Point of care testing and selftest related consultations in general practices in the Netherlands: an exploratory study on general practitioners' experiences

H.J. Hofland (s0089796)
2010-07-02

Health Technology and Services Research (HTSR)
School of Management and Governance, University of Twente,
Enschede, the Netherlands

Executed at the National Institute for Public Health and the Environment (RIVM)
Centre for Biological Medicines and Medical Technology (BMT),
Section Medical Technology (MET)

Supervisors

University of Twente
Prof. Dr. M.J. IJzerman
Dr. C.J.M. Doggen

RIVM
Dr. E.S.M. Hilbers
Ir. R.E. Geertsma

Abstract

Background: In recent years, a wide range of in vitro diagnostic (IVD) point of care tests (POC) and selftests have become available for use by health professionals and individual consumers or patients. Both types of tests may have potential benefits and consequences for general practice care. Therefore, the present study investigated GPs experiences with POC testing and selftest related consultations in general practices in the Netherlands.

Methods: Two-phased study design, i.e. questionnaire followed by semi-structured interviews. Three-hundred randomly selected GPs from the NIVEL register of GPs were sent a questionnaire that collected data regarding the use of POC tests and occurrence of selftest related consultations in general practice. Subsequently, 11 self-enrolled GPs were contacted for an interview to discuss their experiences in greater depth. Descriptive statistics were used to assess the questionnaire answers. Interviews were recorded and analysed using thematic analysis.

Results: Usable questionnaires were returned by 123/294 GPs (42%). Experiences with POC testing related mainly to three types of tests (nitrite, glucose and haemoglobin) for which the users were classified as 'general users', representing 80% of the GPs. The other 20% of the GPs were classified as 'innovative users' by their use of additional tests (D-dimer, candida, cholesterol, faecal occult blood, C-reactive protein, troponin and glandular fever test). A large proportion of 70% of the GPs reported willingness to use additional tests in the future. Overall, interviews illustrated satisfaction with current routines wherein the GPs' assistant operates the POC tests in practice. Additional tests would be considered for implementation if value is demonstrated and costs are reimbursed. Experiences with selftest related consultations were limited to only one third of the GPs observing selftests. Most often observed selftests included tests for diabetes, kidney disease, female fertility and cholesterol. Interviewed GPs had almost no experience with selftest related consultations and accordingly they did not feel that the use of selftests has consequences for general practice care.

Conclusion: In comparison with the wide range of POC tests and selftests available, GPs' experiences with both tests are limited. POC testing in general practice seems to have the potential to increase when value is demonstrated and costs are reimbursed. It is important that more attention is given to operator training and quality control when POC test are used in general practice. Follow-up behaviour of selftesters remains unknown. This needs to be investigated among actual users.

Background

In recent years, technologies to design and manufacture in vitro diagnostic (IVD) tests have strongly developed [1]. A wide range of innovative IVD rapid testing techniques to diagnose or screen for conditions have become available since then and is still expected to continue to increase in a market that currently represents 32% of the global IVD market [2]. Compact, easy-to-use devices for tests on human body samples such as blood, urine or saliva are able to provide test results within minutes and have made it possible to perform diagnostic tests outside the external laboratory setting, closer to the patient. Examples of new settings in which these tests can be used are the operating room, the hospital bedside, the general practice or the patients' home [1]. Different terminologies have been developed to define the tests used by health professionals in the healthcare setting and the tests used by patients or consumers in their homes. The first type is commonly referred to as point of care tests or abbreviated POC tests, the second as selftests [3].

Point of care testing in general practice

In his role as a gatekeeper for secondary care, the general practitioner (GP) has the responsibility to make important decisions about diagnosis and further management of patients with a wide variety of complaints. This early stage decision-making process includes patients' background information, clinical examination and results from diagnostic tests [4]. Consequently, external laboratory tests are frequently ordered to exclude or confirm conditions or to reassure patients [5]. Immediate availability of test results by the use of a point of care test on-site within one single patient consultation can support the GP in a more rationalised decision-making process. Moreover, elimination of waiting time associated with conventional laboratory analyses and obtaining results real-time enables earlier identification of diseases and consequently, earlier start with treatment or referral to secondary care. In addition, by reducing the number of (re)-visits and phone consultations between patients and GPs as well as contacts between the GP and the laboratory, it increases patient throughput, resulting in improved convenience and satisfaction for both patients and GPs [3, 6-7].

As it seems, POC testing can be of great value in the general practice. However, these advantages are only effective in improving the quality of care if patient safety is ensured. Therefore, the test results provided by POC testing must be as accurate and reliable as test results from the conventional laboratory [8]. Expressed concerns

related to the quality of POC test results are largely due to test operation by non-laboratory trained users. Unfamiliarity with sampling, test performance and interpretation as well as with associated tasks such as data-management, device maintenance and quality control increase the likelihood of errors compared to conventional laboratory testing. [3, 6-9]. Other problems reported with POC testing include uncritical use of tests owing to easy availability in practice [3, 9] and difficulties of making changes in established general practice routines [10-12].

There is a wide variety of tests available for POC testing in general practice, ranging from simple disposable dipsticks to complex desktop analysers [13]. Examples include urinalysis and blood glucose testing as well as tests for the detection of allergies, infections, cardiac disease or cancer [3, 6, 13]. A previous study in 1998 demonstrated wide spread use of POC tests in general practices in the United Kingdom, with urine dipstick tests and glucose tests being used most frequently [14]. Recent studies in the Netherlands have shown the value of individual tests such as the D-dimer test [15-16] and C-reactive protein test [17-18] when used in general practice. For other POC tests such as coeliac [19], allergies [20], cholesterol [21] or Helicobacter pylori infection [22], satisfactory performance in comparison with laboratory analyses has been demonstrated. However, further research needs to assess the true effectiveness, benefits and acceptance of implementation in general practice.

Selftest related consultations in general practice

In the present health conscious self-care culture, members of the public take control over their own healthcare [23-24]. The use of selftests seems to fit with this consumer autonomy because it enables people to check for signs of certain health conditions without recourse to a health professional [25-28].

The use of a selftest can be independently initiated by consumers or professionally initiated by doctors' recommendation when patients use a selftest to monitor a previously diagnosed condition [29-30]. Independently initiated selftests are available in different applications. These vary from selftests where the consumer sends a self-obtained sample to a laboratory, or has a sample taken in a laboratory, with test results returned by post or internet, to genuinely true selftests where the consumer is individually responsible for the complete testing procedure with test results immediately available [27]. Selftests allow privacy and convenience as consumers do not have to consult a doctor to receive test results. The fast availability of anonymous

test results can offer reassurance or detect the presence of disease or an increased risk of disease in an early stage enabling early treatment [23, 25-27, 30-32].
In spite of these benefits, the above mentioned reports have expressed several concerns as well, largely due to its use without professional support. Therefore, biggest concerns about selftesting are associated with the independently initiated true selftests [33]. First of all, different studies have claimed that accuracy and reliability is not always proven for these tests [30, 34-36]. Another problem observed with selftests is the poor quality of test instructions, potentially leading to incorrect execution and interpretation of the test [37-39]. However, even if good performance is demonstrated in a clinical setting, this is likely to decrease in the intended real-life setting, which was even the case for pregnancy selftests which are widely accepted for their diagnostic accuracy [40]. For inexperienced and untrained lay users it is difficult to obtain a sample, execute the test and read and interpret the test results correctly [41-44]. This increases the likelihood of false negative or false positive test results causing false reassurance or unnecessary anxiety [42, 44]. Even more, low prevalence of disease among the general population with many low-risk individuals decreases the predictive value of a diagnostic test causing false results as well [33, 44]. False negatives as well as true negatives for symptoms that are misinterpreted and actually due to another condition, can lead to missed cases of disease which causes delay of treatment and increased spread in case of infectious diseases. False positives as well as true positives that would have never have caused severe disease if remained undetected, can generate distress and may lead to increased demand for healthcare services [23-27, 31, 45].

Consumers can obtain selftests for more than 20 different types of conditions including diabetes, allergies, fertility, several infectious diseases, cancers and cardiovascular diseases [27, 45]. These tests are offered directly over the counter in pharmacies and drug stores or via the internet. Studies on the prevalence of use of selftests have shown that approximately 15% of the population has used at least one selftest and that more than half of the population would consider using one in the future [25, 27]. In addition, a study on the use of cancer related selftests alone concluded that about 1% of people has used a selftest for cancer and more than a third may use one in the future [26].
With the internet offering anonymity, it has reduced physical and intellectual barriers for the use of selftests. As the proportion of people having access to the internet continues to increase, selftests are likely to become even more easily available and widely used [25, 27, 34]. Besides that, new developments can increase the number

of tests available and thereby increase demand [2]. If the use of selftests increases while the quality of its performance remains poor, the associated problems may become bigger as well. For the GP with his role as gatekeeper to specialist care, workload may increase by consultations from worried patients with positive test results (whether false of true) seeking for advice or further examination to verify selftest results [23-27, 31, 45]. Moreover, the use of selftests can change the GP-patient relationship when pro-active patients take control over their own health and demand action based on selftest results as a substitute for the GPs' judgment [23]. Two studies investigating the follow-up behaviour of selftest users have shown contrasting results for related consultations with the GP. In the study by Ronda et al. (2009), 75% of users with a positive test result consulted a GP for advice, while this proportion was only 25% in positive testers who used an albuminuria selftest [46].

Aim

The range of POC tests available for use is still growing and several studies have demonstrated promising results for the use of POC tests in general practice. Little is known about the actual extent to which GPs use POC tests in general practice and their experiences with these tests. Even more, available information is out-of-date and based on data from a healthcare system different from the system in the Netherlands.

The use of selftests by the general public exists and is likely to increase. Potential consequences for the demand of healthcare services by selftest users have been reported in several studies. However, only few studies examined the extent to which selftest users actually demand general practice care as a consequence of selftest results and no studies truly investigated the experiences of GPs with these patients.

The aim of this present study is therefore to investigate GPs' experiences with POC testing and selftest related consultations in general practices in the Netherlands.

Methods

This descriptive, exploratory study included two consecutive phases, i.e. a quantitative questionnaire was followed by qualitative semi-structured interviews. The questionnaire was used to examine the extent of use of POC tests and the occurrence of selftest related consultations. The semi-structured interviews involved a limited group of GPs and aimed to explore GPs' experiences with POC testing and selftest related consultations in general practice in greater depth.

Study population and data-collection

On March 3rd 2010, a two-page postal questionnaire and prepaid envelope was sent to a random sample of 300 GPs retrieved from the Netherlands institute for Health Services Research (NIVEL) register of GPs [47]. This register contains nearly all self-employed GPs and GPs employed by other GPs in the Netherlands. According to the standard procedures of the NIVEL, GPs above the age of 65 years, GPs with a history of being non-compliant to surveys, GPs who were already sampled too frequently and GPs participating in a special network (Netherlands Information Network of General Practice – LINH) were labelled as unavailable for this present study. After excluding these GPs, a random sample was drawn. Demographic variables such as birth year, gender and degree of urbanisation of practice location of the GPs were retrieved from the NIVEL register, together with contact information of the GPs (name and postal address).

The interview participants for the second phase of the study were recruited by a request for interview participation integrated in the questionnaire. GPs willing to participate were contacted for an interview appointment of approximately 30 minutes. There were no specific in- or exclusion criteria apart from availability during the interview period (April 15th till May 7th 2010). Interview participants were given the choice between a telephone interview and a face-to-face interview at a convenient time during the interview period. All interviews were undertaken by the same researcher (HJH).

Questionnaire

A cover letter sent with the questionnaire briefly described the aim and contents of the study. As an introduction, definitions of point of care tests and selftests were given. For selftests it was specifically mentioned that monitoring tests for a previously

diagnosed condition and pregnancy tests were excluded from the study. The questionnaire included closed-ended questions to collect further demographic information on the GPs practices such as type of practice and number of patients associated to their practice. Additionally, quantitative data were collected regarding the use and frequency of use of different types of POC tests. Similar data were gathered for the occurrence and frequency of consultations related to different types of selftests. To this end, a list of POC tests and a list of selftests were presented in the questionnaire so that GPs could check the lists on applicable tests. These lists were based on tests mentioned regularly in the retrieved sources of information on both subjects such as the guidelines from the Dutch College of General Practitioners (NHG), literature searches in Scopus™ (Elsevier BV) and Medline/PubMed (US National Library of Medicine) and brochures and websites from IVD product manufacturers and suppliers. Any additional tests could be noted by the GP. Furthermore, the questionnaire included one question concerning the willingness to use (additional) POC tests. To maximise response, questionnaire length was limited and one reminder was sent to non-responders 10 days after the first mailing.

Data-analyses of questionnaires

To safeguard randomness of the sample, validity of the identity of the responding GPs was verified by matching birth year entered in the questionnaire with birth year as provided by the NIVEL register of GPs. Questionnaire answers of GPs with a valid identity were included in the statistical analyses. Basic descriptive statistics were used to describe the characteristics of the responders and the quantitative data on the use and frequency of use of POC tests, and on the occurrence and frequency of selftest related consultations. Possible associations between demographic variables and the use of POC tests were assessed. For selftest related consultations, possible association between their reported occurrence and the degree of urbanisation of practice location was assessed. Differences between groups on categorical variables were analysed using chi-square tests. Differences between groups on mean age were analysed using independent samples t-tests. To identify potential selection bias due to non-response, analyses were conducted with mean age, gender and degree of urbanisation of practice location as independent variables and response versus non-response as the dependent variable. Differences were considered to be statistically significant if $p < 0.05$ (two-sided). All analyses were performed using the Statistical Package for the Social Sciences (SPSS) software, version 18 (SPSS Inc, Chicago, IL).

Interviews

A semi-structured interview guide was developed based on information from the available literature and preparatory consultations with two GPs, prior to the start of the official study. POC testing topics focused on implementation of POC testing in general practice routines, value and satisfaction for GP and patients, and barriers and facilitators for use. Topics for selftest related consultations focused on workload caused by selftesting, the GP-patient relationship and future expectations. Interviews were personalised on the basis of the questionnaire answers of the individual GPs.

Data-analysis of interviews

The interviews were recorded and transcribed verbatim. Transcripts were manually analysed using thematic analysis [48]. A coding system was developed to identify common themes. This process included six steps: familiarisation with the interview material, development of themes, organisation of themes in categories, labelling of categories, interpretation of the meaning of the themes and finally, description of the categories and their context.

Questionnaire Results

Characteristics of the responders

Out of 300 questionnaires sent, six were returned to the research office as undeliverable; two were returned to sender, three GPs were out of employment and one GP was on pregnancy leave. This changed the denominator from 300 to 294 (see figure 1). Completed questionnaires were returned by 133 GPs (45% response). However, for 10 of these GPs the birth year entered in the questionnaire did not match with birth year as provided with the sample from the NIVEL register of GPs. The questionnaire answers of these GPs with an invalid identity were excluded from statistical analysis and considered as non-response. Usable response rate of the questionnaire was 42% (123 out of 294). Characteristics of responding GPs are shown in table 1.

There were more women than men among the responders (58.5% vs. 41.5%) Mean age of the responders was 44.8 years (range 31 to 63). The highest percentages of GPs worked in duo- or group practices (70.6%) and had over 2500 patients (61.0%). For degree of urbanisation of practice location the largest group of GPs was classified as working at a strongly urban practice location (31.7%). The distribution of gender, age group and degree of urbanisation of practice location was practically similar in responders and non-responders.

Questionnaire findings

Use of POC tests in general practice

Almost all GPs (115 out of 123, 93.5%) reported use of one or more POC tests in their practice. Among the 115 POC test users, 43.5% reported use of three different types of tests and 34.8% reported use of two different types of tests. The maximum number of different types of tests used by one individual GP was six. This was only reported by one GP. Two types of POC tests were used by almost all of the 115 GPs: the nitrite test by 95.7% and the glucose test by 91.3% (table 2). Furthermore, around 55% of the GPs reported using the haemoglobin (Hb) test and 10% reported use of the D-dimer test. All other tests were used by less than 10% of the POC test users. Nitrite, glucose, haemoglobin, cholesterol and C-reactive protein tests were principally used with a weekly frequency, while D-dimer, candida and faecal occult blood tests were generally used monthly. Of the eight GPs currently not using any

POC tests, only two reported that they would be willing to use POC tests (28.6% of seven, due to one missing answer). Of the 115 GPs already using POC tests, 75 reported that they would be willing to use additional POC tests (70.8% of 106, due to nine missing answers). There were no considerable differences in demographic variables (i.e. gender, age, degree of urbanisation of practice location, type of practice and number of patients associated to practice) between GPs that were and were not willing to use (additional) POC tests.

General and innovative users

The 115 POC test users were divided into 90 general users (i.e. use of the most common tests only: nitrite, glucose or haemoglobin) and 25 innovative users (i.e. use of additional POC tests: D-dimer, candida, cholesterol, faecal occult blood, C-reactive protein, troponin or glandular fever). All innovative users also reported use of the nitrite, glucose or haemoglobin test. Table 3 shows the proportions of general and innovative users by the different demographic variables. Distributions of demographic variables did not differ statistically significant between general and innovative users. Nevertheless, GPs in the youngest and the oldest age group (< 34 years and 55+ respectively) were more often innovative users than average (36.4% and 30.8% vs. 21.7%). In addition, innovative users were more present in practices in slightly urban locations than average (32.1% vs. 21.7%), while the proportion of innovative users working in practices in non urban locations was below average (7.7% vs. 21.7%). Moreover, GPs working in healthcare centres were more often classified as innovative users than GPs working in solo- and duo- or group practices (41.2% vs. 18.8% and 19.2% respectively), which was also more than average. Finally, 70.6% of the general users reported that they would be willing to use additional POC tests, which was comparable to 71.4% of the innovative users.

Occurrence of selftest related consultations in general practice

About a third of the GPs (42 out of 123, 34.1%) reported the occurrence of selftest related consultations in their practice. Of these 42 GPs, almost 40% observed two different types of tests. The maximum number of different types of tests observed by one individual GP was eight. This was reported by only one individual GP and the subsequent number of observed selftests decreased immediately to five (also one GP). The most often reported selftests observed in a consultation were diabetes selftests (64.3%), followed by selftests for kidney diseases (50.0%), female fertility (40.5%) and cholesterol (38.1%) (table 4). All other selftests were reported by less than 10% of the GPs. Generally, selftest related consultations occurred with a yearly

frequency. Only diabetes selftests were observed more often monthly (53.9%) or weekly (11.5%). Selftest related consultations occurred more often in practices in extremely urban locations than in practices in locations with other degrees of urbanisation (53.8% vs. 24.1% - 35.9%). This was also more than average (53.8% vs. 34.1%). The smallest amount of selftest related consultations was reported by GPs working in practices in moderately urban locations (24.1%). However, these differences were not statistically significant.

Interview results

Characteristics of the interview participants

Eleven GPs were approached for an interview appointment. One GP eventually withdrew due to workload in practice leaving ten GPs available for interview participation. Of these GPs, two were among the group with an invalid identity (see figure 1). However, given the aim of the interviews to explore GPs experiences with POC testing and selftest related consultations in more depth, these two GPs remained included in the non-random interview phase of this study. Of the interviews, nine were conducted by phone and one face-to-face. Among the interviewees were five women and five men. The interviewees had an average age of 49 years (range 34 to 63), representing all age groups. In addition, all five degrees of urbanisation were represented. All of the interviewed GPs used POC tests with seven classified as general users and three as innovative users. Innovative users used tests for D-dimer (one GP), candida (one GP) and faecal occult blood (one GP). All interviewees reported willingness to use additional tests. Selftest related consultations were only reported by four of the interviewed GPs and included the observation of selftests for kidney disease (two GPs), Human Papilloma Virus (one GP) and individual tests for cholesterol, allergies and prostate cancer (one GP). However, the interviews revealed that most of the GPs did observe selftests for kidney disease after all.

Interview findings – POC testing

Implementation in general practice routines

POC tests are usually operated by the practice assistants. Most GPs discussed test results with their patients within one single consultation. Only few GPs mentioned to use phone consultations to discuss test results at a later time. Improvements in

patient throughput in general practice were highest by means of the nitrite test used in a routine in which the assistant executes the test prior to consultation with the GP.
GPs evaluate the POC test systems as very easy to use. Operator training is not considered as a task in general practice as it is integrated in the preceding education of practice assistants. Only few of the GPs mentioned that it might be appropriate to pay extra attention to the possibility of testing errors and the inaccuracy margins of tests. Attention for device maintenance and quality control was limited to routine calibration once or twice a year.

Value and satisfaction for GP and patient

POC testing is used as a supplementary tool in diagnostic decisions based on complete patient profiles. POC test results are trusted if these correspond with the GPs hypothetical diagnosis, thereby are extreme test results mistrusted and verified. Overall, the GPs were confident of the reliability of POC test results, only haemoglobin tests were reported for poor performance, even resulting in removal of this test in some practices. Completion of the diagnosis of a patient within one consultation and eliminating the need for restudying a patient record compensated the extra work associated with the execution of a test. GPs felt that immediate discussion of the test results and follow-up procedures is also more convenient for their patients by reducing distress of waiting for results and the enhancement of a feeling of direct control over their situation.

Main barriers and facilitators for use

Test-performance - Accurate and reliable test performance must have been demonstrated in clinical studies. A test must enable the GP to assume or exclude a condition with confidence. Especially accurate specificity of a test was mentioned as a necessary condition for safe and effective use in general practice. In addition, a POC test must be superior to laboratory testing with respect to convenience and safeguard or improve clinical outcomes.

Ease of use – Test operation must be feasible for practice assistants and the device must be practical, meaning that critical steps in test operation must be eliminated and device volume and equipment must be restricted. Besides that, extra tasks in administration, logistic and quality control must be very limited.

Costs – Overall, GPs mentioned that tests that do not return investments (acquisition of the device, costs per individual test and costs of time needed for execution) will not be implemented. Therefore, remuneration of costs associated with POC testing by

health insurance companies would facilitate implementation of POC testing in general practice.

Interview findings – Selftest related consultations

Workload caused by selftesting

GPs' experiences with patient consultations related to selftest use were very limited. Accordingly, consequences for the workload in general practice were considered as minor and not problematic. The most important task for the GPs concerned reassurance of worried patients, followed by a rationalised determination of the patients' actual risk profile and when appropriate, verification of the selftest results.

GP-patient relationship

The GPs did not feel that the relationship with their patients changed by their use of a selftest. The patients still trusted the GPs diagnosis, even if it differed from the selftest diagnosis.

Future expectations

Overall, concerns about the quality of selftests and poor interpretation by lay users were shared among the GPs. Time will have to show whether the number of users is going to increase and what the consequences for the demand of the GP will be. However, most of the GPs do not expect a giant increase in the use of self-initiated selftests by consumers. In their view, most patients still prefer the GPs diagnosis over selftesting.

Discussion

The present study investigated GPs' experiences with POC testing and selftest related consultations in general practices in the Netherlands. This descriptive, exploratory study used a two-phased study design including a questionnaire sent to 300 GPs (response 123/294 = 42%) followed by semi-structured interviews with 10 GPs.

The questionnaire findings showed that almost all GPs have some experience with POC testing. However, this is mainly related to common use of the nitrite and glucose test, both used by more than 90% of the GPs, and the haemoglobin test used by more than 50% of the GPs. Accordingly, GPs only using one or more of these common tests were classified as 'general users', representing 80% of the GPs. Other additional types of POC tests used by a small group of GPs included the D-dimer, candida, cholesterol, faecal occult blood, C-reactive protein, troponin and glandular fever test. GPs using one or more of these less common tests were classified as 'innovative users', representing the other 20% of the GPs. The percentages of users per individual test were very small, with the D-dimer test being used most, by 10% of the GPs. These numbers demonstrate that the use of POC tests in general practice is limited compared to the wide range of POC tests available. On the other hand, the majority of GPs (70%) did report willingness to use additional tests, indicating that the use of POC tests is likely to increase in the future. No statistically significant associations between demographic variables and the use of POC tests could be identified. Further information from the interviews showed that POC tests are usually operated by the practice assistants with test results immediately used within one consultation. Overall, GPs evaluated POC testing as an easy-to-use, convenient supplement in general practice. Main barriers for using additional tests were undemonstrated value in comparison with laboratory testing, unpractical test devices and associated costs.

For selftest related consultations, the questionnaire findings demonstrated that GPs' experiences were limited to only one third of the GPs reporting occurrence of selftest related consultations in their practice. Even more, for most tests this only occurred on a yearly frequency. Within these consultations, diabetes, kidney disease, female fertility and cholesterol selftests were most often observed. Other selftests were observed by less than 10% of the GPs. The interviewed GPs had almost no

experience with selftest related consultations; accordingly they did not feel that the use of selftests currently has important consequences for the demand of general practice care or the GP-patient relationship. The GPs did not expect a future increase in selftest use to be very likely because they feel that most patients still prefer the GPs' diagnosis over selftesting.

This is the first study to report on the actual extent of use of all available POC tests for use in general practices in the Netherlands. Most other studies in the Netherlands have focused on specific individual tests, e.g. the D-dimer test [15-16] or C-reactive protein test [17-18], or were carried out more than 10 years ago in a different health care system than the system in the Netherlands [14]. Moreover, this is the first study that examined the actual consequences for the demand of healthcare services in relation to the use of selftests. Other studies did demonstrate that selftest use is present among consumers, but associated consequences for GPs were never examined [25-27]. A strength of this study is that the response on the questionnaire was high with a response rate of 45% resulting in a usable response rate of 42%. The apparently high motivation among GPs to participate in the study indicates that the topics of this study are considered important by the GPs. The information from this study provides a first insight in the current situation in general practices in the Netherlands related to POC testing and selftest related consultations. In addition, it reveals aspects of POC testing and selftesting that may need attention in order to ensure patient safety and improve quality of care.

Several limitations should be considered in interpreting the findings from this study. First of all, the 300 GPs in the original questionnaire sample from the NIVEL registration of GPs were more often female compared to the 8789 GPs included in the registration of GPs in 2009 (58.5% vs. 38%) [49]. Consequently, the study population differs from the total Dutch population of GPs on this aspect. However, as gender was not associated with the use of POC tests, this was not considered to be an issue. Furthermore, the questionnaire results were based on self-reported data. As a result, we do not know whether the GPs have interpreted the questions correctly. An example of this problem was identified when one of the interviewed GPs who did not report use of POC tests in the questionnaire turned out to use the nitrite and glucose test after all. In addition, questionnaire answers are always based on a study population that personally chooses to respond. Even though the questionnaire was sent to a random sample and the responders were comparable to non-responders on demographic variables, other unknown characteristics of the GPs

could have influenced their choice for study participation. For example, motivation to complete the questionnaire may have been higher in GPs with a greater interest in POC testing than normal.

The interviews were conducted in a small group of 10 non-randomly selected GPs which even included two GPs that were excluded from the random sample in the first phase of the study due to their invalid identity. However, given that the aim of the interviews did not include the assessment of any quantitative associations, this was not an issue. Furthermore, all interview participants were willing to use additional POC tests. Most probably, the interview participants had a greater interest in POC testing than the average Dutch GP. On the other hand, the interview group included three innovative users, which was only one more than would be expected based on the average distribution. On the whole, the results of the present study may not be representative for the total Dutch population of GPs. However, they can be considered sufficiently strong to fulfil the study aim of carrying out a first investigation of GPs experiences with POC testing and selftest related consultations in general practices in the Netherlands.

POC testing in general practice

To investigate whether demographic variables could be associated with the use of POC tests, the GPs were divided into a group of ‘general users’ and a group of ‘innovative users’. Although we could not identify any statistically significant differences between the two groups, some aspects may require further attention. The most interesting difference was the finding that GPs working in healthcare centres were more often classified as innovative users than GPs working in solo-, duo- or group practices. It is possible that healthcare centres have fewer barriers for the use of innovative POC tests than solo, duo or group practices when for example costs of a POC test can be shared among a larger group of potential users. Unfortunately, there were no GPs from healthcare centres included in the interviews to explore the possible reasons for this difference. A finding illustrated by the distribution of the degree of urbanisation of practice location was that the proportion of innovative users was extremely small in practices in non urban locations with only 8%. However, in practices in slightly urban locations the proportion of innovative users turned out to be high with 32%. Since these two degrees of urbanisation are not very different from each other based on population density, it is difficult to say what may have caused this difference. With the limited information we have in this study, including only 123 GPs, the differences between the groups could be chance findings as well as indications for factors influencing the use of POC tests. Therefore, further research is

needed to investigate if the illustrated differences remain when a larger sample of GPs is included. Moreover, the influence of other factors, e.g. costs, personal traits of GPs, cooperation with the central laboratory or characteristics of the patient population, should be taken into account as well.

The questionnaire illustrated that 70% of the GPs would be willing to use additional POC tests. The question remains why the group of innovative users is still this small. The interviews showed that there are several barriers that need to be overcome before GPs would seriously consider using a specific POC test in practice. One of these factors is that the value of a test compared to standard clinical laboratory testing must have been demonstrated in research. In addition, a test must be practical for use in general practice.

Recent studies in the Netherlands have demonstrated optimistic results for the value as well as the ease of use of the C-reactive protein test [17-18] and the D-dimer test in general practice [15-16]. It is interesting that these two tests were also explicitly mentioned as useful by some of the interviewed GPs. However, costs associated with using a POC tests are expressed to be a barrier for use and these tests are currently not reimbursed by health insurance companies. If demonstrated benefits such as a decrease in unnecessary antibiotic prescribing [17-18] and reducing unnecessary referral to secondary care [15-16] will support the reimbursement of these tests, it can be expected that the C-reactive protein test and the D-dimer test develop into commonly used tests.

In addition, when evidence on the value of a POC test is available, the test could be included in the guidelines from the Dutch College of General Practitioners (NHG) [50] which currently include recommendations for the use of the nitrite, glucose, haemoglobin and D-dimer test. Even though the interviews as well as other studies [51] illustrate that GPs do not always implement these guidelines in their practice routines, recommendation of a test by the NHG can affect implementation of specific POC tests in general practice.

In any case, the value of a test is always arguable by personal preferences and opinions on the usefulness of diagnostic testing. GPs had several personal reasons that influenced their choice for using a specific test. For example, some GPs mentioned that POC tests for severe acute conditions would be very useful in general practice to exclude patients that do not need to be referred to specialist care, while others argued that patients suspected of having such an acute condition need to be transported to specialist care straight away to reduce risks. Also opinions on the usefulness of screening tests differed between the GPs. Some pointed out the value

of reducing unnecessary inconvenient examinations (e.g. a colonoscopy) by using a simple screening test in practice, while others did not see any benefits from these types of tests due to the prolixity of double testing which is always needed to verify a positive test result from the screening test.

A very important finding from the interviews is that even though all GPs express that performance of a POC test must be accurate and reliable; they have a remarkably unconcerned attitude towards operator training and quality control of the device. According to the literature, these two aspects are very important to guarantee the accuracy and reliability of a test and consequently, to ensure patient safety and quality of care [3, 6-9]. The interviews showed that POC tests are usually operated by the GPs' assistants and that the GPs take the testing competence of their assistants for granted. However, assistants acquire education on the general use of POC test devices in their education at school but they do not have special laboratory training before they use the specific devices in general practice. If the user of a test is not adequately trained for all operator dependent steps (i.e. sampling, test execution and interpretation), errors could very well occur resulting in decreased test performance [43]. Moreover, routine procedures are susceptible to sloppiness. Remarks concerning quality control indicated that this is limited to a routine calibration once or twice a year. Moreover, several GPs reported that this routine calibration was disregarded. On the other hand, it must be mentioned that GPs expressed that they always verify extreme test results with a reference test and that devices that repeatedly produced unreliable test results were excluded from their practices (this was the case for the haemoglobin test in some of the GPs' practices).
Even though the GPs do pay attention to the quality of tests results, it seems that operator training and quality control of POC tests is not a main focus of the GPs. Therefore, attention should be given to the importance of implementing these aspects in general practice routines to ensure safe and effective use. Moreover, the optimal use of specific tests, as for example the accompaniment of communication training with C-reactive protein testing [17] must be considered as well.
A suggestion to improve the quality of operator training and quality control is by cooperation with laboratories. For example, the use of a so-called POC test manager to support its use by quality control and maintenance contracts with the central laboratory is currently trialled in Amsterdam [52].

Selftest related consultations in general practice

The expected consequences for the demand of general practice care have not been demonstrated in the present study. Selftests were only observed by one third of the GPs and even though 18 different types of selftests were observed, only four selftests were observed by more than 10% of these GPs. The most often observed selftests (diabetes, kidney disease, female fertility and cholesterol) were reasonably comparable to the selftests that have been reported to be used most often by consumers in other studies [25-27]. A slight difference found in this study is the high occurrence of consultations related to the use of a selftest for kidney diseases. This was most probably due to the availability of the free selftest for screening albuminuria, 'the kidney check', offered by the Dutch Kidney Foundation in 2006 [46]. Moreover, selftests for sexually transmittable diseases (STDs) such as chlamydia or HIV were less often observed in the present study than these were reported to be used in the studies including actual selftest users. This difference could be due to the fact that these users choose not to visit their GP but visit special clinics concerning STDs.

Although not statistically significant, we found that selftest related consultations occurred most often in practices in extremely urban locations (53.8%). First of all, it must be considered that this result was based on a very small sample of 42 GPs and it was not supported by information from actual selftest users. Nevertheless, it could indicate that the use of selftests is more popular in extremely urban regions than in other regions. It would therefore be interesting to investigate if the popularity of selftesting differs between degrees of urbanisation for the actual users.

The objective of this part of the study was to investigate the experiences of GPs with selftest related consultations. However, it seems that most of the GPs have no or just little experience with selftest related visits. This was not expected based on the prevalence of use of 15% of the population and the high number of patients considering use in the future [25-27]. Even more, there are several suppliers of selftests easily accessible on the internet [29] and the industry has recently reported an increase in the demand for selftests [2]. With this limited occurrence of selftest related consultations in general practices, follow-up behaviour associated with selftest use remains unclear. In the evaluation of the above mentioned 'kidney check', the follow-up behaviour of testers was examined among the users of the test. This demonstrated that only 25% of the users with a positive test result consulted their GP to seek advice [46]. To ensure patient safety, it is very important to consider

why the number of patients seeking advice with their GP is limited (e.g. high number of negative test results, patients seeking advice and treatment in other healthcare services or patients ignoring positive test results). In addition, it should be investigated what reasons cause people to use a selftests instead of consulting their GP. To examine factors associated with the use of selftests and consumers' follow-up behaviour, research among users would therefore be the first step. Currently, ongoing studies are investigating factors associated with the use of selftests [25], psychosocial correlates of their use, consumers' information needs and consumers' follow-up behaviour [27].

Conclusion

In conclusion, GPs' experiences with POC testing in general practices in the Netherlands are limited, especially in comparison with the wide range of tests available. On the other hand, its use has the potential to increase if studies keep demonstrating value of tests and health insurance companies decide to reimburse costs associated with POC testing. To ensure patient safety and quality of care it is recommended to include operator training and quality control in general practice routines for POC testing, possibly in cooperation with central laboratories. GPs' experiences with selftest related consultations are very limited. Therefore, the follow-up behaviour of the users of selftest remains unknown. Currently ongoing studies will hopefully give an idea of the reasons for use of selftests and the actions users take on the results of selftests. Future developments will have to demonstrate the consequences of selftesting for patient safety and the demand of healthcare services.

Acknowledgements

This report is the result of a joint project of the National Institute for Public Health and the Environment (RIVM), the University of Twente and the Netherlands Institute for Health Services Research (NIVEL).

Thanks are extended to:
Ellen Hilbers and Robert Geertsma of the RIVM, and Maarten IJzerman and Carine Doggen of the University of Twente for their supervision during the complete study period. Furthermore, Robert Verheij, the research coordinator of the Netherlands Information Network of General Practice (LINH) from the NIVEL for his advice in setting up this study. Finally, all participating GPs for providing data.

References

1. Price, C.P., A. St John, and J.M. Hicks, *Point-of-Care Testing: What, Why, When and Where?*, in *Point-of-Care Testing, 2nd ed.*, C.P. Price, A. St John, and J.M. Hicks, Editors. 2004, AACC Press: Washington. p. 3-9.

2. Intelab Corporation, *The global point-of-care testing market.* Clinica 2010(February): p. 32-35.

3. von Lode, P., *Point-of-care immunotesting: Approaching the analytical performance of central laboratory methods.* Clinical Biochemistry, 2005. 38(7): p. 591-606.

4. Wonca Europe, *The European definition of General Practice/Family Medicine*. 2002.

5. Houben, P.H.H., et al., *Pretest expectations strongly influence interpretation of abnormal laboratory results and further management.* BMC Family Practice, 2010. 11: p. 13.

6. Price, C.P. and A. St John, *Point-of-Care Testing in Primary Care*, in *Point-of-Care Testing. 2nd ed.*, C.P. Price, A. St John, and J.M. Hicks, Editors. 2004, AACC Press: Washington. p. 279-291.

7. Price, C.P., *Regular review: Point of care testing.* British Medical Journal, 2001. 322(7297): p. 1285-1288.

8. Working Group on Point of Care Testing in Primary and Community Care, *Guidelines for Safe and Effective Management and Use of Point of Care Testing in Primary and Community Care*. 2009.

9. Briggs, C., et al., *Guidelines for point-of-care testing: Haematology.* British Journal of Haematology, 2008. 142(6): p. 904-915.

10. Hilton, S., et al., *Near patient testing in general practice: Attitudes of general practitioners and practice nurses, and quality assurance procedures carried out.* British Journal of General Practice, 1994. 44(389): p. 577-580.

11. Butler, C.C., S. Simpson, and F. Wood, *General practitioners' perceptions of introducing near-patient testing for common infections into routine primary care: A qualitative study.* Scandinavian Journal of Primary Health Care, 2008. 26(1): p. 17-21.

12. Haglund, S., et al., *Fast laboratory test results alone cannot deliver the benefits of near patient testing: a follow-up study after 3 years of extended laboratory service at a primary health care centre.* J Eval Clin Pract, 2009. 15(2): p. 227-33.

13. Hobbs, F.D.R., et al., *A Review of Near Patient Testing in Primary Care*, in *Health Technology Assessment Programme*. 1997. p. 1-230.

14. Murray, E.T. and D.A. Fitzmaurice, *An evaluation of quality control activity for near patient testing in primary care.* British Journal of General Practice, 1998. 48(437): p. 1853-1854.

15. Büller, H.R., et al., *Safely ruling out deep venous thrombosis in primary care.* Annals of Internal Medicine, 2009. 150(4): p. 229-235.

16. Ten Cate-Hoek, A.J., et al., *Cost-effectiveness of ruling out deep venous thrombosis in primary care versus care as usual.* Journal of thrombosis and haemostasis : JTH, 2009. 7(12): p. 2042-2049.

17. Cals, J.W., et al., *Effect of point of care testing for C reactive protein and training in communication skills on antibiotic use in lower respiratory tract infections: cluster randomised trial.* BMJ (Clinical research ed.), 2009. 338.

18. Cals, J.W.L., et al., *Point-of-care c-reactive protein testing and antibiotic prescribing for respiratory tract infections: A randomized controlled trial.* Annals of Family Medicine, 2010. 8(2): p. 124-133.

19. Korponay-Szabó, I.R., et al., *Population screening for coeliac disease in primary care by district nurses using a rapid antibody test: Diagnostic accuracy and feasibility study.* British Medical Journal, 2007. 335(7632): p. 1244-1247.

20. Eigenmann, P.A., et al., *The ImmunoCAP® rapid Wheeze/Rhinitis child test is useful in the initial allergy diagnosis of children with respiratory symptoms.* Pediatric Allergy and Immunology, 2009. 20(8): p. 772-779.

21. Carey, M., et al., *Validation of a point of care lipid analyser using a hospital based reference laboratory.* Irish Journal of Medical Science, 2006. 175(4): p. 30-35.

22. Lu, C.Y., et al., *The clinical applications and accuracy of 2 rapid near-patient tests in detecting Helicobacter pylori infection.* Diagnostic Microbiology and Infectious Disease, 2006. 56(3): p. 241-246.

23. Ryan, A., et al., *Self-care - has HIY gone too far?* British Journal of General Practice, 2006. 56(533): p. 907-908.

24. van Bemmel, J.A.G., *Bijwerkingen van Preventie [Side effects of prevention].* Medisch Contact, 2007. 62(16): p. 702-705.

25. Ryan, A., S. Greenfield, and S. Wilson, *Prevalence and determinants of the use of self-tests by members of the public: A mixed methods study.* BMC Public Health, 2006. 6: p. 193.

26. Wilson, S., et al., *Self-testing for cancer: A community survey.* BMC Cancer, 2008. 8: p. 102.

27. Ronda, G., et al., *Use of diagnostic self-tests on body materials among Internet users in the Netherlands: Prevalence and correlates of use.* BMC Public Health, 2009. 9: p. 100.

28. Health Council of the Netherlands (Gezondheidsraad), *Screening: between hope and hype*. 2008, Health Council of the Netherlands: Den Haag.

29. van der Weijden, T., et al., *Diagnostische zelftests op lichaamsmateriaal; aanbod, validiteit en gebruik door de consument [Diagnostic self-tests on body materials: availability, validity and frequency of use]*. 2007, Maastricht University, School for Public Health and Primary Care (Caphri): Maastricht.

30. Health Council of the Netherlands (Gezondheidsraad), *Annual report on screening for disease 2007 - The self-testing of body samples*. 2007, Health Council of the Netherlands: The Hague.

31. Wilson, S., et al., *Prevalence of the use of cancer related self-tests by members of the public: A community survey.* BMC Cancer, 2006. 6: p. 215.

32. Frith, L., *HIV self-testing: a time to revise current policy.* Lancet, 2007. 369(9557): p. 243-245.

33. Deutekom, M. and P.M.M. Bossuyt, *De toegenomen beschikbaarheid van doe-het-zelftests voor medische metingen [The increased availability of self-tests for medical analyses].* Ned Tijdschr Geneesk, 2007. 151(16): p. 901-904.

34. Skidmore, S., S. Randall, and H. Mallinson, *Testing for Chlamydia trachomatis: self-test or laboratory-based diagnosis?* J Fam Plann Reprod Health Care, 2007. 33(4): p. 231-2.

35. Michel, C.E.C., et al., *Pitfalls of internet-accessible diagnostic tests: Inadequate performance of a CE-marked Chlamydia test for home use.* Sexually Transmitted Infections, 2009. 85(3): p. 187-189.

36. Owens, S.L., et al., *Utilising the internet to test for sexually transmitted infections: Results of a survey and accuracy testing.* Sexually Transmitted Infections, 2009. 86(2): p. 112-116.

37. Hollestelle, M.L., A.W. van Drongelen, and E.A.E. van Tienhoven, *Zelftesten [Selftests]*, in *RIVM report: 265011*. 2006, National Institute for Public Health and the Environment: Bilthoven.

38. van Drongelen, A.W., C.G.J.C.A. de Vries, and J.W.G.A. Pot, *Assessment of files of in vitro diagnostic devices for self-testing*, in *RIVM report: 360050017*. 2008, National Institute for Public Health and the Environment: Bilthoven.

39. Wallace, L.S., N.B. Zite, and V.J. Homewood, *Making sense of home pregnancy test instructions.* Journal of Women's Health, 2009. 18(3): p. 363-368.

40. Bastian, L.A., et al., *Diagnostic Efficiency of Home Pregnancy Test Kits: A Meta-analysis.* Archives of Family Medicine, 1998. 7(5): p. 465-469.

41. Oberpenning, F., et al., *Semi-quantitative immunochromatographic test for prostate specific antigen in whole blood: tossing the coin to predict prostate cancer?* European Urology, 2003. 43(5): p. 478-484.

42. Haddow, L.J. and A.J. Robinson, *A case of a false positive result on a home HIV test kit obtained on the internet [1].* Sexually Transmitted Infections, 2005. 81(4): p. 359.

43. Fox, J.W., et al., *Performance of rapid streptococcal antigen testing varies by personnel.* Journal of Clinical Microbiology, 2006. 44(11): p. 3918-3922.

44. Walensky, R.P. and A.D. Paltiel, *Rapid HIV testing at home: Does it solve a problem or create one?* Annals of Internal Medicine, 2006. 145(6): p. 459-462.

45. Ryan, A., et al., *Range of self-tests available to buy in the United Kingdom: An Internet survey.* Journal of Public Health, 2006. 28(4): p. 370-374.

46. Nielen, M.M., F.G. Schellevis, and R.A. Verheij, *The usefulness of a free self-test for screening albuminuria in the general population: A cross-sectional survey.* BMC Public Health, 2009. 9: p. 381.

47. NIVEL. *NIVEL: Professions in Healthcare*. Available from: http://www.nivel.nl/beroepenindezorg/.

48. Polgar, S. and S.A. Thomas, *Introduction to Research in the Health Sciences*. 5th ed. 2008: Churchill Livingstone Elsevier.

49. Hingstman, L. and R.J. Kenens, *Cijfers uit de registratie van huisartsen, peiling 2009 [numbers from the registration of general practitioners, bearing 2009]*, in *Cijfers uit de registratie van beroepen in de gezondheidszorg*. 2009, Netherlands Institute for Health Services Research (NIVEL): Utrecht.

50. NHG. *Nederlands Huisartsen Genootschap [Dutch College of General Practitioners]*. Available from: http://nhg.artsennet.nl.

51. Lugtenberg, M., et al., *Why don't physicians adhere to guideline recommendations in practice? An analysis of barriers among Dutch general practitioners.* Implementation Science, 2009. 4(1).

52. Bliekendaal, M., *POCT in de huisartsenpraktijk [POCT in the general practice].* Diagned Magazine, 2009. June: p. 15-16.

Tables

Table 1. Characteristics of responders (N=123)

Demographic variable	N	(%)
Gender (female)	72	(58.5)
Mean age (years)	44.8	
Age group (birth year)		
<= 1955	16	(13.0)
1956 – 1965	46	(37.4)
1966 – 1975	49	(39.8)
1976+	12	(9.8)
Degree of urbanisation of practice location†		
Extremely urban	13	(10.6)
Strongly urban	39	(31.7)
Moderately urban	29	(23.6)
Slightly urban	29	(23.6)
Non urban	13	(10.6)
Type of practice*		
Solo	17	(14.3)
Duo- or group	84	(70.6)
Healthcare centre	18	(15.1)
Number of patients associated to practice*		
< 2000	9	(7.6)
2000 – 2500	37	(31.4)
> 2500	72	(61.0)

* Maximum number of missing answers was 5
† For definitions see [49]

Table 2. Types of POC tests used among 115 GPs and frequency of use

Test	GPs		Frequency of use*					
	N	(%)	Weekly N (%)		Monthly N (%)		Yearly N (%)	
Nitrite	110	(95.7)	104	(99.0)	1	(1.0)	-	-
Glucose	105	(91.3)	90	(90.0)	10	(10.0)	-	-
Haemoglobin (Hb)	63	(54.8)	43	(70.5)	17	(27.9)	1	(1.6)
D-dimer	12	(10.4)	-	-	8	(72.7)	3	(27.3)
Candida	7	(6.1)	1	(16.7)	5	(83.3)	-	-
Cholesterol	4	(3.5)	4	(100.0)	-	-	-	-
Faecal occult blood (FOB)	3	(2.6)	-	-	2	(66.7)	1	(33.3)
C-reactive protein (CRP)	2	(1.7)	2	(100.0)	-	-	-	-
Troponin	1	(0.9)	-	-	1	(100.0)	-	-
Glandular fever	1	(0.9)	-	-	1	(100.0)	-	-

* Maximum number of missing answers was 5

Table 3. Differences between general and innovative users (N=115)

Demographic variable	General users		Innovative users	
	N	(%)	N	(%)
Average distribution (n = 115)	90	(78.3)	25	(21.7)
Gender				
Female (n = 71)	54	(76.1)	17	(23.9)
Male (n = 44)	36	(81.8)	8	(18.2)
Mean age (years)	44.3		45.4	
Age group (birth year)				
<= 1955 (n = 13)	9	(69.2)	4	(30.8)
1956 – 1965 (n = 44)	34	(77.3)	10	(22.7)
1966 – 1975 (n = 47)	40	(85.1)	7	(14.9)
1976+ (n = 11)	7	(63.6)	4	(36.4)
Degree of urbanisation of practice location				
Extremely urban (n = 13)	10	(76.9)	3	(23.1)
Strongly urban (n = 34)	28	(82.4)	6	(17.6)
Moderately urban (n = 27)	21	(77.8)	6	(22.2)
Slightly urban (n = 28)	19	(67.9)	9	(32.1)
Non urban (n = 13)	12	(92.3)	1	(7.7)
Type of practice*				
Solo (n = 16)	13	(81.3)	3	(18.7)
Duo- or group (n = 78)	63	(80.8)	15	(19.2)
Healthcare centre (n = 17)	10	(58.8)	7	(41.2)
Number of patients associated to practice*				
< 2000 (n = 8)	6	(75.0)	2	(25.0)
2000 – 2500 (n = 35)	30	(85.7)	5	(14.3)
> 2500 (n = 67)	50	(74.6)	17	(25.4)

* Maximum number of missing answers was 5

Table 4. Types of selftests observed among 42 GPs and frequency of occurrence

Test	GPs		Frequency of occurrence*					
	N	(%)	Weekly N	(%)	Monthly N	(%)	Yearly N	(%)
Diabetes	27	(64.3)	3	(11.5)	14	(53.9)	9	(34.6)
Kidney diseases	21	(50.0)	1	(5.0)	2	(10.0)	17	(85.0)
Female fertility	17	(40.5)	1	(5.9)	2	(11.8)	14	(82.3)
Cholesterol	16	(38.1)	-	-	6	(37.5)	10	(62.5)
Urinary infection	4	(9.5)	1	(25.0)	1	(25.0)	2	(50.0)
Allergies	2	(4.8)	-	-	-	-	2	(100.0)
Prostate cancer (PSA)	2	(4.8)	-	-	-	-	2	(100.0)
Anaemia	1	(2.4)	-	-	-	-	1	(100.0)
Gluten intolerance	1	(2.4)	-	-	-	-	1	(100.0)
Lactose intolerance	1	(2.4)	-	-	-	-	1	(100.0)
Vaginal infection/Candida	1	(2.4)	-	-	1	(100.0)	-	-
Chlamydia	1	(2.4)	-	-	-	-	1	(100.0)
Vaginal pH balance	1	(2.4)	-	-	-	-	1	(100.0)
Male fertility	1	(2.4)	-	-	-	-	1	(100.0)
Bowel cancer (FOB)	1	(2.4)	-	-	-	-	1	(100.0)
International normalised ratio (INR)	1	(2.4)	-	-	-	-	-	-
Human papilloma virus (HPV)	1	(2.4)	-	-	-	-	1	(100.0)
E.coli bacterium	1	(2.4)	-	-	-	-	-	-

* Maximum number of missing answers was 1

Figures

Figure 1. Flow chart of study participants