an electronic medical record (EMR), primarily for direct patient care [10]. When several GPs collaborate in the collection of patient information (e.g., using a uniform data collection method, and the same registration rules and classification system) and, gather their information from separate EMRs into a central database, a general practice registration network (GPRN) is established [9, 11, 12]. Besides estimating morbidity figures, GPRNs can be used for a variety of purposes: they can act as an index for selecting patients with certain characteristics for research, for research into the course of illnesses, healthcare utilization, or quality of care, and for education or management [5].

In the Netherlands, there are multiple continuously recording GPRNs. The Continuous Morbidity Registration (CMR) Nijmegen, the oldest Dutch GPRN, dates back to 1967 [9]. Since then, many other continuously recording GPRNs have been established, and several continuously operating GPRNs still exist today.

Gijsen and Poos [13] demonstrated how data from GPRNs can be used to estimate morbidity in the Dutch population. They also showed that these estimations differ among various Dutch GPRNs. An example of these differences, the prevalence rates of rheumatoid arthritis, calculated from data from five different GPRNs, are presented in Box 1 (14)

[BOX 1]

To increase the utility of GPRN data for morbidity estimations in the Netherlands, a research project has been set up. The first part of this project is to gain more insight into differences in morbidity estimations among GPRNs. In this article, we describe and categorize several factors that may explain the differences in morbidity rates as calculated from data provided by Dutch GPRNs. In addition, we give an overview of several Dutch GPRNs and consider their dissimilarities as a first step towards explaining these differences.

FACTORS INFLUENCING MORBIDITY ESTIMATES FROM GPRNS

The factors described in this section potentially influence morbidity estimates calculated from GPRNs. The categories of factors are based on different levels, such as country, region, practice, and doctor, as described by Marinus 15. These levels relate to different sources of variation, which we translated into the GPRN situation and to which added the "patient" level as an additional source of variation 15. Explanations for these factors are based on findings from previously published studies. It is important to realize that the occurrence of diseases in the population determines morbidity, but that the different factors described here influence the estimation of that morbidity. The categories and factors are presented in Figure 1.

[FIGURE 1]

Within a GPRN, we distinguish four categories of factors: "healthcare system", "methodological characteristics of the network", "general practitioner", and "patient". The factors and sub-factors are shown as independent, but they are often interrelated.

The healthcare system refers to the levels of the country and regions. The healthcare system defines the accessibility of GPs and other healthcare professionals in a specific country and the rules or laws to which GPs have to comply 3, 16. If medical specialists or other healthcare providers are directly accessible and do not report information to the patient's GP, the completeness of the information from general practice based data about morbidity will be reduced 5. Most healthcare system related characteristics are identical for an entire country, but within a country regional differences also exist. Examples of regional differences are the distance between the general practice and the nearest hospital, the organization of GP out-of-hours services, and cooperation with other healthcare facilities 17. The geographical spread of the GPRN is also an important factor 18.

The second category of factors includes the methodological characteristics of the GPRN. The operating definitions and registration rules affect the validity and reliability of the data for estimating morbidity rates 13, 19, 20. A large range of factors concerning definitions and rules are important: Which morbidity data are included in the GPRN database (only chronic conditions or also acute, minor health problems)? Which classification system or diagnostic criteria, if any, are used to record the morbidity information? What are the operational definitions of incidence and prevalence to determine morbidity? How are all patients with a specific disease counted in the GPRN (numerator)? Are data from all contact with the patient taken into account or only from face-to-face contact? Is all information received by a GP on morbidity taken into account, such as information from medical specialists? 21, 22. Another important methodological aspect is size, i.e., the sampling size of the total population of interest (in our case, the total Dutch population). Sampling size influences the power of the estimations 23.

The methodological characteristics of a GPRN are strongly influenced by the main purpose of the GPRN. As Knottnerus 24 comments: "a diversity of objectives inevitably brings diversity of methods and systems". The definitions and registration rules of a GPRN are derived from its purpose 19.

In addition, "quality assurance" is an essential methodological factor; it determines, for example, GPs' compliance with the rules and therefore also influences the validity and reliability of the data 9. Key issues here are the application of minimum quality criteria, systematic checking of the data, and feedback to GPs about data quality, all of which are incentives for providing high-quality data 23, 25.

The third category of factors regards the "general practitioner" and refers to the influence of GP characteristics within a GPRN on morbidity figures. Marinus 26 studied this factor and concluded that morbidity rates vary considerably among GPs. Research also showed that this variation depends on the disease under study 27. Less variation in morbidity rates between

GPs is found regarding diseases that are easy to recognize or have clear diagnostic criteria, such as herpes zoster or diabetes mellitus 8, 15, 28-30.

The factor "general practitioner" also contains practice characteristics. These characteristics include, for example, the number of GPs working in a practice, whether GPs work in a healthcare centre or in separate practices, the intensity of cooperation among GPs, and the employment of other personnel such as practice assistants and practice nurses 29. Less variation in contact frequency is found among GPs within a practice compared to that among practices 29.

The software package used to record patient information, the actual EMR, is also a factor that can explain differences between GPRNs. For example, previous research showed some unexpected differences in consultation rates related to these information systems, even after adjustment for explaining factors 29.

The category of factors related to the "patient" is divided into individual patient characteristics ("case mix") and the GPRN population as a whole. Patients differ from each other in many aspects, such as age, gender, socio-economic status, ethnic origin, and lifestyle 31. These aspects determine the probability of contracting a disease and whether a person seeks help and contacts his or her GP 32. Furthermore, the representativeness of the population of all practices participating in the GPRN, compared to the population of interest, is important for the generalizability of the results 19.

GPRNs in the Netherlands

A first step towards understanding the differences in morbidity estimations among various GPRNs is to review these GPRNs with respect to the factors from the four categories. The GPRNs described in this article meet two criteria: they continuously collect data concerning all morbidity presented in general practice, and they are part of a long-term project. Eleven Dutch GPRNs fulfilled these criteria; the abbreviation and full name of each GPRN is presented in Box 2.

[BOX 2]
The authors from RIVM created a list of GPRN characteristics, which includes different aspects of the main categories of factors. Using the available background information in books, reports, and articles, they completed this list for each GPRN. The network coordinators of each GPRN checked and completed the list. Table I shows the characteristics of the 11 GPRNs.

[TABLE 1]

All the studied GPRNs function within the Dutch healthcare system, so little difference is expected in terms of the healthcare system. The only differences may occur with respect to geographical differences, as only LINH and IPCI operate nationally.

Methodological characteristics, however, do vary between GPRNs. The sizes of the GPRNs range from 13500 to 600000 registered patients, with the number of GPs and practices ranging between 8 and 362 and 3 and 80, respectively.

The main goals of the GPRNs can be divided into two objectives, but providing input for and conducting scientific research are common aims. One objective is to generate information about general practice in general; the other objective regards to supply a sampling framework.

The method used to establish the epidemiological numerator depends on several characteristics, such as the type of network, the recording rules of the GPRN, the classification system used, and the software package used. In the Netherlands, there are two

main network types: "contact" and "problem list" based GPRNs. "Problem list" based GPRNs only contain information about the health problems of a patient that are permanent, chronic (duration longer than 6 months), or recurrent 18. HAG-net-AMC and RNH are "problem list" based GPRNs and consequently count the number of diseases recorded on the "problem list" to establish the numerator. "Contact" based GPRNs store information about all patients' health complaints and diagnoses from all contact with the practice in their database. Information from several contacts is structured into "episodes" for a specific disease. Such "episodes" are assigned by the GP. To establish a numerator, all episodes are counted. CMR-N, HNU, RNG, and Trans count all "episodes" for a specific disease. ANH-VUmc, RNUH-LEO, and SMILE extract information from both methods (problem list and episode construction by GPs) into their database. LINH is a "contact" based GPRN, which constructs episodes afterwards using EPICON, a computerized algorithm which links separate contacts into one "episode" 33.

The most commonly used classification system for classifying diseases is ICPC-1. Other classifications in use are ICPC-2 and E-list. All GPs in the included GPRNs record information in an electronic medical record software system, but they vary with regard to the software package used. A GPRN usually utilizes only one or two software packages.

A software package sometimes forces the GP or the GPRN to choose a certain method. GPRNs use different operational definitions of episodes. CMR-N includes all the information a GP has about a patient in determining morbidity. SMILE, RNG, and LINH include data about all GP-patient contact, including indications for prescriptions. For "contact" based GPRN databases, the completeness of the numerator depends on what information is recorded. "Contact" based GPRNs vary substantially in this respect. Data from face-to-face contact with the GP and home visits during weekdays are usually recorded, as well as data from telephone contact. Data regarding contact during out-of-hours services are recorded the least. Data regarding contact with practice nurses and assistants are recorded when this is important for patient care, but these entries are often incomplete.

Nine GPRNs check for misclassifications and impossible or illogical data combinations after data extraction from the practices. HAG-net-AMC, HNU, IPCI, LINH, and RNUH-LEO also monitor data completeness.

To ensure a reliable and valid registration of diseases, different methods are used: training of GPs, explicit documentation, and meetings among GPs concerning registration difficulties and consensus procedures. Ten out of the 11 registrations give feedback to GPs about their recording performance.

The epidemiological denominator indicates the total population at risk for all practices participating in the GPRN. It is possible that the composition of the population with respect to socio-economic status, ethnicity, level of urbanization, etc. differs among the GPRNs. Moreover, several GPRNs are located in limited regions of the country, and it is well known that the health status of the population differs among regions 34. For all GPRNs, the population's age and gender distribution is known. Eight out of 10 GPRNs also record family characteristics, such as household size. CMR-N, RNH, and SMILE also include socio-economic status indicators, such as education and occupation. Most GPRNs include the numerical part of the zip codes of the addresses of their population, from which socio-economic status can be roughly estimated 35.

DISCUSSION

In this article, several factors that may explain the differences in morbidity estimates from various GPRNs are described. Four main categories of factors are distinguished. In future research, we will investigate the influence of these different factors on morbidity estimations. In addition, an overview is given of 11 Dutch GPRNs, which reveals considerable differences among GPRNs. In this article, most attention is dedicated to the factors in the "methodological characteristics" category. One reason for this is that these

factors can be directly influenced by the GPRNs, unlike for example the healthcare system or patient factors.

Using the differences in estimations of the prevalence of rheumatoid arthritis (RA) among five GPRNs (Box 1) and the variation of factors among these GPRNs, we can identify several possible explanations. RNH and RNUH-LEO show relatively high estimations, which may be explained by the fact that both GPRNs are "problem list" based networks. A diagnosis on the "problem list" remains in the database until the patient is cured or until the disease is no longer relevant for the patient's care, whereas the contact-based databases LINH and Trans only count prevalent cases of RA when contact related to RA has taken place in a particular year. Another difference is that CMR-N uses the E-list for classification of RA, in contrast with the other networks, which use ICPC. In the ICPC classification, the code for RA also contains other rheumatoid disorders such as ankylosing spondylitis, whereas the E-list code only includes RA. However, this was not reflected by a lower estimation of RA in the CMR-N. At this point, the only conclusion is that explaining the differences is complex.

The other categories of factors that might explain the differences may not be influenced by the GPRN, but they cannot be ignored. The geographical areas covered by the Dutch GPRNs vary. Because some GPRNs act regionally instead of nationally, a part of the variation in morbidity rates is probably based on real differences, as the health status of the population is not equally distributed across the country [34].

The composition of the practice and GP and patient characteristics in relation to the entire population of interest determine the representativeness of the GPRN population. In addition to adjusting for gender and age of the GPRN population, one could adjust for socio-economic status. Direct measurements of socio-economic status, such as education, are preferred to indirect measures such as zip codes.

In further research, we want to study the influence of the factors described in this article. It would be particularly interesting to establish which factors affect the validity of the estimations of morbidity figures. However, we do not expect that the factors presented here will explain all variance in morbidity figures, because the process of diagnosing is known to be a complex interaction between knowledge, the wishes of the patient, the GP's opinion, and other factors [29].

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BOX, FIGURE AND TABLE

Box 1. Prevalence rates of rheumatoid arthritis from five general practice registration networks (GPRNs) in the Netherlands.

The National Institute for Public Health and the Environment uses information about diseases derived from GPRNs for the estimation of morbidity rates presented in the National Public Health Compass (14).

Prevalence[‡] rheumatoid arthritis (per 1000 patients)

	CMR-Nijmegen	LINH	RNH	RNUH LEO	Transition Project
Men	5.11	2.97	9.40	6.83	3.06
Women	6.40	5.92	13.49	13.19	7.18

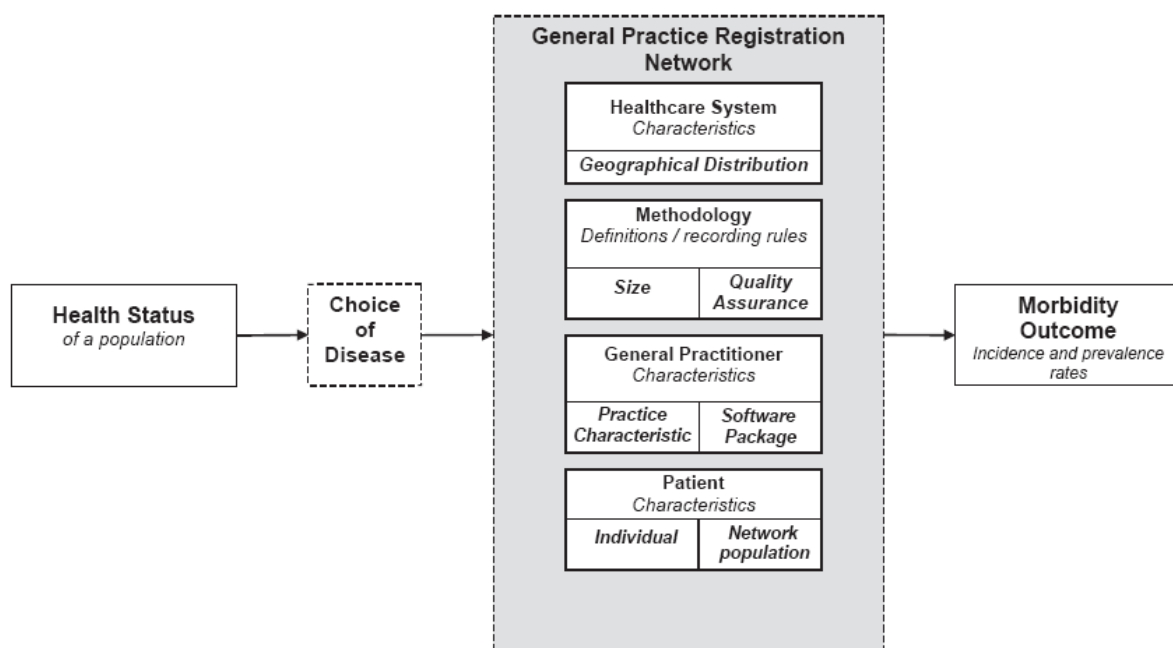[‡]These rates are based on data from GPRNs, which were available in 2005

Figure 1. Factors influencing morbidity figures of general practice based registration networks.

Box 2. Ten Dutch general practice registration networks.

Abbreviation	Full name (Dutch)	Full name (English)
ANH-VUmc	Academisch Netwerk Huisartsgeneeskunde, Vrije Universitair medisch centrum	Academic General Practice Network of VU University Medical Centre
CMR-N	Continue Morbiditeit Registratie Nijmegen	Continuous Morbidity Registration Nijmegen
HAG-net-AMC	Huisartsen Netwerk Academisch Medisch Centrum	General Practice Network Academic Medical Centre
IPCI	–	Integrated Primary Care Information
LINH	Landelijk Informatie Netwerk Huisartsenzorg	Netherlands Information Network of General Practice
RNG	Registratie netwerk Groningen	Registration Network Groningen
RNH	Registratie net huisartspraktijken	Registration Network Family Practices
RNUH Leo	Registratie Netwerk Universitaire Huisartspraktijken Leiden en omgeving	Registration Network of General Practitioners Associated with Leiden University
SMILE	Studie naar Medische Informatie en Leefwijzen in Eindhoven	Study into Medical Information and Lifestyle in Eindhoven
Trans	Transitie Project	Transition Project
HNU	Huisartsen Netwerk Utrecht	The Utrecht Network of General Practitioners

Table I. Outline of 11 Dutch general practice registration networks (GPRNs).

	ANH-VUmc	CMR-N	HAG-net-AMC	HNU	IPCI	LINH	RNG	RNH	RNUH- LEO	SMILE	Trans
Healthcare system											
Localization	Amsterdam, Amstelveen, and Haarlem	Nijmegen and surrounding area	Care area AMC Amsterdam	Province Utrecht	Throughout the Netherlands	Dutch representation	Groningen, Hoogezand-Sappemeer, and Hoogeveen	Province of Limburg	Leiden and surrounding area	Eindhoven	Amstelveen and Franeker
Methodological aspects											
- Sample size											
Size	70 000	13 500	57 000	56 210	600 000	350 000	30 000	87 780	30 000	56 000	13 160
No. of GPs/practices	47/12	11/4	44/37	35/22	362/not counted	160/80	17/6	65/22	20/4	32/9	8/5
- General information											
Goal	Improving quality of family medicine	Generating epidemiologic data for diseases	Providing a sample framework for scientific research	Collecting longitudinal data for scientific research	Collecting data from primary care for post-marketing surveillance	Providing information about GP care, quality of care, and public health	Systematic collection of information for patient care	Providing a sample framework for scientific research	Supporting scientific research, education, and GP care in general	Collecting hybrid data for research and sampling framework from questionnaires and GP care	Formulating, characterizing, and describing GP-based epidemiology
Type of network	Problem list and contact based GPRN	Contact based GPRN	Problem list based GPRN	Contact based GPRN	Contact based GPRN	Contact based GPRN	Problem list and contact based GPRN	Problem list based GPRN	Problem list and contact based GPRN	Problem list and contact based GPRN, and patient questionnaires	Contact based GPRN
Classification[#]	ICPC	E-codes	ICPC	ICPC-2	ICPC	ICPC	ICPC	ICPC-1	ICPC-1	ICPC-1	ICPC-2/ ICD-10
- Definitions											
Numerator	Episodes[a] and problems[b]	Episodes[c]	Problems[b]	Episodes[a]	Complete records[d]	Contacts[e]	Episodes[f]	Problems[b]	Episodes[a] and problems[b]	Episodes[a] and problems[b]	Episodes[g]
- Data available											
Recorded information	Morbidity, prescriptions, and referrals	Morbidity, referrals, and hospital admission	Morbidity, prescriptions, and intervention	Morbidity, prescriptions, referrals, and intervention	Morbidity, complete records	Morbidity, prescriptions, referrals, and intervention	Morbidity, prescriptions, referrals, type of contact	Morbidity, prescriptions, medication dossier	Morbidity, prescriptions, medical history, diagnostic dossier, and referrals	Morbidity, prescriptions, referrals, number and type of contacts	Morbidity, all proceedings in practice[§]

Table I (*Continued*)

	ANH-VUmc	CMR-N	HAG-net-AMC	HNU	IPCI	LINH	RNG	RNH	RNUH- LEO	SMILE	Trans
Recording: out-of-office hours, telephone contact, visits	No agreements	Out-of-hours and telephone contact, and visits	Differs per location	Telephonic contact and visits, but incomplete	No agreements	Telephonic and e-mail contact, and visits	Out-of-hours and telephone contact, and visits	No	Out-of-hours (except one practice) and telephone contact, and visits	Telephone contact and visits	Yes, all out-of-office hours only employee GP
Recorded contact with other employees?*	Varies between practice and GPIS	Yes Assistant	Yes Assistant	Yes Assistant	Yes But no agreement	Yes Assistant and nurse practitioner	Yes Assistant, nurse practitioner, and locum tenens	Contacts are not used in database	Yes Assistant, physician assistant, and locum tenens	Yes	Yes Assistant, physician assistant, and locum tenens
- *Quality assurance* Control of data after extraction	Yes Impossible or illogical combinations	Yes File size and misclassifications	Yes Impossible or illogical combinations and missing values	Yes ID codes and completeness	Yes Completeness and internal consistency	Yes Completeness and internal consistency	No	Yes Impossible or illogical combinations or values	Yes Population, impossible values, missing links, completeness, and doubles	No (in future)	Yes Doubles
Classification agreements	Instruction GP	Training GP	Internal training GP	Expertise promotion	Absence of paper registration	Explicit documentation, introduction period for new GPs	Explicit documentation	Training GP, coding assistance (RNH web, RNH assistant program, help file)	Internal training GP and explicit documentation	Instruction GP	Inclusion and exclusion criteria registered in ICPC-2
Feedback concerning data to GP	?	Yes	Yes	Yes GP info-net	Yes	Yes	Yes+annual report and newsletter	Yes	Yes	Yes	Yes
Meetings	Yes Monthly and 2 per year	Yes Monthly	Yes 2 per year	Yes 5 per year	Occasionally	Optional Once a year	Yes 2 per year and 1 weekend	Yes 2 per year	Optional Once a year	Optional	Yes, 6-weekly and 1 weekend
Content of meetings	Education, GP work-shops	Classification difficulties, consensus	Quality of the registration, special items	Education and registration	Scientific topics	Not applicable	Registration problems	Consensus	Not applicable	Registration difficulties, benchmarking	Classification problems, special items

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Table I (*Continued*)

	ANH-VUmc	CMR-N	HAG-net-AMC	HNU	IPCI	LINH	RNG	RNH	RNUH-LEO	SMILE	Trans
Information system software package	OmniHIS, MicroHIS, and Medicom	Promedico	Mira and MicroHIS 8	MicroHIS and Promedico	Elias, Promedico, MicroHIS, Medicom, and HetHIS	Arcos, Mira, Promedico, OmniHIS, MicroHIS, Elias, and Medicom	MicroHIS	MicroHIS and Zorgdossier	Medicom	Medicom	TransHIS
Patient characteristics Patient characteristics	Year of birth, gender, zip code, patient category (fixed or not fixed)	Gender, age, social class, education level, family situation, occupation, zip code	Date of birth, gender, family situation (ethnicity)	Date of birth, gender, family situation, zip code	Gender, age, family situation, patient category (fixed or passer-by)	Date of birth, gender, family situation, zip code, patient category (fixed or passer-by), GP code	Date of birth, gender, zip code, GP code	Date of birth, gender, family situation, education (>25 years old), zip code, status fixed or not	Age, gender, number of family members	Date of birth, gender, educational level, marital status, living arrangement, zip code	Date of birth, gender, family situation, zip code

[#]Classification system according to the GPRN.
[*]Employees, other than practice GPs, who record data in the EMD, according to the GPRN.
[a]Counting 1-year prevalence, thus after at least one GP–patient contact in the reference year.
[b]Use all diseases or complaints which are permanent, chronic, or recurrent, or which need to be brought to GP's attention.
[c]Use all information about morbidity a GP receives, aditionally chronic and permanent disease episodes are continued in the following years.
[d]Depends on the research question: whole record information is possible (free text, diagnoses, prescriptions, specialist letters, etc.).
[e]Episode construction after collection in database.
[f]Start with morbidity episodes, with possible completion with prescriptions, referrals, and interventions.
[g]Use all information about what takes place in general practice.
[§]All proceedings in practice, including type of contact, reason for contact, episode-of-care status, coding changes, referrals, test results, interventions, prescriptions, etc.