Using medical call center data to explore the ecology of health information: a prospective cross-sectional study

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1. Abstract

Background The relationships between people and their health care environments are known as the ecology of medical care. Over the last few decades structured and classified data, reflecting the health problems of patients consulting a formal healthcare provider, have become more and more available. These data allow a deeper insight into the ecology of medical care at the primary and secondary care level. Contemporary information and communication technologies reveal new ways of interaction between citizens and health care professionals and lead to new sources of digitized data on people's demands for health care information and support prior or after consulting a formal health care provider.

Aim To achieve deeper insight into the demand for health care information of Swiss citizens by analyzing the reasons for encounter with a medical call center.

Methods Cross-sectional study considering all the medical information and triage datasets from a Swiss medical call center from January 1, 2006 to December 31, 2006 (n=32,784). The data were analyzed descriptively and by applying inferential statistics. The independent variables (age group, gender, time of the day, time of the year, residence) were related to the dependent variables (by ICPC-2 chapters and codes).

Results The vast majority of the people called because of symptoms and for medication and treatment advice. The reasons for encounter across the different age groups mirror the everyday aches and pains of the human experience, starting with the adaptation disorders of the toddler and ending with the complaints related to degenerative disorders in the elderly. The study revealed an obvious gender difference with regard to the utilization rate of the service as well as to the presented reasons for encounter. Respiratory symptoms were overrepresented during wintertime and skin problems, mainly insect bites, predominated in the summer. The residence of the callers played no role.

Conclusions Modern information and communication technologies offer opportunities to learn more about the health information demands of the public. The distribution of the reasons for encounter with the medical call center we studied resembles the case mix among primary care practices. However, there are some divergences indicating a demand for health information by the public, which might be underestimated when relying on primary care morbidity data alone. The findings can have an impact on the organization of health care, research, and medical education in primary care and public health.

2. Introduction

A key issue for European health policy is to enable and empower individuals to take more responsibility for their own everyday health[1]. On one hand this implies that the individual must acquire the cognitive and social skills and abilities necessary to access, understand, and use information to promote and maintain good health. On the other hand this means that the supply of information has to be adapted to meet the demands and needs of the public[2]. In order to target the actual health information requirements of the citizen, the stakeholders need a deeper insight into the ecology of medical care[3].

Ever since the landmark conceptualization by White et al. was published in 1961[4], the relationships between people and their health care environments have been known as the ecology of medical care. Webster's dictionary defines ecology as the totality or pattern of relationships between organisms and their environment[5]. Nowadays, health and medical information has become ubiquitous and easily accessible through the Web or telephone-based citizen-oriented health information systems. This publication referred to the interrelationship of citizens and patients with their health information environment as the ecology of health information.
White et al. investigated the proportions of persons using health care services in particular settings. According to the original data and subsequent updates, the monthly prevalence of symptoms in a typical U.S. population of all ages is about 80%[4, 6, 7]. However, only about 20% of the population visits a physician's office for their health complaints. Despite the wide acknowledgement of the ecology model, White himself emphasized the limited exploitation of its true potential in an editorial published in the Annals of Family Medicine in 2003[8]. He advocates for the expansion of the model and urges health information systems to strive to trace the natural history of the search by individuals and populations for the resolution of their initial and ongoing problems.

The development and application of the international classification of primary care during the past two decades has been shown to be a major prerequisite for a deeper insight and understanding of the daily clinical work in primary care and hence the ecology of this specific field. However, the corresponding studies primarily focus on the literal position that primary care begins only when a patient first consults a formal healthcare provider[9-13]. With reference to the ecology model, this approach considers only a minor part of the population that seeks health information or experiences some kind of illness symptom. Moreover, information systems in primary care are bound to the institutions of the formal care providers (medical practices, hospitals) and are not designed to mirror the problems and needs of individuals and populations beyond the consultation rooms. By contrast, contemporary information and communication technologies reveal new ways of interaction between citizens and health care professionals and lead to new sources of digitized data on people's demands for health care information [14-18]. In recent years medical call center services and online counseling have become

operational in Switzerland. The information systems of these health care institutions contain digital data, which are perfectly suited to trace the natural history of the search by individuals and populations for the resolution of their initial and ongoing problems.

The purpose of this study is to achieve a deeper insight into the demands of Swiss citizens for health information by analyzing the reasons for encounter with a medical call center. In order to make more general statements, the respective findings will be discussed with reference to other comparable research[19-21] and from a socio-technological perspective[22, 23]. The study results could have an impact on the medical content and design of citizen-oriented health information systems. Moreover, this study might influence the thinking about the organization of health care, research, and education in public health and primary care.

3. Methods

3.1. Design and Setting

The study design corresponds to a prospective cross-sectional study. All incoming calls received from January 1, 2006, to December 31, 2006 were included in the study.
The data source for this investigation is the operational database of a medical call center in Switzerland. The services of the call center we studied are available 24 hours a day, 7 days a week and cover the Swiss German-, French- and Italian-speaking regions. The staff of the medical call center consists of 42 nurses with an average of 15 years' work experience in different health care institutions. Prior to starting work, the nurses received specialized training for three months, including the theory and practice of ICPC-2 coding. This coding process is integrated into the telephone consultation and is carried out just in time by the nurse. The coding is mandatory. However, the nurse is allowed to code on the ICPC-chapter level or use the rag bag categories (e.g. general and unspecified, other), when necessary, to maintain an even workflow. The nurses are supported 24 hours a day by 7 board-approved general practitioners and internists. The services are reimbursed through a yearly capitation fee paid by the health insurers.
The callers can claim two different services. One is called *medical triage*, whereby qualified nurses on the phone, using a computerized decision support system[24], assess the presented ailments and advise the callers on how to treat themselves or, depending on the urgency, to seek further medical assistance from their GP or an ER. The other is called *medical information*, whereby qualified nurses on the phone, using validated medical information sources, answer a wide range of medical questions.

3.2. Population and sample

In 2006, the basic health insurance package of 1.63 million Swiss citizens (1/5 of the Swiss population) provided them with free access to the services of the medical call center. The potential user population can claim the provided services voluntarily. The health care insurers sporadically advertise the service in their customer magazines. In 2006 the call center received 32,784 calls, resulting in a utilization rate (calls/insured population/year) of 2.01%.

3.3. Instrumentation

Apart from the voice recording, all calls are digitally documented by the nurse in a structured way, using a proprietary process management information system.
Since April 2005, the nurses at the medical call center code the main reason for encounter of the caller at the end of the telephone conversation according to ICPC-2. Using a digital hierarchical display (component, chapter, code), the coding can be done just in time at the point of care. When designing the information system ICPC was selected from among other classification systems (ICD-10, SNOMED) because it has been shown to be a reliable and valid tool to classify a large number of the issues arising in the primary[11-13, 25] and community[26] health care environment. ICPC enables the data to be coded according to presenting complaints as well as diagnosis. Since the working method of counseling at a medical call center is essentially symptom-oriented or based on existing diagnoses, component 1 (symptoms and complaints) and 7 (diagnosis) fit perfectly into this environment. Components 2-6 of the classification system are designed to code procedures which are applied in the practice of physicians (e.g. test and treatment). These procedures are not performed at a medical call center. However, people call to ask questions about diagnostic and treatment procedures. The components were reduced to the component numeration (2-6) and, if useful, to some procedure codes (e.g. -43: other diagnostic procedures; -44: preventive immunizations/medications; -45 preventive education/counseling). In addition, a few codes were added for call center issues that ICPC-2 did not cover (e.g. -1001 specific question about complementary and alternative medicine; -1002: specific question about referral).

ICPC has been used by other researchers as well to characterize the medical complaints presented during telephone consultations[27-29]. However, these publications were restricted to the specific setting of an outpatient/emergency clinic, the coding was compiled retrospectively by a researcher and the complaints were only presented under the 17 broad chapters of ICPC. Moreover, the study questions did not focus on a detailed epidemiology of the reasons for encounter with a medical call center.

In the absence of a comparable study in the medical call center environment, and with the aim of framing our data within a broader context, we decided to

compare our results with two primary care studies[19, 20] and one publication on the use of online counseling in Switzerland[21]. We chose the study by Okkes et al.[19] because it was published recently, the reasons for encounter were coded with ICPC-2 and it included different countries. The studies by Busato et al.[20] and Neuhaus et al.[21] were selected because they relied on the same health care system as our study.

3.4. Variables

The independent variables (age group, gender, time of day, time of year, urban/suburban/rural region) were related to the dependent variables (prevalence of ICPC-2 chapters and codes). In order to get a manageable data set and to increase the accuracy of the statistical analysis, only prevalences above 0.001 were considered[10].
The different age groups were as follows: <1, 1-4, 5-16, 17-25, 26-35, 36-45, 46-55, 56-65, 66-79, 80-99, 99+ [years of age]. Furthermore, since the case mix between adult and pediatric medicine differed considerably and in order to achieve better comparability with the existing literature, the population was divided into adult (>16) and pediatric subpopulations (0-16). The time of day was aggregated as follows: 0-6 (night), 6-12 (morning), 12-18 (afternoon), 18-24 (evening). The times of the year were aggregated to a cold season (winter): December/January/February, a warm season (summer): June/July/August and two in-between seasons (spring): March/April/May and (autumn): September/October/November. The calls from the different regions of Switzerland were divided into urban, suburban and rural regions in accordance with the specifications of the Swiss Federal Institute of Statistics.

3.5. Data Analysis

In addition to a descriptive analysis, inferential statistics were also applied as briefly described below. For a more detailed description of our methods, including explicit formulas for the estimators and standard errors, the reader should refer to the technical report[30].

For any incoming call we considered a first variable, T (called independent variable above) with possible values 1, 2, …, j_o and a second variable R (called dependent variable above) with possible values 1, 2, …, k_o. For arbitrary fixed numbers $1 \le j \le j_o$ and $1 \le k \le k_o$ we considered the following unknown parameters:

$h(j,k)$:= expected number of calls with $T = j$ and $R = k$,
$h(j,k^c)$:= expected number of calls with $T = j$ and $R \neq k$,
$h(j^c,k)$:= expected number of calls with $T \neq j$ and $R = k$,
$h(j^c,k^c)$:= expected number of calls with $T \neq j$ and $R \neq k$.

The question was whether the events $[T = j]$ and $[R = k]$ were "positively correlated" in some sense. This could be expressed as follows: Let

$p(k \mid j) := h(j,k) / (h(j,k) + h(j,k^c))$,
$p(k \mid j^c) := h(j^c,k) / (h(j^c,k) + h(j^c,k^c))$.

These numbers were the expected relative proportions of calls with $R = k$ among all calls with $T = j$ and $T \neq j$, respectively. Similarly, let

$q(j \mid k) := h(j,k) / (h(j,k) + h(j^c,k))$,

$q(j \mid k^c) := h(j,k^c) / (h(j,k^c) + h(j^c,k^c))$,

the expected relative proportions of calls with $T = j$ among all calls with $R = k$ and $R \neq k$, respectively. Finally we defined the odds ratio

$\mathrm{OR}(j,k) := h(j,k)\, h(j^c,k^c) / (h(j,k^c)\, h(j^c,k^c))$.

Then we considered the two events $[T = j]$ and $[R = k]$ as being "positively correlated" if one of the following inequalities was satisfied, all of which were easily shown to be equivalent:

$p(k \mid j) - p(k \mid j^c) > 0$,

$q(j \mid k) - q(j \mid k^c) > 0$,

$\ln(\mathrm{OR}(j,k)) > 0$.

Because of the equivalence of these three conditions we then focused on the log odds ratios In OR(j,k) and compiled a list of pairs (j,k), such that the corresponding values ln OR(j,k) were strictly positive with a certain (simultaneous) confidence interval of 95%.

If we could model the set of observed calls as independent, identically distributed random variables, our task could have been performed easily via Fisher's exact test combined with Holm's (1979) adjustment of p-values. Unfortunately, the independent entities are callers (insured people) rather than calls, and modeling the calls of one person as independent observations would be very unrealistic. Thus we developed different expressions for the standard errors of the estimated log odds ratios ln(OR(j,k)) and computed

(i) simultaneous right-sided p-values for the $j_o k_o$ null hypotheses "ln(OR(j,k)) ≤ 0" via a normal approximation and Holm's (1979) adjustment;

(ii) simultaneous lower confidence bounds for the $j_o k_o$ parameters ln OR(j,k) via a normal approximation and Bonferroni adjustment.

Finally we considered the special case of T being defined in terms of gender and age of the caller (or, to be more exact, the person for whom the call was made). Here our goal was a list of values j for T such that

$p(j)$:= expected relative proportion of calls with $T = j$

was significantly larger than

$p_o(j)$:= expected relative proportion of calls with $T = j$

Again we resorted to suitably defined estimators and standard errors plus normal approximations and Bonferroni-Holm adjustments in order to solve this problem.

4. Results

4.1. Descriptive statistics

In 2006, the medical call center received 32,784 calls from all regions of Switzerland: 21,067 (64%) medical triage calls and 11,717 (36%) medical

information calls. In 26,185 cases (80%) the call was for an adult, in 6,599 cases (20%) the call concerned a child. There were 20,273 calls (62%) for females and 12,477 calls (38%) for males. For 34 calls (0.1%) the sex was not specified. The relative frequency of calls and insured persons were stratified according to gender and age group, as shown in Table 1.
The calls for females were overrepresented in the age groups <1 ($p<0.0001$, $SE=0.0009$, $CB=0.0125$), 1-4 ($p<0.0001$, $SE=0.0015$, $CB=0.0352$), 26-35 ($p<0.0001$, $SE=0.0024$, $CB=0.0931$), 36-45 ($p<0.0001$, $SE=0.0021$, $CB=0.0787$), 56-65 ($p=0.0001$, $SE=0.0032$, $CB=0.0780$) and 66-79 ($p<0.0230$, $SE=0.0085$, $CB=0.0819$). The calls for males were overrepresented in the age groups <1 ($p<0.0001$, $SE=0.0010$, $CB=0.0141$) and 1-4 ($p<0.0001$, $SE=0.0015$, $CB=0.0388$). Displayed in the brackets are the adjusted right-sided p-values (p), the standard error (SE) as well as the left-sided 95% confidence bound (CB) for the relative frequency of the calls.
These data show a pronounced need for health information support among parents of toddlers. Moreover, there is an obvious gender difference, revealing a higher utilization rate of medical call center services among adult females than adult males. While women have been shown in population-based studies to report symptoms more frequently[31-33] this phenomenon is still a subject of an ongoing debate[34]. However, our results speak in favor of a gender difference.
Table 2 shows the call distribution according to the different times of day and year. The utilization rate was highest in the cold season and lowest during the summertime. The call frequency was within the same range in the morning, afternoon and evening (30%) and fell significantly during the night (6%). The calls broke down as follows: 15,881 (48%) callers lived in urban areas, 10,108 (31%) callers lived in suburbs and 6,438 (20%) calls concerned persons living in rural areas. In 357 (1%) cases the callers did not provide information about their residence.

The vast majority of people called because of symptoms (68.2%) and for medication and treatment advice (18.6%). Only a minority sought information about a specific disease or support concerning diagnostic, screening and preventive measurements, test results or referrals. In order to encompass one year of call center activity, 665 ICPC codes were used, which broke down as follows: 285 ICPC codes (89% of the 320 available) were used in order to code all the complaints and symptoms, while 200 ICPC codes (55% of the 366 available) were used for coding all the diseases and diagnoses. Five-thousand-one-hundred-twenty calls (15.6%) were coded on the chapter level or using rag bag codes.

Questions about the medication and treatment of general and unspecified health problems (ICPC code A50) accounted for the single most frequent reason for encounter among the total user population. Table 3 shows the distributions of the reasons for encounter for all calls by ICPC chapters, stratified to the adult and pediatric subpopulations. More detailed information about the 30 most frequent reasons for encounter by ICPC code are summarized in Table 4.

4.2. Inferential statistics

In addition to the prevalence and rank of the different codes and chapters in the adult and pediatric subpopulation (Section 4.2), we wanted to know, which reasons for encounter are characteristic for more specific age groups of the medical call center user population. Table 5 displays those ICPC codes, which are overrepresented in the different age groups, providing a portrait of the aches and pains associated with the human experience: starting with fever, cough, vomiting and constipation during infancy and ending with vision disorders, and musculoskeletal and circulatory problems in later years. Our data mirror quite well the picture drawn by public health research, where respiratory symptoms like sore throat, and female genitourinary and reproductive symptoms are being reported more frequently among patients under the age of 45 and musculoskeletal, cardiovascular, as well as eye and ear problems are more common in the over-65 group[35].

Apart from the differences in the frequency of calls, we were interested in which reasons for encounter were dependent on gender, time of day, season and residence (Table 6 and 7).
The gender-specific chapters obviously were overrepresented in the female and male subpopulations (X,W,Y). Moreover, general information about medication and neurological complaints were overrepresented in the female subpopulation, while men called more often because of ear/hearing and musculoskeletal problems, as well as fever, chest pain and urinary retention. The overrepresentation of urinary retention in men can be attributed to prostate obstruction; however, we can currently only speculate about the possible reasons for the other above mentioned gender-specific effects.
There is an unequal distribution of the different reasons for encounter with regard to the time of day and a seasonal effect for respiratory (winter) and skin problems (summer). We would have expected an effect for allergic rhinitis (R97) during blooming season and for fever (A03) during wintertime. The lack of a seasonal effect for fever could be explained by very weak influenza in Switzerland since 2006[36]. The variety of allergic symptoms was very broad and ranged from a congested nose to redness of the eyes and wheezing. This might have diluted the effect. Further analysis on a syndrome level would be required.
Residence had no significant effect.

4.3. Relating the results to comparable investigations

Okkes et al.[19] compared the distribution of morbidity among family practices in different countries (the Netherlands, Poland, Japan and the United States), using existing databases that contained data coded with or classified by ICPC in an episode-of-care structure. Despite great differences among the national health care systems, they found a striking resemblance in the distribution of common symptoms and complaints in the different countries. The distribution of the reasons for encounter revealed digestive (8-15%), circulatory (5-23%), musculoskeletal (12-23%), respiratory (11-19%) and skin problems (5-10%) to be frequent in all databases.

Unfortunately, ICPC is not yet widely used in the practices of Swiss GPs, and so far there is no comparable study in Switzerland. However, in 2005 Busato et al.[20] investigated the health status and health care utilization of patients in complementary and conventional primary care in Switzerland. This cross-sectional study included 11,932 adult patients and documented their general health status and the nature of their main health problem while sitting in the waiting room prior to the consultation. The main health problem was coded retrospectively by the researchers using the chapters of the ICD-10 coding system. The distribution of the main health problems revealed the following frequency for different chapters: digestive (5.1%), circulatory (13.5%), musculoskeletal (21.8%), respiratory (9.8%), skin problems (3.5%), mental and behavioral disorders (7.1%).
By comparing the distribution of the reasons for encounter for our adult population with the data of Okkes et al.[19] and Busato et al.[20], we found respiratory symptoms (8%) to be below and skin problems (11%) above the range defined by the above investigations by Okkes and Busato. Circulatory (6%) problems were close to the lowest reference value. With the exception of endocrine/metabolic problems, which were represented as lower in our data than in that of the family practices, our prevalences for the remaining ICPC chapters were within the range defined by the data from Okkes et al.
At the code level, Okkes et al. presented a ranking order for 35 groups of symptoms/complaints, composed of 52 codes, covering the top-thirties in all databases of the involved countries. Comparing our top 52 codes with these data revealed an overlap of two thirds of the respective codes. Looking at the dissimilar codes we found such reasons for encounter as redness of the eyes (F02), constipation (D12), fear of hypertension (K25), palpitations/awareness of heart (K04), rectal bleeding (D16), hematuria (U06), burns/scalding (S14), animal/human bite (S13) and tingling fingers (N05). Looking at the rank order of the codes, we noted some conspicuous findings, as follows. Compared with the order of minor illnesses in Okkes et al., insect bites/stings (S12), teeth/gums and mouth/tongue/lip symptoms (D19/D20), and diarrhea (D11) are more prominent, while shortness of breath (R02), wheezing (R03), pruritus (S02) and weakness/tiredness (A04) were less prominent in our population.

In 2005, Neuhaus et al. evaluated the free medical internet consultation services of the University Hospital Zurich/Switzerland[21]. Between August 1999 and December 2003, 12,984 online inquiries were coded by the responding physician using ICD-10 categories. Converting the published ICD-10 codes to ICPC-2 codes[37], there were only 5 (14%) of their 36 most frequent codes overlapping with our corresponding reasons for encounter. Seventeen (47%) of the codes belonged to the disease component of ICPC. However, this direct comparison might be limited, since the online counseling physicians may have coded the health problem as assessed by a medical doctor, while the medical call center nurses explicitly coded the reason for encounter from the patient's point of view. The authors reported that topics like HIV and sexual dysfunction were overrepresented. In our data, we did not observe intimate and private health questions to be more pronounced.

5. Discussion

By analyzing the data of a medical call center in Switzerland, our study aimed to explore the interrelationship of citizens with their health information environment and added a patient-oriented perspective to the existing debate.

Our investigations revealed a pronounced need among parents of toddlers for health information and support. Moreover, there is an obvious gender difference, revealing a higher utilization rate of medical call center services among adult females. Our study suggests that people in Switzerland need more adequate guidance on how to take their medications. Despite official information campaigns about prevention and treatment, our data raised a strong suspicion that the public needs far more support to cope appropriately with tick bites and related diseases. According to the results of our investigation we assume that fear of hypertension, rather than hypertension itself, seems to influence the well-being of the everyday lives of the elderly.

Therefore, we might become aware about suitable target groups of health information and we might rethink how to design health information campaigns. A few guidelines on how best to deal with the most common symptoms in sick children would be perfectly suited to support young families in the majority of situations of health related uncertainty. We might revise how to deliver drug information more adequately to the public. We might want to help patients become better informed about the difference between elevated blood pressure and hypertension, and when an intervention is actually necessary.

In order to target the actual health information requirements of the public, the stakeholders need a deeper insight into the ecology of health information. Our study points out that the medical call center is the preferred means of seeking advice about the aches and pains of everyday, where the patient often feels uncertain. First, the comparison with the primary care studies revealed some reasons for encounter, which were more prominently represented in the medical call center data than in family practices. Some of these symptoms might underlie a serious disease (palpitation, rectal bleeding, hematuria, animal/human bites), deserving further diagnostic intervention. Medical call centers can play an important role in the triage of medical diseases at an early stage and the initiation of timely diagnosis and treatment. Second, the comparison of our results with those of primary care studies revealed that circulatory, respiratory and endocrine problems were more frequent in family practices than in medical call centers. Since the corresponding diseases are often chronic and require a continuity of care with more face-to-face consultations, this led to a higher prevalence in the family practice environment. Third, by comparing our results with the online counseling, we found quite distinct reasons for encounter. Intimate and private health questions were far more pronounced in the setting of the medical internet consultation. Hence, the underlying information and communication technologies influence the way, in which people use the different settings of health information delivery[23, 38]. According to the subject

of a medical consultation either a telephone-, an online- or a face-to-face contact seems to be more suitable.

By analyzing the medical call center data we gained insight into patient-centered perceptions of illness. Patients do not primarily call the medical call center to get more information about diseases; they call in order to get advice on how best to deal with their symptoms. While a disease is an exceptional state in life, symptoms are a constant part of life. Only about 10-30% of health problems are receiving professional medical attention that could lead to diagnostic interventions. The vast majority of health problems remain ailments perceived by the citizens in their everyday lives[4, 6, 7, 39]. As population longevity increases, health policy concerns will shift from the quantity to the quality of life. Life quality, however, depends greatly on physical symptoms experienced day by day and on satisfactory ways of caring for them.

The expansion of health information in everyday life is leading to altered health expectations and behavior. In a survey by the Institute of Social and Preventive Medicine at the University of Zurich, where 1250 Swiss citizens were interviewed about health literacy, 85% of those interviewed stated that they would play a more active roll in the medical decision-making process[40]. More than 60% were very interested in doing more self care. However, only a minority of them responded that they were receiving sufficient support to do so. Similar results were published in the 2006 Health Monitor of the Bertelsmann Foundation, studying patient trends in Germany[41]. A 2005 survey published by the Department of Health in England that included 1638 citizens revealed that the lack of knowledge and information about health and treatment issues was becoming the largest barrier to self care. Twenty-six percent of the study participants wanted to have a better knowledge of minor ailments or long-term health conditions, 20% wanted more advice and guidance from health professionals and 19% advocated for more health information[42]

This implies a recognition that medical care, as provided by physicians, is neither central nor necessary to the health-care-seeking process[39]. Focusing on the literal position that medical care begins only when a patient first consults a formal health care provider might result in health information systems that are unsuitable in content and design for attempting to increase health literacy among the population.
The European forum for primary care is developing position papers to inform policymakers at the World Health Organization, as well the European Union and its member states, about the importance of self care for the health and well-being of the population[43]. The expansion of primary care into the field of self care will undoubtedly reveal new possibilities for the profession. However, this move poses a great challenge for the family doctor, who needs to play the multiple roles of problem-solver, guide to interpret symptoms, information navigator and facilitator in decision-making. Relying on morbidity data and experiences from primary care alone might underestimate some of the daily complaints and demands of the public. We might therefore need to

rethink the organization of health care, research, and education in public health and primary care.

Providing health information is part of health care. Health information needs to be dealt with in the same scrupulous manner as prescriptions. The right information, at the right dosage, at the right moment to the right person for the right problem can be very effective. Conversely, the inappropriate use of information can lead to negative side effects, such as confusion and uncertainty. The correct application of health information could pose one of the greatest challenges to the information society in these times of eHealth. Choosing an appropriate communication and suitable technologies is crucial for the multivocal, postmodern medical consultation[44] in primary care.

6. Limitations and strengths

We emphasize that the utilization rate of the medical call center services is low. Medical call centers were introduced in Switzerland only six years ago and people are still not very familiar with their services. The results apply to medical call centers in Switzerland, but they can not be generalized to the Swiss population. However, the results might stimulate further investigations with a population denominator, which allows for better generalization.
However, the study has no restrictions on demographic or socioeconomic characteristics. All calls for the year 2006 were able to be analyzed. Apart from a few missing data concerning the gender and residence of the callers, the data sets were complete. ICPC-2 is a standard classification scheme for coding lay-reported complaints and allows the full scope of symptoms to be encompassed in a structured manner[45].
The information on the ICPC code level was sometimes not detailed enough to draw conclusions and required further study of the free text notes made by the nurses.

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8. Declarations

The demographic, medical and procedural data from the operational process management information system were anonymized, de-identified and transformed from the transaction-oriented operational data base to a multidimensional analysis-oriented data model. Once anonymized, the data are no longer subject to the data protection law[46, 47]. The study is of a socio-epidemiological nature and implies no intervention. According to Swiss

regulations, this kind of study does not require the approval of an ethics committee.

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Conflicts of interests: none.

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11. Key words

medical call center, reason for encounter, ICPC, information ecology, ecology of medical care, primary care, self care.

12. Appendices

12.1. Table 1

		00 - 01	01 - 04	05 - 16	17 - 25	26 - 35	36 - 45	46 - 55	56 - 65	66 - 79	80 - 99	99+
Calls	F	0.0151	0.0394	0.0411	0.0464	0.1000	0.0847	0.0656	0.0871	0.1060	0.0336	0.0000
	M	0.0170	0.0431	0.0456	0.0264	0.0618	0.0477	0.0302	0.0402	0.0507	0.0181	0.0000
Insured	F	0.0030	0.0146	0.0535	0.0524	0.0619	0.0707	0.0711	0.0728	0.0794	0.0409	0.0002
	M	0.0033	0.0155	0.0567	0.0554	0.0657	0.0715	0.0675	0.0658	0.0585	0.0197	0.0000

Tab 1. Number of calls (n=32750) and insured persons (1633067) stratified by gender and age group.

12.2. Table 2

Time of day	Time of year				
	Dec-Feb	March-May	June-August	Sept-Nov	Total
0-6	597 (1.82)	549 (1.67)	457 (1.39)	511 (1.56)	2114 (6.45)
6-12	3282 (10.01)	2573 (7.85)	2288 (6.98)	2678 (8.17)	10821 (33.01)
12-18	3111 (9.49)	2544 (7.76)	2200 (6.71)	2571 (7.84)	10426 (31.80)
18-24	2588 (7.89)	2482 (7.57)	2185 (6.66)	2168 (6.61)	9423 (28.74)
Total	9578 (29.22)	8148 (24.85)	7130 (21.57)	7928 (24.18)	32784 (100)

Tab 2. Absolute count and percentage of calls stratified by time of day and time of year.

12.3. Table 3

α-Code	Chapter	Adult (n=26185)			Pediatric (n=6599)		
		n	Prevalence*	Rank	n	Prevalence*	Rank
A	General and unspecified	4547	0.174	2	1596	0.242	1
B	Blood/blood-forming organs/immune mechanism	266	0.010	14	23	0.003	13
D	Digestive	3757	0.143	3	1357	0.206	2
F	Eye	1183	0.045	8	305	0.046	8
H	Ear (Hearing)	716	0.027	11	393	0.060	6
K	Circulatory	1577	0.060	7	18	0.003	14
L	Musculoskeletal (Locomotion)	4613	0.176	1	394	0.060	5
N	Neurological	1583	0.060	6	320	0.048	7
P	Psychological	790	0.030	10	25	0.004	12
R	Respiratory	2076	0.079	5	948	0.144	4
S	Skin	2821	0.108	4	1010	0.153	3
T	Endocrine, metabolic and nutritional	158	0.006	16	7	0.001	16
U	Urological	808	0.031	9	87	0.013	9
W	Pregnancy, child-bearing, family planning	473	0.018	13	9	0.001	15
X	Female genitalia	632	0.024	12	40	0.006	11
Y	Male genitalia	178	0.007	15	67	0.010	10
Z	Social problems	7	<0.001	17	0	0	17

Tab 3. ICPC chapters stratified by adult and pediatric subpopulations.

12.4. Table 4

	Adult (n=26185)				Pediatric (n=6599)			
Rank	Code	Reason for encounter	n	Prevalence*	Code	Reason for encounter	n	Prevalence*
1	A50	Medication, general and unspecified	1712	0.0654	A03	Fever	841	0.1274
2	D01	Abdominal pain/cramps	676	0.0258	R05	Cough	415	0.0629
3	L02	Back symptom/complaint	661	0.0252	D10	Vomiting	373	0.0565
4	S12	Insect bite/sting	553	0.0211	A50	Medication, general and unspecified	256	0.0388
5	L14	Leg/tight symptom/complaint	533	0.0204	H01	Ear pain/earache	256	0.0388
6	N01	Headache	521	0.0199	D01	Abdominal pain/cramps	229	0.0347
7	D11	Diarrhea	515	0.0197	D11	Diarrhea	186	0.0282
8	R05	Cough	477	0.0182	S07	Rash, generalized	177	0.0268
9	R21	Throat symptom/complaint	461	0.0176	N01	Headache	173	0.0262
10	L17	Foot/toe symptom/complaint	457	0.0175	S06	Rash, localized	167	0.0253
11	N17	Vertigo/dizziness	439	0.0168	S12	Insect bite/sting	162	0.0245
12	A03	Fever	372	0.0142	R21	Throat symptom/complaint	116	0.0176
13	L15	Knee symptom/complaint	359	0.0137	F02	Red eye	113	0.0171
14	A59	Other therapeutic procedures, general and unspecified	355	0.0136	D20	Mouth/tongue/lip symptom/complaint	101	0.0153
15	L04	Chest symptom/complaint	340	0.0130	S04	Lumps/swelling, localized	82	0.0124
16	S06	Rash, localized	326	0.0124	R50	Medication respiratory	76	0.0115
17	A44	Preventive immunizations/medications, general and unspecified	308	0.0118	D1	Complaint/symptom Digestive	71	0.0108
18	D10	Vomiting	306	0.0117	D12	Constipation	66	0.0100
19	D02	Abdominal pain, epigastric	298	0.0114	F03	Eye discharge	63	0.0095
20	F02	Redness of the eyes	295	0.0113	S1	Complaint/Symptom Skin	60	0.0091
21	L12	Hand/finger symptom/complaint	282	0.0108	D19	Teeth/gum symptom/complaint	58	0.0088
22	A5	Administrative component, general and unspecified	281	0.0107	L17	Foot/toe symptom/complaint	56	0.0085
23	S04	Lumps/swelling, localized	261	0.0100	A59	Other therapeutic procedures, general and unspecified	54	0.0082

24	K1	Complaint/Symptom Circulatory	240	0.0092	R04	Breathing problem, other	54	0.0082
25	S1	Complaint/Symptom Skin	226	0.0086	A44	Preventive immunizations/medications, general and unspecified	50	0.0076
26	D1	Complaint/Symptom Digestive	209	0.0080	S59	Other therapeutic procedures Skin	50	0.0076
27	L01	Complaint/Symptom Musculoskeletal	205	0.0078	D02	Abdominal pain, epigastric	46	0.0070
28	D20	Mouth/tongue/lip symptom/complaint	202	0.0077	N80	Head injury	46	0.0070
29	L50	Medication Musculoskeletal	196	0.0075	L12	Hand/finger symptom/complaint	44	0.0067
30	D50	Medication Digestive	193	0.0074	L01	Complaint/Symptom Musculoskeletal	43	0.0065

Tab 4. Top 30 ICPC codes stratified by adult and pediatric subpopulations.

12.5. Table 5

Age	Code	Reason for encounter	LOR	SE	P-Value	CB
<1	A03	Fever	1.8985	0.0963	<0.0001	1.4795
	D11	Diarrhea	0.8482	0.1658	0.0011	0.1273
	R05	Cough	1.7974	0.1145	<0.0001	1.2993
	D10	Vomiting	1.0949	0.1478	<0.0001	0.4519
	S07	Rash, generalized	1.2263	0.2043	<0.0001	0.3376
	D12	Constipation	1.9207	0.2288	<0.0001	0.9258
	N80	Head injury	1.7187	0.3760	0.0176	0.0836
	A16	Irritable infant	3.8647	0.5018	<0.0001	1.6821
	F03	Eye discharge	1.5859	0.2919	0.0002	0.3163
	R07	Sneezing/nasal congestion	2.4526	0.2999	<0.0001	1.1484
1-4	A03	Fever	2.0018	0.0710	<0.0001	1.6929
	S06	Rash localized	0.6576	0.1380	0.0068	0.0574
	D11	Diarrhea	0.6584	0.1178	0.0001	0.1461
	R05	Cough	1.0273	0.0991	<0.0001	0.5962
	D10	Vomiting	1.7223	0.0948	<0.0001	1.3101
	S07	Rash, generalized	1.2247	0.1417	<0.0001	0.6084
	N80	Head injury	1.8833	0.2757	<0.0001	0.6841
	A72	Chickenpox	1.2354	0.2789	0.0342	0.0224
	H01	Ear pain	1.5035	0.1222	<0.0001	0.9723
	D20	Mouth/tongue/lip symptom	1.0474	0.1547	<0.0001	0.3747
	D79	Foreign body digestive system	2.3082	0.4600	0.0019	0.3078
	F03	Eye discharge	1.7282	0.2174	<0.0001	0.7826
	H04	Ear discharge	1.7527	0.3115	0.0001	0.3982
	H50	Medication/Treatment Ear	1.9370	0.3691	0.0006	0.3317
5-16	A03	Fever	0.8267	0.0853	<0.0001	0.4559
	D01	Abdominal pain	0.7833	0.0965	<0.0001	0.3638
	S12	Insect bite/sting	0.5165	0.1135	0.0196	0.0227
	N01	Headache	0.7704	0.1093	<0.0001	0.2952
	S07	Rash generalized	0.8958	0.1442	<0.0001	0.2685

	H01	Ear pain	1.4452	0.1161	<0.0001	0.9402
	N79	Concussion	1.9544	0.4195	0.0116	0.1298
17-25	R21	Throat symptom	0.7208	0.1359	0.0004	0.1297
	D01	Abdominal pain	0.5656	0.1107	0.0012	0.0842
	X50	Medication Female Genital	1.0594	0.2382	0.0314	0.0236
	W50	Medication Pregnancy, child-bearing, family planning	1.8658	0.2222	<0.0001	0.8993
	U01	Dysuria/painful urination	1.1247	0.2071	0.0002	0.2239
	W2	Diagnostic/screening/prevention pregnancy, child bearing	2.0666	0.3405	<0.0001	0.5857
26-35	R21	Throat symptom	0.8165	0.1118	<0.0001	0.3302
	W03	Antepartum bleeding	2.4313	0.3144	<0.0001	1.0639
	W29	Pregnancy symptom/complaint, other	2.1055	0.3799	0.0001	0.4532
	R09	Sinus symptom/complaint	1.1566	0.2287	0.0016	0.1618
	W50	Medication pregnancy, child-bearing, family planning	1.4653	0.2200	<0.0001	0.5087
	W1	Symptom/complaint pregnancy, child bearing	2.0808	0.3992	0.0007	0.3447
	W49	Other preventive procedures pregnancy	2.3328	0.5024	0.0124	0.1478
	W3	Medication/treatment/procedure pregnancy, child-bearing	1.4088	0.3026	0.0117	0.0927
36-45	L02	Back symptom/complaint	0.6238	0.1017	<0.0001	0.1817
	L10	Elbow symptom/complaint	1.1905	0.2597	0.0166	0.0608
46-55	L02	Back symptom/complaint	0.5312	0.1137	0.0109	0.0366
	K02	Pressure/tightness of heart	0.8540	0.1904	0.0263	0.0261
56-65	A50	Medication General and unspecified	0.3235	0.0689	0.0097	0.0238
	F05	Visual disturbance, other	1.1066	0.1842	<0.0001	0.3056
	L50	Medication Musculoskeletal	0.8487	0.1785	0.0072	0.0724
	F04	Visual floaters	2.1679	0.4286	0.0015	0.3038
66-79	A59	Other therapeutic procedures, general and unspecified	0.5229	0.1173	0.0299	0.0129
	L3	Medication/treatment/procedures musculoskeletal	0.7225	0.1585	0.0187	0.0332
	A50	Medication, general and unspecified	0.4802	0.0672	<0.0001	0.1879
	K85	Elevated blood pressure	1.9101	0.3176	<0.0001	0.5288
	K05	Irregular heart beat	1.4935	0.3003	0.0024	0.1873
	K1	Symptom/complaint Circulatory	1.1055	0.1419	<0.0001	0.4885
	K59	Other therapeutic procedures Circulatory	1.2102	0.2351	0.0010	0.1877

	K50	Medication Circulatory	1.5447	0.1600	<0.0001	0.8491
	K29	Cardiovascular symptom/complaint, other	1.2825	0.2476	0.0008	0.2058
	K25	Fear of hypertension	2.0151	0.2823	<0.0001	0.7872
	L50	Medication Musculoskeletal	1.1333	0.1641	<0.0001	0.4196
	L13	Hip symptom/complaint	1.2470	0.2574	0.0046	0.1274
80-99	L14	Leg/thigh symptom/complaint	0.7327	0.1525	0.0056	0.0695
	D12	Constipation	1.0532	0.2370	0.0320	0.0225
	K1	Symptom/complaint Circulatory	1.4318	0.1837	<0.0001	0.6327
	K50	Medication Circulatory	1.4037	0.2108	<0.0001	0.4867
	A02	Chills	1.8559	0.3974	0.0109	0.1276

Tab 5. ICPC codes overrepresented in the different age groups.
LOR= log odds ratios ln(OR(j,k)), P-Value= the adjusted right-sided p-values for the null hypothesis OR(j,k) ≤1, SE= the standard errors of the estimated log odds ratios ln(OR(j,k)), CB= the simultaneous 95% confidence bound for ln OR(j,k).

12.6. Table 6

Age	Independent variable		Chapter	Reason for encounter	LOR	SE	P-Value	CB
Adult	Gender	Female	X	Female Genital	3.0363	0.2741	<0.0001	2.2293
			W	Pregnancy/Childbearing/ Family Planning	1.4876	0.1746	<0.0001	0.9685
			N	Neurological	0.2037	0.0638	0.0208	0.0143
		Male	Y	Male Genital	3.3727	0.3150	<0.0001	2.4359
			H	Ear (Hearing)	0.3491	0.0926	0.0025	0.0740
			L	Musculoskeletal	0.3491	0.0466	0.0392	0.0012
	Time of day	Morning	F	Eye	0.4027	0.0643	<0.0001	0.1982
			L	Musculoskeletal	0.3049	0.0374	<0.0001	0.1859
			T	Metabolic/Endocrine	0.6155	0.1695	0.0086	0.0764
		Afternoon	A	General and unspecified	0.2056	0.0364	<0.0001	0.0898
		Evening	D	Digestive	0.1654	0.0425	0.0031	0.0301
			S	Skin problems	0.2970	0.0469	<0.0001	0.1479
			W	Pregnancy/Childbearing/ Family Planning	0.3708	0.1049	0.0123	0.0371
		Night	K	Circulatory	0.6078	0.1461	0.0010	0.1432
			P	Psychological	1.9793	0.4895	0.0017	0.4225
	Time of year	Winter	R	Respiratory	0.3422	0.0531	<0.0001	0.1733
			D	Digestive	0.2537	0.0428	<0.0001	0.1177
		Summer	S	Skin	0.7203	0.0457	<0.0001	0.5748
Pediatric	Time of day	Morning	S	Skin	0.2577	0.0794	0.0347	0.0065
			F	Eye	0.7358	0.1253	<0.0001	0.3394
		Evening	A	General and unspecified	0.2735	0.0616	0.0003	0.0787
			N	Neurological	0.5348	0.1184	0.0002	0.1604
		Night	D	Digestive	0.4236	0.1258	0.0227	0.0258
			H	Ear	0.7917	0.1803	0.0003	0.2213
	Time of year	Winter	R	Respiratory	0.3584	0.0831	0.0005	0.0956
		Summer	S	Skin	0.5442	0.0803	<0.0001	0.2903

Tab 6. ICPC chapters overrepresented according to gender, time of day and time of year in the adult and pediatric subpopulations.

LOR= log odds ratios ln(OR(j,k)), P-Value= the adjusted right-sided p-values for the null hypothesis OR(j,k) ≤1, SE= the standard errors of the estimated log odds ratios ln(OR(j,k)), CB= the simultaneous 95% confidence bound for ln OR(j,k).

12.7. Table 7

Age	Independent variable		Code	Reason for encounter	LOR	SE	P-Value	CB
Adult	Gender	Female	A50	Medication General and unspecified	0.2649	0.0622	0.0135	0.0188
		Male	L04	Chest pain attributed to musculoskeletal system	0.5087	0.1177	0.0101	0.0432
			A03	Fever	0.5765	0.1186	0.0008	0.1076
			U08	Urinary retention	1.7806	0.4449	0.0406	0.0218
	Time of day	Morning	F02	Red eye	0.6377	0.1246	0.0004	0.1248
		Afternoon	A59	Other therapeutic procedures General and unspecified	0.5477	0.1100	0.0008	0.0947
		Evening	S12	Insect bite/sting	0.3880	0.0938	0.0451	0.0021
			A50	Medication General and unspecified	0.2377	0.0561	0.0288	0.0070
			S1	Symptom/complaint Skin	0.7204	0.1436	0.0007	0.1292
			A03	Fever	0.6073	0.1152	0.0002	0.1330
			U1	Symptom/complaint Urinary	1.0127	0.2424	0.0380	0.0149
			S19	Skin injury, other	1.5731	0.3421	0.0055	0.1652
		Night	D02	Abdominal pain, epigastric	1.0489	0.2095	0.0007	0.1866
			D01	Abdominal pain/cramps	0.7840	0.1799	0.0170	0.0434
			K85	Elevated blood pressure	1.5168	0.3260	0.0042	0.1748
			D10	Vomiting	1.1135	0.2070	0.0001	0.2614
			K04	Palpitation/awareness of heart	1.5363	0.2395	<0.0001	0.5503
			P29	Psychological symptom/complaint, other	1.9713	0.3342	<0.0001	0.5955
			P1	Symptom/complaint Psychological	2.4868	0.6020	0.0466	0.0089
			K01	Heart pain	1.4542	0.2667	0.0001	0.3566
			P06	Sleep disturbance	3.4025	0.6351	0.0001	0.7885
			P01	Feeling anxious/nervous/tense	1.7630	0.1666	<0.0001	1.0770

	Time of year	Winter	R05	Cough	0.5082	0.1045	0.0015	0.0782
		Summer	S12	Insect bite/sting	1.9329	0.0949	<0.0001	1.5424
			S59	Other therapeutic procedures Skin	1.0675	0.1710	<0.0001	0.3638
Pediatric	Time of day	Morning	F02	Red eye	1.0825	0.1974	<0.0001	0.3000
		Evening	A03	Fever	0.3322	0.0776	0.0125	0.0247
			A50	Medication General and unspecified	0.7554	0.1322	<0.0001	0.2314
			N01	Headache	0.6253	0.1569	0.0454	0.0035
		Night	D10	Vomiting	1.0672	0.1753	<0.0001	0.3722
			H01	Ear pain/earache	1.1911	0.1925	<0.0001	0.4282
	Time of year	Winter	R05	Cough	0.7146	0.1161	<0.0001	0.2544
		Summer	S12	Insect bite/sting	1.9060	0.1693	<0.0001	1.2349

Tab 7. ICPC-codes overrepresented according to gender, time of day and time of year in the adult and pediatric subpopulations.
LOR= log odds ratios ln(OR(j,k)), P-Value= the adjusted right-sided p-values for the null hypothesis OR(j,k) ≤1, SE= the standard errors of the estimated log odds ratios ln(OR(j,k)), CB= the simultaneous 95% confidence bound for ln OR(j,k).