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Determinants of general practitioner's cancer-related gut feelings—a prospective cohort study

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ABSTRACT

Background: General practitioners (GPs) use gut feelings to diagnose cancer in an early stage, but little is known about its impact.

Method: Prospective cohort study of patients in 44 general practices throughout the Netherlands, from January 2010 until December 2013. GPs completed a questionnaire regarding gut feelings, patient and GP characteristics, if they noticed a cancer-related gut feeling during patient consultation. Follow-up questionnaires were sent 3 months later requesting information about the patient's diagnosis. χ^2, univariate and multivariate logistic regression and multilevel analyses were performed.

Results: A gut feeling (N=366) is most often triggered by weight loss (24%, N=85) and rare GP visits (22%, N=76), but all triggers were not predictive of cancer in a multivariate analysis. Most GPs (95%) acted immediately on the gut feeling, either referring to a specialist or by performing additional medical tests. The average positive predictive value of cancer-related gut feeling was 35%, and it increased with 2% for every year a patient becomes older, and with 3% for every year a GP becomes older.

Conclusions: GP's gut feeling for cancer proves to be a useful tool in diagnosing cancer and its relative high predicting value increases if the GP is older or more experienced and when the patient is older. How can younger GPs be trained to increase the predictive value of their gut feeling?

Strengths and limitations of this study

- This is the first study to analyse cancer-related gut feelings quantitatively combining triggers of the gut feeling, general practitioner (GP) and patient characteristics.
- The prospective design enabled analyses of the temporal sequence between the suspicion of cancer and the actual diagnosis preventing selection bias.
- The multilevel analysis adjusts for clustering of patients within 59 GPs.
- A study limitation is the relatively small sample size per GP.
- Gut feelings are probably underreported, since it could be a subconscious process and GPs had to work with a newly created International Classification of Primary Care (ICPC) code and complete questionnaires during routine clinical practice activities.

In Europe, an estimated 3.45 million persons were diagnosed with cancer in 2012.[1] Approximately half of the patients survive cancer. Survival is slowly increasing, partially due to earlier diagnosis.[2 3] In countries with a relatively strong primary care system, most of the initial consultations for cancer are with general practitioners (GPs).[4] In referring patients suspected of cancer, GPs need to find a balance between taking no risks (referring everyone) and taking too many (referring only those with high suspicion). Taking no risks may cause high costs, increase patient anxiety and exceeding healthcare capacity, taking too many risks may lead to delayed diagnosis and poorer survival.[5]

GPs often use analytical cognitive processes to become aware of cancer, through applying medical knowledge and assessing alarm symptoms.[6] However, two studies showed that only one out of three patients show early warning signs of cancer,[7] and one out of eight present with alarm symptoms on the initial consultation with the GP.[8] These percentages show the difficulty of diagnosing cancer with only the help of analytical processes. Therefore, many GPs also use non-analytical processes to diagnose cancer: they use their intuition build on professional experiences and their own or patient's fear of cancer.[6]

One of these non-analytical processes to use in diagnostic reasoning is described by Stolper, named 'gut feeling': '*The gut feeling emerges as a consequence of non-analytical processing of available information and knowledge*'.[9] Gut feeling, as a sense of alarm, is defined

as: '*an uneasy feeling perceived by a general practitioner as he or she is concerned about a possible adverse outcome, even though the specific indications are lacking*'.[10 11] GPs appear to value this gut feeling, since they respond to the feeling by adjusting their actions. A clear correlation exists between suspicion of cancer and more referrals, more (imaging) investigations and more GP visits.[12 13] Specialists also appear to value the gut feelings, since most specialists would accept a referral based on only the gut feeling of a GP, especially when the GP is older.[14] Qualitative research has been done concerning gut feelings, but hardly any quantitative study, especially concerning GP characteristics. To enhance the early diagnosis of cancer, we performed a prospective quantitative study exploring the gut feeling. The following questions were investigated:

1. What triggers the cancer-related gut feeling of a GP?
2. Based on the gut feeling, which diagnostic actions are taken by the GP?
3. What is the predictive value of cancer-related gut feelings of GPs measured 3 months later?
4. How is the predictive value of GP's gut feeling influenced by specific triggers, patient and GP characteristics?

METHODS

GP practices and data collection

Data for this dynamic prospective cohort study were collected from the Sentinel Practices of NIVEL Primary Care Database.[15] This network of GPs, existing since 1970, is designed to be nationally representative by age and sex of the patient, regional distribution and population density. Data collection took place from January 2010 until December 2013 in 44 general practices with a total population of 119 882 patients (at the beginning of 2013), representing 0.7% of the Dutch population.[16 17] In December 2009, every participating GP was informed about this study through mailing followed by more detailed instructions in a face-to-face meeting 1-month later. Annually the GPs received a mailing to remind them about the continuation of this study up to 2013.

The GPs were instructed to fill in a questionnaire throughout the year if they noticed a gut feeling concerning any kind of cancer, independent of the presence of clinical signs or symptoms. Gut feelings related to other subjects, for example partner violence, were not included in the study. This broad definition of gut feeling was based on earlier work of Stolper concerning gut feelings in focus groups of GPs.[10 11] In the Netherlands, diagnoses are recorded using the International Classification of Primary Care (ICPC), and the GPs were instructed to use a special ICPC code (A29) for gut feelings. If NIVEL didn't receive a questionnaire 2 weeks after a reported case, a reminder was sent to the GP. The questionnaire included open-ended questions concerning patient and GP characteristics, the predicted type of cancer, the gut feeling triggers and GP's interventions in response to the gut feeling. After 3 months, a follow-up questionnaire was sent to the GP evaluating the patient's diagnosis. Patient data were anonymised, guaranteeing the patient's privacy before questionnaires left the practice.

Statistical analyses

The survey results were analysed using Stata V.13.0. Descriptive statistics of the triggers of gut feelings and diagnostic actions were applied. To assess the predictive value of gut feeling, the percentage of patients diagnosed with cancer after 3 months was calculated. χ^2 analyses and univariate logistic regression analyses were performed with cancer outcome after 3 months as the dependent variable. The independent variables were patient characteristics (age, gender, ethnicity and how long and how well the patient was known by the GP), GP characteristics (gender, age and years of experience) and triggers of the gut feeling (like 'unexplained weight loss' and 'rarely consulting the GP'). Missing data weren't included in the analyses. To compose a prediction model, each variable was first individually tested through univariate analyses. Second, all variables from the univariate analyses with a $p<0.10$ were used for a multivariate logistic regression analysis and for a multilevel mixed effect logistic regression analysis. The GP was entered as a level in the multilevel analysis, to adjust for GP variation in patient population. Statistical significance was defined as a $p<0.05$.

RESULTS

Study population

A total of 366 questionnaires were completed in 44 general practices, by 59 different GPs. About 1–60 surveys were completed per GP, with an average of 5.6 surveys. Of the 366 questionnaires, most were filled-out by male GPs (74%), with a mean age of 50 years and 17 years of experience. Regarding the patients, 175 (48%) were female and most were of Dutch origin (93%). Half of the patients were between 61 and 80 years old and GPs indicated that they knew these patients (81%) very well or quite well (table 1). The patient population of the sentinel practices fluctuated between 119 822 in 2013 and 134 415 in 2010, respectively 0.7–0.8% of the total Dutch population with nationwide regional distribution, but slight over-representation of the northern part of the country.[17]

Triggers causing the gut feeling and actions based on the gut feeling

Weight loss (24%, N=85), rare GP visits (22%, N=76) and duration of symptoms (19%, N=64) were frequent triggers for the gut feeling as reported by the GP (figure 1). These triggers resulted in a cancer diagnosis in a quarter of the patients after 3 months (25–28%). Gut feelings triggered by a palpable tumour, abnormal test results and a suspect medical history of the patient

Table 1 Distribution of patient and GP characteristics involved in the study of cancer-related gut feelings

Patient characteristics	N=366	Percentage
Gender patient		
Female	175	48
Male	191	52
Age patient		
0–20 years	11	3
21–40 years	16	4
41–60 years	100	27
61–80 years	182	50
>80 years	57	16
Nationality of patient		
Dutch	340	93
Turkish	5	1.5
Surinamese and Antillean	5	1.5
Other	15	4
Missing	1	0
How long does the GP know the patient?		
0–5 years	55	15
6–10 years	94	26
11–20 years	122	33
>21 years	89	24
Missing	6	2
How well does the GP know the patient?		
Very well	137	37
Quite well	162	44
A little	38	10
Not well	28	8
Missing	1	1
GP Characteristics	**N=59**	**Percentage**
Gender of GP		
Female	20	34
Male	38	64
Missing	1	<1
Age category of GP		
≤50 years	24	40
>50 years	31	53
Missing	4	6
Years of experience		
0–15 years	10	17
>15 years	15	25
Missing	34	58

The number indicated in percentages are relative to the total number reported from January 2010 until December 2013.
GP, general practitioner.

showed the highest proportion of diagnosed cancer, respectively 47%, 42% and 39% in univariate analyses.

Most GPs acted immediately on the gut feeling, only 5% decided to perform watchful waiting. The majority of the patients (N=234, 64%) were referred to a specialist and in two-third of the cases the GP made it a (semi) urgent referral. Instead or along with the referral, 118 patients (32%) had a laboratory test, 77 (21%) were sent for X-ray and 49 (13%) had an ultrasound examination.

Predictive value of the gut feeling in univariate analyses

Of the 366 patients, 118 (35%) had a cancer diagnosis after 3 months and the diagnosis was unknown in 30 patients. The univariate analyses (table 2) showed that the positive predictive value of the GP's cancer-related gut feeling was related to two patient characteristics: how long the GP knows the patient and patient's age. When the GP knew the patients for >10 years (N=196), 41% had proven cancer within 3 months, an increase of 13% compared with those where the GP knew the patient <10 years (p=0.01). The odds for an accurate gut feeling increased with a factor 1.04 (95% CI 1.01 to 1.06, p=0.004) for every year the GP knew the patient and with a factor 1.02 (95% CI 1.00 to 1.03, p=0.03) for every year a patient becomes older.

GP's age and years of experience showed significant influences on the predictive value of the gut feeling. GPs older than 50 years had an accurate gut feeling in 43% of the cases, 16% higher compared with younger GPs (p=0.004) (figure 2). When GPs had >15 years of experience, 43% of the patients had proven cancer after 3 months, an increase of 17% compared with those with <15 years of experience (p=0.006). The odds for an accurate gut feeling increased with a factor 1.04 (95% CI 1.01 to 1.07, p=0.007) for every year a GP becomes older and a factor 1.04 (95% CI 1.01 to 1.08, p=0.002) for every year of additional experience.

Of the 11 triggers causing the gut feeling, only the palpable tumour was a statistically significant predictor of cancer; 48% of the patients with a palpable tumour had cancer after 3 months (p=0.03). Weight loss was nearly statistically significantly less frequently predicting cancer, with 27% of the patients having cancer after 3 months (p=0.07) as well as patients who rarely visited the GP; 26% of them had cancer (p=0.07).

Multivariate logistic regression analysis and multilevel analyses

The following variables were entered in one multivariate logistic regression model: palpable tumour, weight loss, rare GP visits, patient's and GP's age. Owing to a high correlation between GP's age and 'years of experience' (correlation 0.91) and GP's age and 'how long the GP knows the patient' (correlation 0.47), the 'years of experience' and 'how long the GP knows the patient' were excluded from the analysis. In this multivariate model, only the patient's age and GP's age remained significant; with the odds increasing with a factor 1.02 for every year, a patient becomes older and a factor 1.03 every year, a GP becomes older (table 3). The Spearman correlation between patients' and GPs' age is 0.12 (p=0.03). Older doctors tend to have slightly older patients. When repeating the multivariate analyses after exclusion of all patients with a palpable tumour, the ORs of 1.02 for patient's age and 1.03 for GP's age remained the same with slightly wider 95% CIs due to smaller numbers (N=284).

A multilevel regression analysis (table 4) was conducted with a GP level added to the multivariate model. Dependent and independent variables were the same as in the multivariate logistic regression model. The ORs

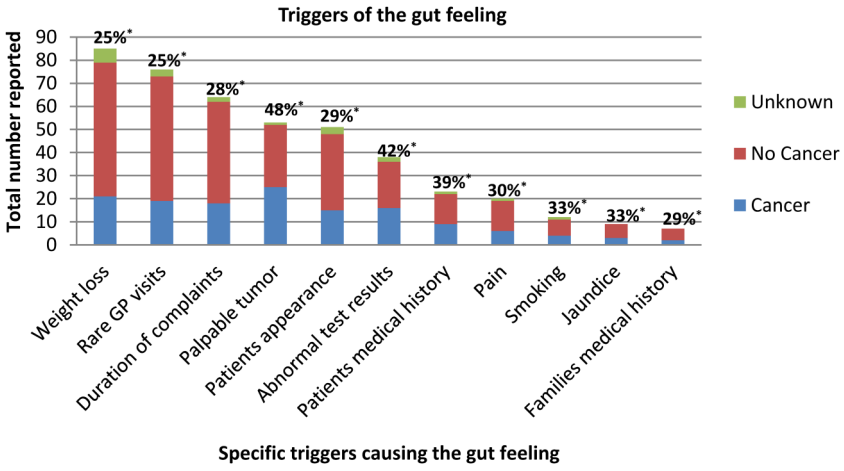

Figure 1 Histogram of triggers causing the cancer-related gut feelings reported by general practitioners (GPs), from January 2010 until December 2013.

remained similar, but only the age of the patient was significant, even though the other variables still had a p<0.10. The complete model did not show significant differences between GPs. When age of patients and age of GPs were removed from the model there was a significant difference between GPs; 7% of variation was at GP level (p=0.03). Thus, differences between GPs are largely due to differences in age of GPs.

DISCUSSION

This study showed that the triggers for cancer-related gut feelings are diverse. Frequent triggers are weight loss and patients who rarely visit the GP, but none of these triggers were predictive of cancer 3 months later in multivariate analyses. Most GPs (95%) acted immediately on the gut feeling, either by referring the patient to a specialist or by performing additional medical tests which is reassuring to the community. The gut feeling's predictive value for cancer was 35%, and it increased with patient's and GP's age.

Strengths and limitations

To our knowledge, this study is the first study quantitatively analysing cancer-related gut feelings, combining triggers of the gut feeling, as well as GP and patient characteristics. The use of a long running nationally representative network of GPs and the prospective design enabled analyses of the temporal sequence between the suspicion of cancer and the actual diagnosis, thereby preventing selection bias.

The multilevel analysis adjusts for clustering of patients within 59 GPs. A study limitation is the relatively small sample size per GP. Thus, the 44 practices were not added as a level to the model, so dependency of GPs within practices could not be adjusted for. Some GPs contributed multiple submissions. The questionnaire about the 3 months outcome may have made them more aware about the accuracy of their gut feeling and may thus have influenced their response in subsequent cases. Another limitation of this study was the lack of a control group. Although a case–control study may be feasible by using a matched random sample as the control group, it would not contribute in answering the questions of this exploratory study.

The large variation in the number of gut feelings GPs reported probably reflected interpersonal differences in recognising gut feelings, interest in the subject and devotion to completing surveys. The gut feeling is probably under-reported by many GPs; since it could be a subconscious process, GPs had to work with a newly created ICPC code and complete questionnaires during routine clinical practice activities.

Although most medical professionals are familiar with gut feelings,[18] their definition is not easy. Stolper explained the gut feeling as a sense of alarm with '*specific indications for a serious disease lacking*'.[10] In another study, he explained that the gut feeling '*effectuates the GP to take extra time to consider the analytical and non-analytical aspects*'.[9] This last definition allows the presence of clinical symptoms additionally to gut feelings. The GPs in this study were asked to complete a survey whenever a gut feeling arose, independently, but not necessarily in the absence of clinical symptoms. This may be seen as study strength and a limitation. Is it possible to disentangle gut feelings from an unpleasant feeling when clinical symptoms are possibly indicating cancer? If clinical symptoms clearly point towards cancer, how much value does the gut feeling attribute? We may have overestimated the predictive value of the gut feeling. On the other hand, GPs were only asked to complete a questionnaire if they clearly noticed a gut feeling and the resulting predictive value is the consequence of the definition used.

Comparison with existing literature

Other studies support the existence of cancer-related gut feelings and the high prevalence of GPs acting on gut feeling as found in our study.[10 11 13 18] Ingeman *et al*[19] found that one out of four patients with serious non-specific symptoms and signs of cancer referred to a special cancer pathway, had gut feeling as a reason of referral. They also found that patients referred with a lump or tumour had a high probability of cancer

Table 2 Univariate analyses of the predictive value of GP characteristics, patient characteristics and specific triggers causing the gut feeling

Patients characteristics	Number of patients*	Number of patients with cancer (percentage confirmed cancer)	p Value
Gender			p=0.67
Female	159	54 (34%)	
Male	177	64 (36%)	
Age category			p=0.17
0–30 years	16	3 (19%)	
31–64 years	140	45 (32%)	
65–100 years	180	70 (39%)	
How long does the GP know the patient?			p=0.01
0–10 years	134	37 (28%)	
>11 years	196	80 (41%)	
How well does the GP know the patient?			p=0.11
Not well	27	7 (26%)	
A little	32	15 (47%)	
Quite well	151	45 (30%)	
Very well	125	50 (40%)	
Ethnicity			p=0.87
Dutch	204	110 (35%)	
Other	14	7 (35%)	
General practitioner characteristics		**Number of patients with cancer (percentage confirmed cancer)**	**p Value**
Gender			p=0.89
Female	81	29 (36%)	
Male	249	87 (35%)	
Age category			p=0.004
≤50 years	151	41 (27%)	
>50 years	151	65 (43%)	
Years of experience			p=0.006
0–15 years	116	30 (26%)	
>15 years	119	51 (43%)	
Triggers causing the GUT feeling		**Number of patients with cancer (percentage confirmed cancer)**	**p Value**
Weight loss	79	21 (27%)	p=0.07
Rare GP visits	73	19 (26%)	p=0.07
Duration of symptoms	62	18 (29%)	p=0.27
Palpable tumour	52	25 (48%)	p=0.03
Patient's appearance	48	15 (31%)	p=0.54
Abnormal test results	36	16 (44%)	p=0.22
Patients medical history	22	9 (41%)	p=0.56
Pain	19	6 (32%)	p=0.74
Smoking	11	4 (36%)	p=0.93
Jaundice	9	3 (33%)	p=0.91
Family's medical history	7	2 (29%)	p=0.71

*Patients were excluded in analysis in case of a missing value in the involved variables.
GP, general practitioner.

(26.9%).[19] So our study and those of Green and Ingeman show that gut feelings triggered by a palpable tumour certainly identify patients at higher risk for cancer.

The predictive value of the cancer-related gut feeling was 35%, this is in line with a previous study from Donker and Dorsman in a smaller sample, who also found a predictive value of 35%.[12] Hjertholm *et al*[13] found a predictive value of 16.4% for suspicion of cancer. Another Norwegian study found that 3.8% of the suspected cancer cases had a cancer diagnosis and that GPs' correct cancer suspicions were six times more frequent than their erroneous lack of suspicion.[20] The difference between these percentages could be explained by the duration of the studies. The GPs in Norway only registered consultations for either one workday or ten workdays, while the data collection in our study lasted 4 years. The follow-up in the Norwegian

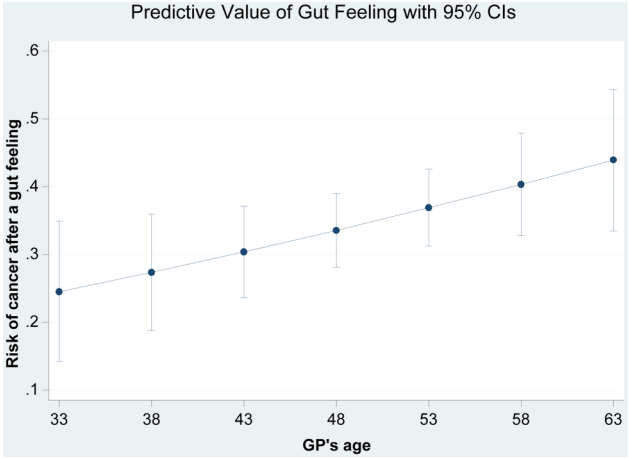

Figure 2 The predictive values of the cancer-related gut feeling (N=366), depending on the age of the general practitioner (GP).

Table 3 Multivariate logistic regression analysis of the positive predictive value of the cancer-related gut feeling, with the significant triggers and characteristics of patients and GPs from the univariate analysis

Variables	OR (95% CI)	p Value
Age patient	1.02 (1.01 to 1.04)	p=0.01
Age GP	1.03 (1.00 to 1.06)	p=0.04
Palpable tumour	1.90 (0.97 to 3.74)	p=0.06
Weight loss	0.58 (0.31 to 1.09)	p=0.09
Rare GP visits	0.58 (0.32 to 1.09)	p=0.09
Constant	0.03 (0.01 to 0.18)	p<0.001

GP, general practitioner.

Table 4 Multilevel analysis of the positive predictive value of the cancer-related gut feeling, with the significant triggers, characteristics of patients and GPs from the univariate analysis

Variables	OR (95% CI)	p Value
Age patient	1.02 (1.00 to 1.04)	p=0.01
Age GP	1.03 (1.00 to 1.06)	p=0.09
Palpable tumour	1.93 (0.97 to 3.82)	p=0.06
Weight loss	0.58 (0.31 to 1.10)	p=0.10
Rare GP visits	0.58 (0.31 to 1.09)	p=0.09
Constant	0.04 (0.01 to 0.23)	p<0.001

GP, general practitioner.

studies was, on the other hand, 3 months longer than our 3 months follow-up.

Ingeman showed that 16.2% of the Danish people sent towards the cancer pathway outpatient clinic for patients with serious non-specific symptoms eventually had cancer.[19] A possible explanation for this lower outcome is that in our study the GP *always* had a gut feeling for cancer, while that wasn't conditional in Ingeman's study. In addition, Ingeman found that patients referred by the GP with a strong to very strong gut feeling had a higher probability of cancer compared with those referred without.

An interesting finding is the increasing predictive value of the gut feeling for cancer for older and more experienced GPs, independently of GPs' gender. Apparently the gut feeling isn't a static phenomenon, but a GP can learn by experience. This is in line with a focus group study from Stolper, reporting that specialists in the hospital regarded experience as an important condition to develop and rely on the gut feeling.[14] Stolper also observed a supervisor assuring his GP trainee that experience enhances the GP to trust his gut feeling more.[21] None of these findings were tested in a quantitative study, however, making our study quite unique.

Another finding in our study was the increasing value of the gut feeling for older patients. To our best knowledge, no other studies have observed this finding, although the result is not unexpected because older patients generally have a higher incidence of cancer than younger patients.[22] This could mean that the predictive value of the gut feeling doesn't actually increase due to patients' older age, but that the main effect is due to the increased incidence of cancer.

Implications for research and practice

Our results show that gut feelings are a valuable diagnostic tool for cancer with a predictive value of 35%. Shapley *et al*[23] considered a symptom with a predictive value >5% as a highly predictive symptom. Thus, our findings indicate that the gut feeling has an added value as a diagnostic tool. For older and more experienced GPs, the cancer-related gut feeling is even a better predictor, revealing the value of professional experience. Assimilating experiences over time may turn gut feelings into a conscious analytical process and enhance the use of these feelings as a diagnostic tool by older GPs.

Future studies with a larger study population increasing the study power, would enable analyses to assess variation in positive predictive value for different types of cancers. Questions remain about gut feeling triggers and interdoctor variation. A questionnaire study of clinical vignettes may reveal more about interdoctor variation. A question also arose about the increased predictive value of the gut feeling for older GPs: 'How can younger GPs be trained to increase the predictive value of their gut feeling?'. More research on this topic is highly recommended in order to improve the early diagnosis of cancer and the survival rate of patients.

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Contributors GAD was responsible for study design, data collection, supervision of analyses, interpretation of the results and writing the article. EW performed data analyses and assisted in writing the article. LvdH assisted in performing, interpretation and reporting of the multilevel analyses. MH assisted with analyses and writing of the article. All authors approved the final version of the article.

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Competing interests None declared.

Ethics approval Ethical approval according to the Medical Research (Human Subjects) Act (WMO), formal approval for this research project by a medical ethics committee was not required. The NIVEL Primary Care Database extracts data according to strict guidelines for the privacy protection of patients and GPs. In addition, we sought and obtained permission for this work from the board of the NIVEL network. Patient data were anonymised guaranteeing the patient's privacy before questionnaires left the practice.

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