Evaluating the population-based utilization and benefit of digitally collected patient-reported outcomes and experiences in patients with chronic diseases: The PROMchronic study protocol

Janis Nikkhah (janis.nikkhah@tu-berlin.de)
Technical University of Berlin: Technische Universitat Berlin https://orcid.org/0009-0003-9311-8808
Viktoria Steinbeck
Technical University of Berlin: Technische Universitat Berlin
Thomas Grobe
Institut für angewandte Qualitätsförderung und Forschung im Gesundheitswesen
Thorben Breitkreuz
Institut für angewandte Qualitätsförderung und Forschung im Gesundheitswesen
Christoph Pross
Technical University of Berlin: Technische Universitat Berlin
Reinhard Busse
Technical University of Berlin: Technische Universitat Berlin

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Abstract

Background

Chronic diseases are associated with a high disease burden. Under- and overprovision of care as well as quality variation between healthcare providers persists, while current quality indicators rarely capture the patients' perspective. Capturing patient-reported outcome measures (PROMs) as well as patient-reported experience measures (PREMs) is becoming more and more important to identify gaps in care provision, prioritize services most valuable to patients, and aid patients' self-management.

Methods

This prospective cohort study aims to evaluate the potential benefits of PROM usage in patients with chronic diseases. We evaluate whether (1) digitally collected PROMs and PREMs can be used for health system performance assessment (HSPA) by generating a representative response of chronically diseased individuals with asthma, chronic obstructive pulmonary disease (COPD), diabetes, and coronary artery disease (CAD) across Germany and (2) whether, based on the PROMs and PREMs, low-value care can be identified. As patient-reported outcomes (PROs) are rarely presented back to patients, (3) this study also examines patients' reactions to their PROM scores in the form of digital PRO feedback. For these purposes, randomly selected patients from a nationwide German insurer are digitally surveyed with generic and disease-specific PROMs and PREMs as well as additional questions on their health-related behavior four times over one year. Individual PRO feedback is presented back to patients longitudinally and compared to a peer group after each survey period. Patient-reported data is linked with health insurance data. Response rates, changes in health and experience outcomes over time, self-reported changes in health behavior, and healthcare system utilization will be analyzed.

Discussion

We aim to fill the research gap on the population-based utilization of PROMs and PREMs in patients with chronic diseases and add to the current understanding of PROM data-sharing with patients. The study's results can thereby inform whether a healthcare system-wide approach of collecting PROMs and PREMs can be utilized to identify low-value care, assess quality variation within and across chronic conditions, and whether PRO feedback is helpful and associated with any changes in patient's health behaviors.

Trial registration

German Clinical Trials Register - DRKS00019916. Registration date: August 22, 2023.

Administrative information

Note: the numbers in curly brackets in this protocol refer to SPIRIT checklist item numbers. The order of the items has been modified to group similar items (see http://www.equat or-network.org/reporting-guidelines/spirit-2013-statementdefning-standard-protocol-items-for-clinical-trials/).

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Author details {5a}	Janis Nikkhah, Research Fellow, Department of Health Care Management, Berlin University of Technology, janis.nikkhah@tu-berlin.de Viktoria Steinbeck, Research Fellow, Department of Health Care Management, Berlin University of Technology, steinbeck@tu-berlin.de Dr. Christoph Pross, Senior Research Fellow, Department of Health Care Management, Berlin University of Technology, christoph.pross@tu-berlin.de Prof. Dr. Reinhard Busse, Head of Department, Department of Health Care Management, Berlin University of Technology, mig@tu-berlin.de
Name and contact information for the trial sponsor {5b}	Department of Health Care Management, Berlin University of Technology, Straße des 17. Juni 135 – Secretariat H80, 10623 Berlin, Germany mig@tu-berlin.de +49 30 314-28420
Role of sponsor {5c}	The sponsor is not responsible for the study design, data collection, analysis as well as any publication related to the study.

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Introduction

Background and rationale {6a}

Globally, one in three persons and up to 60% in industrialized countries are suffering from at least one chronic disease.[1-3] Furthermore, this share is continuously increasing across the globe due to demographic change and consumption patterns.[3,4] Chronic diseases, including conditions such as diabetes, cardiovascular diseases, and chronic obstructive pulmonary disease (COPD), are long-lasting conditions that can significantly impact a patient's quality of life and are a key driver of escalating health costs in both developed and developing economies.[5] Diagnosing and treating chronic conditions comes

with substantial uncertainties for patients, families, and caregivers.[6] The high complexity of chronic care, for instance, raises the uncertainty regarding whether patients with chronic diseases will respond to a selected treatment in the way a priori expected and in case they do whether it is the most efficient one.[7]

Patient-reported outcome measures (PROMs) and patient-reported experience measures (PREMs) have been utilized for over 20 years, but have become increasingly widespread and accepted only in recent years[8], as reflected by their increasing utilization in oncology[9-11] and orthopedics[12-14]. PROMs are questionnaires that allow valuable insights into the patient's perspective of living with a (chronic) disease as they reflect the patient's own perception of their health status.[15,16] PREMs are questionnaires used to gather information from patients about their personal experiences and perceptions of the care and services they have received.[17] With digital PROMs (ePROMs) and digital PREMs (ePREMs) being reported and used more frequently in the last years[18,19], utilization for population health purposes appears more in reach but has rarely been examined.[20]

PROMs and PREMs might have care improvement potential in the field of chronic diseases due to their information value for patient empowerment including self-management and shared decision-making which could influence treatment adherence and lifestyle choices.[21] However, PROMs and PREMs have rarely been used in routine chronic care due to the unspecified timeline and the complexity of implementation. [22] Due to the high relevance of this topic, the OECD PaRIS initiative focuses on collecting and analyzing PROMs in patients with chronic diseases across 18 countries starting their trial phase in 2023. The initiative does not cover Germany.[23] The present study "PROMchronic" aims to fill the research gap by evaluating the utilization of ePROMs and ePREMs in the German chronic disease population for four selected chronic disease profiles.

Furthermore, providing patients with information on their health status based on PROMs in reference to a comparable peer group is rarely done.[24,25] Yet, specific information about patients' health status is crucial because it can help patients better understand their health conditions and enable decision-making and overall patient empowerment. When patients are well-informed about their health, they are more likely to adhere to treatment plans and achieve better health outcomes.[26] Patients can use this information together with their healthcare providers to set realistic goals for their treatment, monitor their progress, and identify areas where additional support is needed.

Objectives {7}

Our study aims to evaluate the potential benefits of the structured and population-based use of ePROMs and ePREMs to improve care for chronically ill patients in Germany. First, we evaluate whether and how representative the response to the digitally collected questionnaires is and thereby investigate PROMs as a tool for health system performance assessment (HSPA). Second, we assess if low-value care elements can be identified in today's care for chronically ill patients across Germany. Third, we analyze patients'

understanding of and reactions to individualized PRO feedback. To achieve these objectives, this study aims to answer three overarching research questions and their sub-questions:

1. Can ePROMs and ePREMs be used in patients with chronic diseases for quality measurement at the health system level (e.g., for HSPA)?
    - How representative are response rates in patients with chronic diseases via digital surveys?
    - How do response rates and willingness to respond multiple times vary over time by age, gender, indication, city/state, health system use (frequent versus infrequent users), web- or app-based surveys, and Disease Management Program (DMP) participation?
2. To what extent can value of care variation be identified from ePROMs and ePREMs surveys?
    - What is the share of suspected low-value care and suspected high-value care in Germany, per indication and in subgroups?
    - How do ePROM and ePREM results and health indicators of health insurance data differ according to age, gender, indication, city/state, healthcare system utilization (changes in frequency of outpatient practitioner attendance, prescriptions, hospitalizations, etc.), and DMP participation?
    - Can ePROMs and ePREMs function as an early warning signal for deteriorating chronic conditions or adverse events such as hospital admission?
3. What are the benefits or drawbacks of PRO feedback (outcome reports) sent to patients?

- Are the PRO outcome reports understandable to patients?
- Can PRO feedback function as a positive nudge (lead to positive behavioral changes e.g., healthier, or more active lifestyle, more active participation in medical treatment, actively approaching treating physicians in the office setting)?
- Are there any negative emotional reactions when receiving PRO feedback that shows values worse than those of a comparable group?

Trial design {8}

This is an observational prospective cohort study covering the four chronic diseases asthma, COPD, diabetes type one and two, and coronary artery disease (CAD). As shown in Figure 1, the first point of contact will be a letter from the insurer to insured patients selected for their chronic disease. A patient can then sign up digitally for the study via a QR code or online link. For each of the different diseases, a distinct patient pathway is automatically assigned, with a registration process followed by some background questions and the respective generic and disease-specific PROMs and PREMs. The study covers a timeframe of one year split, into four time intervals with further information and reoccurring questionnaires. The time intervals are split into smaller tasks to facilitate the answering process for participants. The first interval includes self-registration and baseline assessment on health behavior. A

few weeks after responding to the first set of questions (A & B in Figure 1), patients will receive a report with their individual PROM scores compared to a peer group and will be surveyed on the comprehensibility of the PRO report (C in Figure 1). From the second interval onwards, patients will also receive their individual PRO results longitudinally. Lastly, following the individual PRO feedback report participants will be surveyed regarding their health behavior (D in Figure 1). After one year, the primary data collection process is finished, and patient-reported data will be merged with health insurance data. Further explanation of subgroup definitions can be found in the Statistical Analysis Plan (Additional File 1).

Figure 1: Study design: Patient pathways including timeline and tasks

Methods/Design

Study setting {9}

This study will recruit patients all over Germany who are insured at one of the largest statutory health insurer in Germany (BARMER). The BARMER represents more than 10% of the German population. After the identification of individuals based on their chronic disease profile, validated PROM sets are employed digitally to regularly survey patients with asthma, COPD, diabetes, or CAD on their health outcomes as well as experience with the health care system.

Eligibility criteria {10}

Patients are eligible for participation in the study if they are above the age of 18 and have at least two outpatient consultations in 2021 documenting a confirmed chronic disease diagnosis of one of the four focus diseases. Additionally, for type 1 diabetes patients at least one insulin prescription must be documented in 2021. To contact patients and enable the linkage of health insurance data, patients must be insured by the BARMER health insurance all year in 2021. Patients enrolled in a DMP as well as patients not enrolled in any DMP are eligible. However, enrolment in more than one DMP is not permitted to avoid multiple invitation letters and cross-over groups.

Who will take informed consent? {26a}

Informed consent must be provided digitally, before patients can participate in the study. By signing the digital informed consent, patients allow contact for follow-up surveys via e-mail and to process their survey data for academic research purposes. Additionally, patients are asked to sign a second consent form for processing and linking their insurance data to their survey data. All consent is given directly at the start of the trial. The first consent form is necessary to be part of the study, the second consent form is optional and is no prerequisite to participate in the study. The separate consent in two steps is due to German data regulation on the secondary utilization of claims data. Patients will be free to withdraw

from either one of the consents without stating a reason until the anonymization of the data. If the patients withdraw their consent for participation, all their data will be deleted. Consent forms can be found in Additional File 2.

Additional consent provisions for collection and use of participant data and biological specimens {26b}

Not applicable, as no further consent forms are used besides those in 26a, and no biological specimens are collected.

Intervention

Explanation for the choice of comparators {6b}

This prospective observation cohort study does not involve any specific therapeutic treatment. To analyze and report insights on sub-cohorts of the study population splits for age, gender, indication, PRO feedback, and utilization of the healthcare system (e.g., DMP) are formed.

Intervention description {11a}

In addition to filling out the survey questions (considered here as intervention 1), all participants will receive PRO feedback (considered here as intervention 2 – see Additional File 3). The PRO feedback will be a pdf report sent via email, which graphically (line charts) shows the patients' individual generic and disease-specific health status in comparison to a patient-specific peer group. In addition to the visual feedback, the results will shortly be explained on the same page. The description will cover whether patient-individual PRO scores are better or worse compared to the peer group and that if worse the patients' health status might be still good and can be discussed with the patients' physician. Additional details on the scores and sub-scores are shared with the patients on the subsequent pages of the report. Peer groups are classified according to their disease, gender, and age group (18 to 45 years, 45 to 65 years, 65 to 75 years, and 75 and above). The report refers to a patient's routine care physician(s) as the main contact to discuss the results or in case of questions.

Criteria for discontinuing or modifying allocated interventions {11b}

Participants may withdraw from the study at any time. Following discontinuation, all participants' individual study data will be deleted, and surveys and reminders will not be sent anymore.

Strategies to improve adherence to interventions {11c}

To enhance adherence, the sign-up process for the digital solution was kept to a minimum. In addition, email reminders will be sent to patients. Moreover, the PRO feedback includes multiple elements (graphics, bolded text, and descriptions), as this was shown to improve patient understanding.[25,27]

Relevant concomitant care permitted or prohibited during the trial {11d}

There are no relevant concomitant therapies that are necessary or prohibited during the study.

Provisions for post-trial care {30}

Participants will receive their usual care during and after the study.

Outcomes {12}

The primary endpoint (research question 1) of the study is the sufficient study participation to determine the representativeness of results. As expected, study participation will vary depending on gender, age, and diagnosis, but this can be compensated for by weighting the study participants according to structural information on the target population.

Within our study, data on healthcare utilization is available for both participants and the whole target population. Weighted measures of health care utilization from participants will be compared with measures of health care utilization of the complete target and will be assumed to be formally representative if the weighted measures from participants fall within the 95% confidence interval of the same measures based on data of the complete target population.

Secondary endpoints are the endpoints to answer research questions 2 and 3 are:

Research question 2:

1. Share of low-value care using the VBHC framework introduced in Figure 2 and specified in further detail in the Statistical Analysis Plan (Additional File 1)

2. Share of high-value care, specified in Figure 2

3. Outcome and patient experience variation across subgroups

4. Adverse events such as hospital admission due to chronic disease profile

Research question 3:

5. Comprehensibility and usability of PRO feedback

6. Impact of PRO feedback on healthcare behavior

Figure 2 represents how PROMs and PREMs can be combined into one value of care indicator, e.g., if PREMs and PROMs are both average or above (up to 1 standard deviation (SD)), care is suspected to be high-value, whereas if PROMs and PREMs are below 1 SD of the average, care is suspected to be low-value. Since for each disease group, a disease-specific PROM will be used next to a generic PROM, the assessment of low- and high-value care across diseases will be conducted by utilizing the generic PROMs. Moreover, the disease-specific PROMs will be used to create low- and high-value care categorizations on a detailed level within a disease group. Adding cost data, as a third dimension to the value of care framework (as described in the Statistical Analysis Plan, Additional File 1) then enables a clear distinction between patients considered to have received low-value care and patients which received high-value care. A more detailed description of the outcomes can be found in the Statistical Analysis Plan (Additional File 1).

Figure 2: Assessment of Value-Based Healthcare - Outcome dimension

Participant timeline {13}

Eligible participants will be participating in the study for a maximum of four quarters, starting with the first access of the digital questionnaires followed by quarterly digital surveys split into several tasks (compare Figure 3). To start the survey, participants register with their study pseudonyms received in their enrollment letter and then share basic demographics. Each survey period contains four tasks to be completed by participants defined as sets of questions that each will take five to ten minutes to complete. The participants will receive individual reports on their patient-specific and peer group outcomes (PRO feedback) and will be asked about the comprehensibility of the report. Following the report, the participants receive a set of questions regarding their health-related behavior.

Figure 3: Schedule of enrollment, interventions, and assessments

Sample size {14}

The initial enrollment letter is sent to 200,000 insured patients, 50,000 for each of the selected chronic conditions. Diabetes type 1 and type 2 are considered jointly as there is no differentiation in the selected PROMs. The patients of all chronic diseases are allocated to groups based on their participation in DMP (DMP or non-DMP group). Prior experiences suggest that around 30% of patients react to invitations to participate in research by their insurer.[28-30] Two-thirds of initial participants are expected to allow follow-up contacts and processing of their health insurance data and around 40% of these patients will continue

participating in all the follow-up surveys after receiving reminders for each task. Therefore, after accounting for non-participants and participants with no complete survey data we expect a complete data set for 16,000 participants. However, the first research question will investigate response rates as there is no evidence on this population yet.

Recruitment {15}

An initial enrollment letter including the study explanation, a QR code, and a link as an invitation to participate in the study will be sent to insured patients in October 2023 (see Additional file 4). The enrollment survey and thereby the recruitment period will be open for two months.

Assignment of interventions: allocation

Sequence generation {16a}

The BARMER health insurance will send out enrollment letters based on a random selection of BARMER-insured patients following the defined eligibility criteria (see Eligibility criteria {10}). Matching of DMP- and Non-DMP participants will be done according to the following steps:

- Stratification by
    - Gender (male, female)
    - 10-year age groups (1st group: 18 - under 30 years, last group: 90 years and above)
        - Number of outpatient cases with indication diagnoses within the year 2021 (outpatient cases in less than four quarters, outpatient cases in all four quarters but less than or equal to six cases, outpatient cases in all four quarters with more than six cases)
- Matching DMP- and Non-DMP-patients by strata and a generated random numbering within the strata (1:1 matching).
- Consecutive selection of randomly sorted matched pairs if both matched individuals are insured all year long

The output is a dataset containing matched pairs per indication. The first 25,000 matching pairs for each chronic condition will be selected. Diabetes type 1 and type 2 are considered jointly with patients having diabetes type 1 selected first (approximately 6,600 matched pairs are expected), followed by supplementing the remaining required matched pairs with patients having diabetes type 2.

Concealment mechanism {16b}

Allocation concealment is ensured as the sequence generation is generated in a data warehouse by the health insurance.

Implementation {16c}

The random selection of patients will be performed by the BARMER health insurance according to the selection process description provided by the independent evaluating aQua institute.

Assignment of interventions: Blinding

Who will be blinded {17a}

All patients in the study population will be invited to participate in the study and all participants will receive surveys as well as PRO feedback. Therefore, no blinding method will be implemented.

Procedure for unblinding if needed {17b}

Not applicable as no blinding was used in this trial.

Data collection and management

Plans for assessment and collection of outcomes {18a}

There are two main data sources used in this study. First, primary data will be collected from the participants' surveys. Second, secondary data from the cooperating health insurer BARMER will be used. The primary data collection is conducted via digital surveys which include different questionnaire categories, namely: PROMs, PREMs, comprehensibility of the PRO feedback, and questions on patients' health behavior. Additionally, an anchor question using the Global Rating of Change (GRC) scale[31] with five answer options is included to assess changes in health status.

An overview of all selected survey items including the selected validated PROMs can be found in Figure 4 and is described in more detail in the following paragraphs.

Figure 4: Survey items in the PROMchronic trial

PROMs

Various PROMs exist that can be classified into generic, treatment-specific, and disease-specific instruments. Generic PROMs assess health outcomes broadly and enable comparison across diseases whereas treatment- or disease-specific PROMs are tailored to a specific treatment or disease and are more suitable for comparisons inside patient groups receiving the same treatment or a population with similar diseases.[15] The selection of the PROMs is in line with the selection criteria reported in the literature[32-35] as well as project-specific criteria. The criteria which were used for the selection of PROs are listed in the following:

1. **Short:** The questionnaire must be brief to not burden participants and increase response rates.[36] The overall item count across one survey period was restricted to 60 items and less than 15 minutes to complete.
2. **Language:** The PROM must be available in German.
3. **Validation:** The sets must be validated at least in the German language, and ideally also for digital application.
4. **Licensing fees: L**icensing fee for survey in academic use does not exceed $5,000 per set.
5. **Scoring:** Scoring information must be available to enable PRO feedback based on overall scores.
6. **Health dimensions:** The combined set of PROMs must cover all overarching health dimensions of physical, mental, and social health and reflect a mix of generic and disease-specific PROMs to enable informative intra and inter-group comparisons.
7. **OECD comparison:** If possible, given the before-mentioned selection criteria, similar PROMs as the OECD PaRIS initiative were selected to facilitate the comparability of results.

As a result, all participants will receive the PROMIS PROPr questionnaire[37] as well as disease-specific PROMs based on their chronic disease The disease-specific PROMs are:

- Asthma: Asthma Impairment and Risk Questionnaire (AIRQ)[38]
- COPD: Clinical COPD Questionnaire (CCQ)[39]
- Diabetes: Problem Areas In Diabetes (PAID-5)[40]
- CAD: Seattle Angina Questionnaire (SAQ-7)[41], and Rose Dyspnea Scale (RDS)[42]

PREMs

PREMs are used to collect information about the experiences of patients with healthcare services. PREMs ask patients about aspects of care such as communication, coordination, and access to care.[17,43] The responses can provide valuable insights into how healthcare services are perceived by patients and how they can be improved. There are a variety of different PREMs surveys available, each with its own strengths and weaknesses and focus areas. Similar to the selection of the PROMs the selection of PREMs followed criteria of time required to complete, validity, language, licensing fees, and HSPA relevance. Consequently, participants will receive the 11-item “responsiveness” component of the IPHA

questionnaire with modified observation periods, as it is validated in chronic disease patients in Germany, is available in the German language, and is relatively short (eleven items).[44]

Questions on PRO feedback

The study examines a patient's perception and reaction to individual PRO feedback. First, patients will be asked if they have opened the pdf report. In addition, the comprehensibility and usefulness of the report will be investigated by asking one question each. A final question is asked about a possible change in mood after seeing the results in the pdf report. The set of questions can also be found in Table 1.

Table 1: List of questions on reactions to PRO feedback

Focus area	Question
Review of report	Have you looked at your health report?
Comprehensibility	Is the information in the health report understandable for you?
Usefulness	Is the information in the health report helpful for you?
Change in mood	How do you feel based on the information in your health report?

Health behavior

Health behavior is significantly associated with health outcomes like mortality or the occurrence of chronic diseases.[45] Regarding chronic diseases, there are five essential health behaviors related to health outcomes which include physical activity, diet, smoking, alcohol consumption, and sleep.[46] Participants' perception of health behavior is assessed by one question on each of these five health behavior dimensions. Thereafter, their intention to change health behavior in the coming months and triggers for change is assessed. Additionally, participants receive a question regarding whether the results were discussed with their treating physicians.

Health Insurance Data

For those participants who have given consent, health insurance claims data will be linked to the participants' primary data after the completion of the final survey period. Claims data will contain healthcare resource consumption (residence, comorbidities, inpatient hospital stays, outpatient consultations, complications, rehabilitation, drugs, physiotherapy, medical remedies and aids, and care services) and additional data points further specified in the Statistical Analysis Plan (Additional File 1).

Plans to promote participant retention and complete follow-up {18b}

Complete survey data is important to calculate PROM scores.[47] Participants can access digital dashboards showing open tasks (questionnaires) and remaining time to complete them. To increase data completeness, the participants will be reminded by e-mail to fill in their follow-up questionnaires one, three, and ten days after the initial dispatch of surveys.

Data management {19}

The collection, storage, and processing of personal data in this project are carried out in accordance with the General Data Protection Regulation in Germany, the specific data protection provisions of the Social Code, and all other national data protection regulations. During the study, all electronically recorded primary data as well as participation and consent forms will be stored on the server of Oncare GmbH and are deleted after the end of the evaluation period. The Oncare team will manage patient information through the myoncare app and study website, always respecting data security and confidentiality. All reading and processing processes are logged in the database. All data will be collected and transferred completely pseudonymized.

Pseudonyms are created by the health insurer BARMER following the UUID (universally unique identifier) standard and are only re-identifiable by the BARMER health insurance. Consequently, the pseudonym is added to the health insurance data to match primary patient data to insurance claims data. All identification information will be erased prior to data transfer to the research institutes Technical University Berlin and aQua institute. Pseudonymized data will be kept for the period of data analysis of two years by the Technical University Berlin and aQua institute and stored for an additional ten years at study centers to ensure further evaluation of the study's outcome. This follows the recommendations for good practice in secondary data analysis.[48]

Confidentiality {27}

A unique study pseudonym is assigned to each participant by the health insurer. The pseudonym list with patient names will only be accessible to the health insurer, while they will not receive any primary data. During the primary data collection, no data that would allow re-identification will be collected. Minimum contact data is collected to ensure follow-up surveys can be completed and reminders can be sent to the participants. Linkage of health insurance data will be conducted via study pseudonyms. The project adheres to all data protection laws.

Plans for collection, laboratory evaluation and storage of biological specimens for genetic or molecular analysis in this trial/future use {33}

Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analyses are not necessary for the study because no biological samples are collected.

Statistical methods

Statistical methods for primary and secondary outcomes {20a}

The statistical analyses are reported in the separate Statistical Analysis Plan (Additional File 1) but generally include descriptive statistics, parametric and non-parametric methods as well as time series analyses for the primary and secondary endpoints.

Interim analyses {21b}

Not applicable as there are no stopping guidelines to the PROM collection.

Methods for additional analyses (e.g., subgroup analyses) {20b}

Participants with the respective chronic diseases are grouped into specific subgroups based on the research questions. For all participant groups, additional control data from overall insured patients will be accessible on an aggregated level. Therefore, the study population is segmented into different subgroups (see Figure 5):

- All patients: Full BARMER-insured population with at least one of the chronic diseases included in the study, with data available only at aggregated level
- Invited patients (from “All patients”): Patients that receive the initial invitation letter
- First responders (from “Invited patients”): Patients that complete the first survey period including consent to use their health insurance data
- Regular responders (from “First responders”): Patients that complete at least three out of four survey periods
- Full responders (from “Regular responders”): Patients that complete all four quarterly survey periods

Figure 5: Definition of patient groups for statistical analysis

Methods in analysis to handle protocol non-adherence and any statistical methods to handle missing data {20c}

The study is set up as a prospective observational cohort study inviting patients to complete different surveys over a one-year time frame. Non-adherence defined as non-participation or drop-out in this study is one of the main research questions and will not be handled specifically for research question 1. Complete PROM data is important to calculate scores (also see {18b}). In case of missing data, we will adhere to the PROM-specific guidelines to handle missing data (e.g., imputation or calculating scores based on remaining values).

Plans to give access to the full protocol, participant-level-data, and statistical code {31c}

Full protocol and fully anonymized data can be requested, and distribution will be decided per request by the study committee.

Oversight and monitoring

Composition of the coordinating center and trial steering committee {5d}

The study is monitored by the German research center "Deutsches Zentrum für Luft- und Raumfahrt" (German Aerospace Center). Quarterly status reports are provided by the project team. Status reports include an overview of the achievement levels of the milestones defined prior to the start of the study.

Composition of the data monitoring committee, its role and reporting structure {21a}

The management of the study is overseen by a project team from the Technical University Berlin. The project team is composed of researchers responsible for the study's design, representatives from the participating BARMER health insurance, the technical service provider Oncare, and the evaluating aQua institute. Regular updates on the study's status are provided to the sponsor.

Adverse event reporting and harms {22}

Adverse events are not expected as the medical treatment of patients with chronic care is not affected. Effects of the PRO feedback intervention are one of the primary endpoints and results will be monitored and published.

Frequency and plans for auditing trial conduct {23}

Information on the study process is reported by transmitting milestone achievement reports to the study sponsor on a quarterly basis. Additionally, the project management group meets bi-weekly to discuss the current state of data collection and address potential problems.

Plans for communicating important protocol amendments to relevant parties (e.g. trial participants, ethical committees) {25}

Any substantial amendments to the protocol will be submitted to the ethics committee (see below) and all relevant regulatory institutions. Additionally, any amendments to the study design, timeline, or budget need to be communicated to the study sponsor and approval by the coordination center must be obtained.

Dissemination plans {31a}

The results of this study will be disseminated via publications in peer-reviewed journals and presentations at relevant conferences. Moreover, the funding institution (Innovation Fund of the Federal Joint Committee) will receive an evaluation report that includes the findings of the study as well as interim reports on the study’s milestones. All results will be aggregated with no opportunity to reconnect on an individual patient level.

Discussion

The study aims to fill the gap in the literature on large-scale utilization of ePROMs and ePREMs in patients with chronic diseases. It also introduces an approach to sharing individual PRO feedback with patients with chronic diseases and therefore strengthening patient empowerment. The study's findings can provide a deeper understanding of self-reported health and outcome variation for patients with chronic diseases and low-value/high-value care provision across Germany. Thereby the results can help identify potential gaps in care provision or over-provision for patients with chronic diseases and evaluate the impact of DMP enrollment. Additionally, the study examines how patients with chronic diseases respond to PRO feedback and provides insights into the usability and usefulness of PRO feedback for patients.

ePROM collection will increasingly be the standard for capturing patient's perspective on treatment outcomes as well as their own health status. It is shown that the administrative burden for patients and healthcare providers can be significantly reduced while response rates and completeness of data collection remain high.[49] Additionally, the use of ePROMs and ePREMs can enable (almost) real-time, individual PRO feedback.[50–52] Comparison between the different disease cohorts included in this study will generate insights into the usability of generic and disease-specific PROMs in patients with chronic diseases and their collection by digital health technologies.

Given the OECD PaRIS study will assess PROMs and PREMs across many countries and thereby enable international learning and benchmarking, this study enables Germany to be part of this community and benchmark its healthcare system to those of other OECD countries. Benchmarking results across countries and within Germany can have implications for healthcare spending based on patient’s needs and care reorganization while raising awareness of low-value care.

Providing PRO feedback is one way to enhance the use of PROMs in clinical practice and shared decision-making.[53] Previous studies indicate that patients who reviewed shared information on their PRO outcomes are more engaged and actively participate in their healthcare.[54,55] This study will examine if and to what extent automatically generated PRO feedback could strengthen patient empowerment, informed shared decision-making, and behavior changes in patients with chronic diseases.

There are some limitations to the study that need to be considered. One limitation is the potential for non-response bias, as patients who choose to participate in the study may differ from those who do not. However, given the access route via large-scale, randomized health insurance paper-based outreach, we hope some participants who would not take part in studies in a clinical study will be accessed. Moreover, it is one of the study’s aims to detect the representativeness of the responders. Given that the letter and questionnaire will be in German, we anticipate that non-German speakers will be excluded from the study, which unfortunately could not be addressed via the digital solution, the adjustment to letters, and given the low availability of validated PROMs in other languages often spoken besides German in Germany (e.g., Russian, or Turkish).

Trial Status

The current protocol is version 1, dated October 5, 2023. Patient recruitment will begin with BARMER's letter dispatch around October 11, 2023. The collection of survey data will be finished by September 30, 2024. The study is expected to run until June 30, 2025.

Abbreviations

AIRQ – Asthma Impairment and Risk Questionnaire

CAD – Coronary artery disease

CCQ – Clinical COPD Questionnaire

COPD – Chronic obstructive pulmonary disease

DMP – Disease Management Program

ePREM – digital PREM

ePROM – digital PROM

GRC – Global Rating of Change

HSPA – Health system performance assessment

PAID – Problem Areas in Diabetes

PREM – Patient-Reported Experience Measures

PRO – Patient-Reported Outcome

PROM – Patient-Reported Outcome Measures

RDS – Rose Dyspnea Scale

SAQ – Seattle Angina Questionnaire

SD – Standard Deviation

Declarations

Acknowledgments

Not applicable.

Authors' contribution {31b}

JN and VS jointly prepared the manuscript of this paper. VS, CP, and RB prepared the research proposal. JN is responsible for the implementation of the trial and leading the project administration. TG and TB provided inputs for the statistical analysis plan and reviewed the manuscript. CP and RB reviewed and provided valuable feedback on the manuscript. RB supervises the study. All authors reviewed and approved the final version of the protocol for submission.

Funding {4}

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Availability of data and material {29}

Data will be collected and stored in a secure database, accessible only by study personnel.

Ethics approval and consent to participate {24}

The study will be conducted in accordance with the Declaration of Helsinki and was approved by the Charité’s Ethic Committee, Berlin (EA2/035/23). All potentially eligible participants will be approached to offer their informed consent to participate in the study as well as to allow linkage of their insurance data for further analysis. The current protocol is version 1, dated September 11th, 2023. Any changes in the study design will be communicated to all project partners.

Consent for publication {32}

Consent for publication is given by taking the informed consent form (Additional File 2).

Competing interest {28}

For transparency purposes, CP is contracted full-time with Stryker Corporation, a medical technology company that also produces knee and hip implants. JN is partially employed at Boston Consulting Group GmbH, a global consulting company. All others declare that they have no relevant competing interests.

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Figures

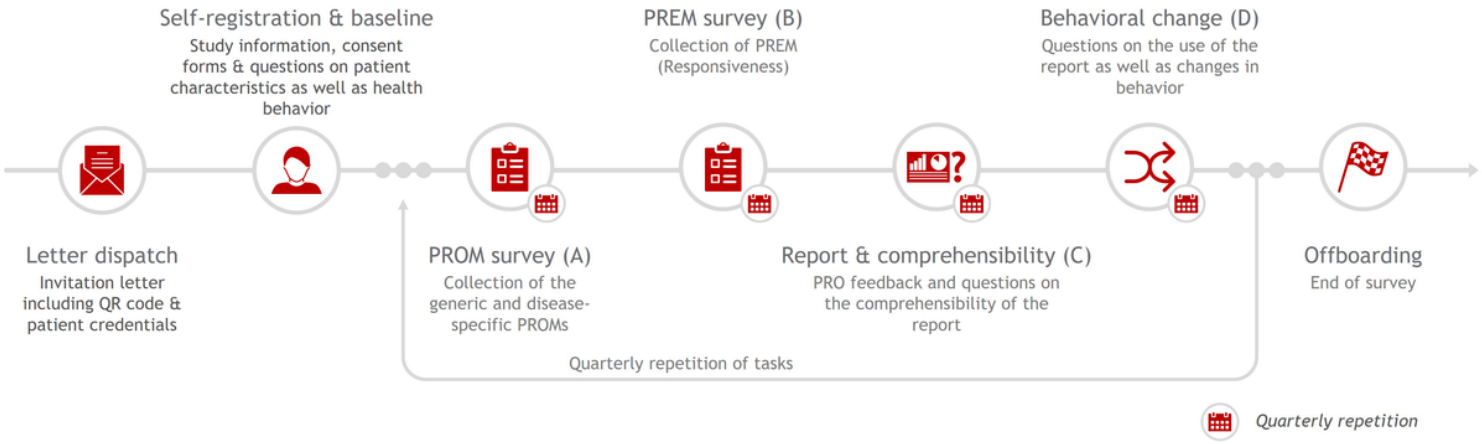

Figure 1

Study design: Patient pathways including timeline and tasks

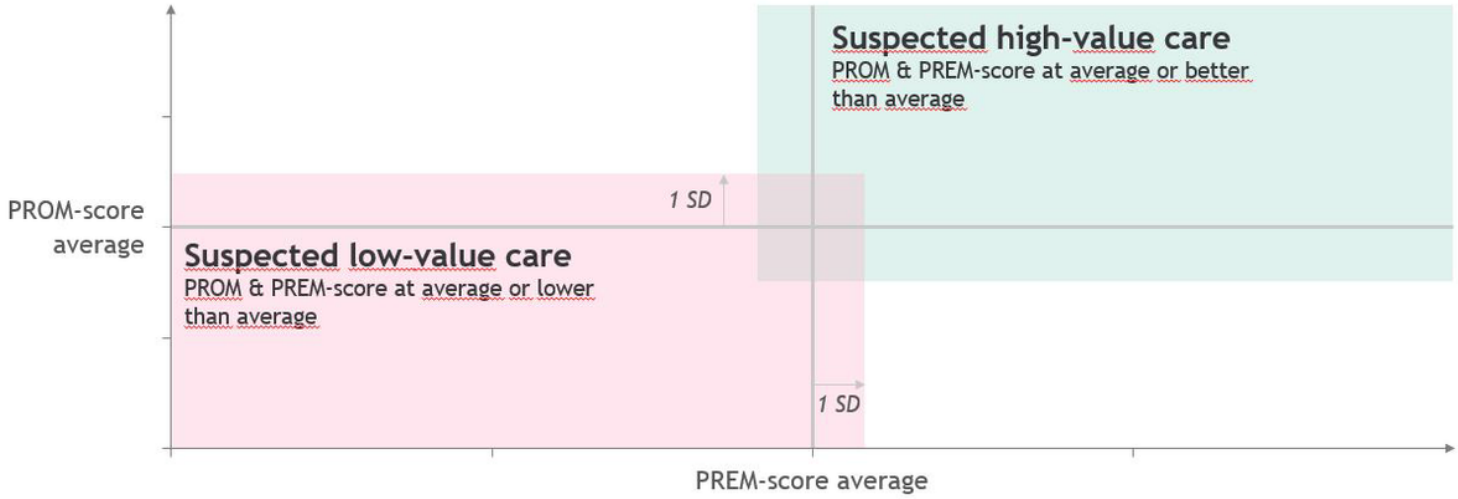

Figure 2

Assessment of Value-Based Healthcare - Outcome dimension

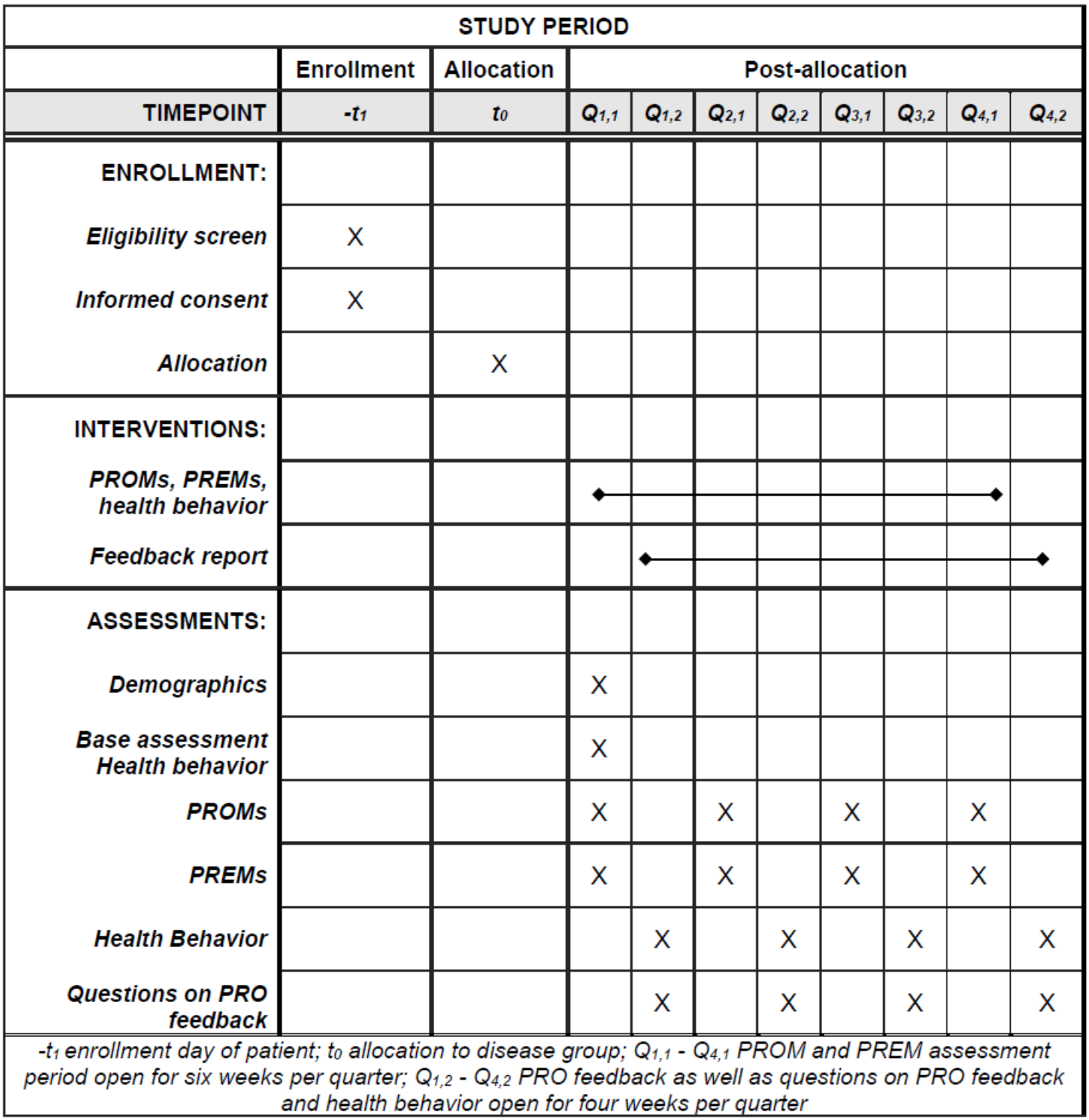

Figure 3

Schedule of enrollment, interventions, and assessments

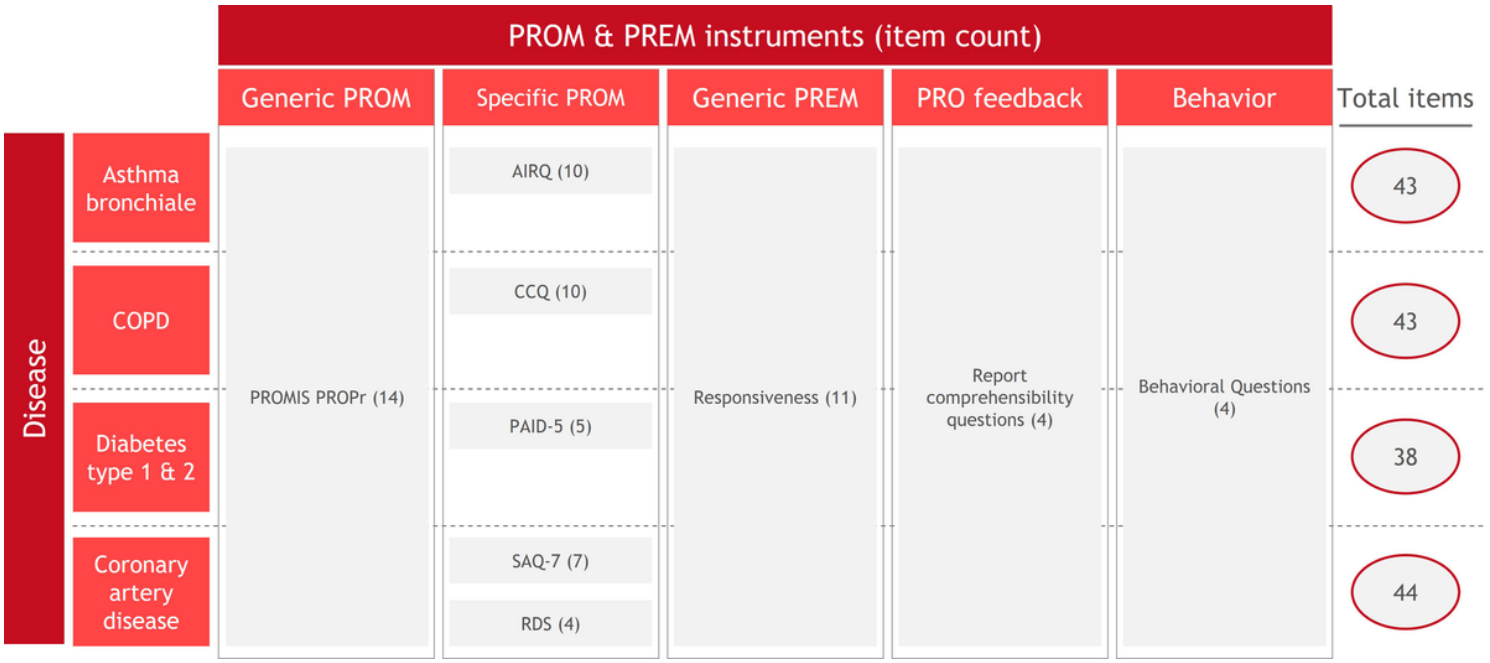

Figure 4

Survey items in the PROMchronic trial

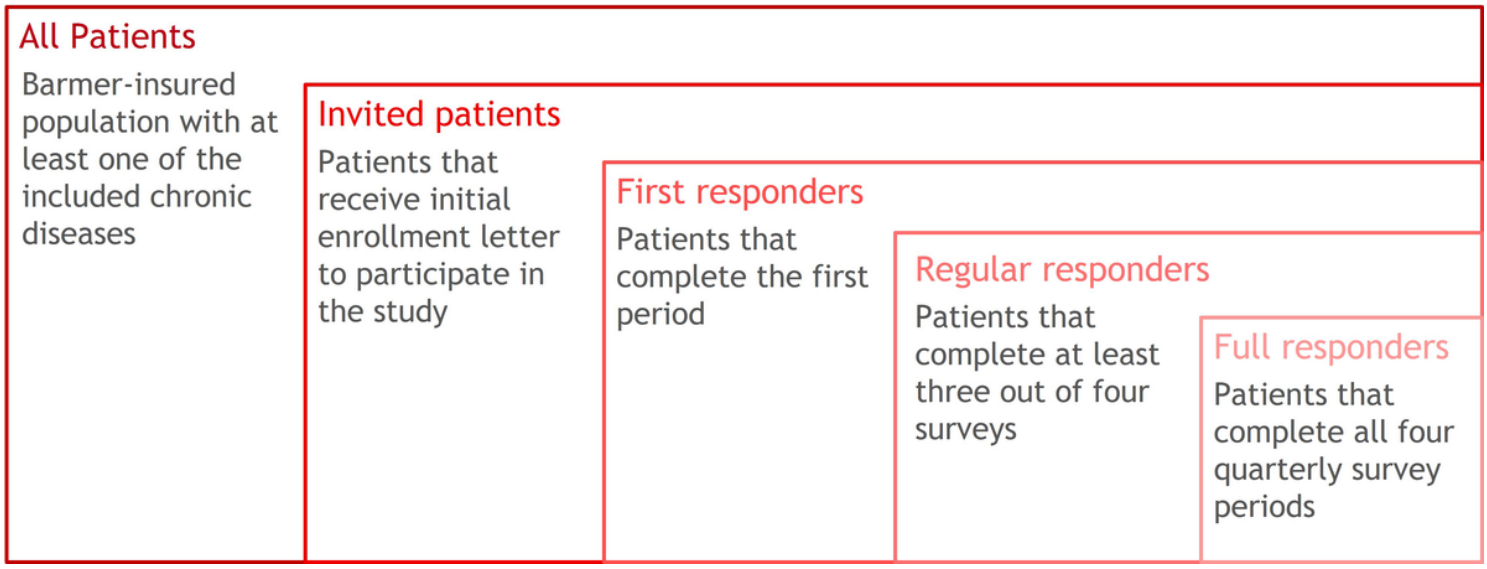

Figure 5

Definition of patient groups for statistical analysis

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- AdditionalFile1StatisticalAnalysisPlan.docx

- AdditionalFile2StudyInformationandConsentForm.docx
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