**Stage 2 Prototype Creation**

**Kingston**

Part 1:

Task: Select at least five updated systematic reviews on e-PROMs in cancer patients; make a table by feature and list findings of each paper

Keywords: cancer AND patient-reported outcome AND telehealth (Mobile health, mobile apps) AND systematic review

Time Required: From Past 5 years

DD: By 5 April for Cyrus for second editing

Literature Review Notes (Systematic Review: Google Scholar):

[Highlighted Articles](https://connectpolyu-my.sharepoint.com/:f:/g/personal/22101071d_connect_polyu_hk/EuSO_3-DamxFpnNTqscL_KEBzGzN_z5rI4ua2j7JC9_5lA?e=J392CW): Yellow-Article Important Points/Red-Points that can related to our project

**Article 1 (2023):** [**Patient-facing cancer mobile apps that enable patient reported outcome data to be collected**](https://www.sciencedirect.com/science/article/pii/S1386505622002453)

Articles Information Summary:

The article presents a systematic review of patient-facing mobile applications designed for cancer patients that facilitate the collection of patient-reported outcome measures (PROMs). It emphasizes the importance of enabling patients to self-manage their symptoms through these mobile apps, which can lead to more informed and autonomous patients. By collecting PROMs prior to clinical reviews, the quality and frequency of holistic assessments can be enhanced, ultimately improving patient experience and reducing the burden on healthcare services. The review focuses on identifying the purpose, functionality, quality, and integration capabilities of the apps with electronic health records (EHRs).

The systematic review analyzed 405 apps available in the UK, ultimately identifying 12 that met the eligibility criteria. Key findings indicated that while most apps were free to download and affiliated with healthcare organizations, none integrated with EHRs. The apps averaged 7.3 functions each, with a mean quality score of 4 out of 5 on the Mobile App Rating Scale (MARS). However, the need for better integration with EHRs is highlighted, as this capability could enhance the clinical utility of the apps and lead to more proactive patient care. The study concludes that further research is necessary to explore the feasibility of integrating these apps with EHRs to improve overall patient outcomes and healthcare efficiency.

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| Summarized Finding and Features | Features that may be adjusted to our application |
| * Exclusion Criteria: Non-English apps, those aimed at children, healthcare providers, and specific cancer types or symptoms were excluded. * User Engagement: 58% of mobile users downloaded health apps, but 45.7% stopped using them due to data entry burden and loss of interest. * App Characteristics: 12 reviewed apps: 75% affiliated with health bodies, none integrated with EHR, all required passwords, and none allowed third-party sharing. * Functionality: Average of 45 symptoms available; 42% allowed users to input custom symptoms. Common functions: record data (100%), collect data (100%), reminders (83%); less common: evaluate (50%), intervene (50%). * Online Shift: Increased online use could reduce operational pressures and enhance patient care pathways for cancer treatment. * Data Collection: Apps may collect data less systematically than validated questionnaires; the Liyfe app notably uses AI for triage and advice. | 1. Include medical advice links to videos/articles more than only health reports 2. Recordable reminder of appointments and schedules of patients 3. Storing registered hospital of patient 4. Providing at least English and Traditional Chinese version 5. Considering the technology skills of users, provide guidance videos at home page 6. Include privacy strategies like login 7. Considering integrations with EHR (Can become a standing out point as not many apps have this function) and affiliated with health body or charity 8. AI chat box for answering questions from users. (Would need testing and consideration on technology skills)   Eileen Comment (Blue): Default answer for previous answers for questionnaires. Update or news can be considered to put into app to increase attractiveness of app, background music etc.  Voice recognition for entering answers |

**Article 2 (2020):** [**Longitudinal study of symptom burden in outpatients with advanced cancers based on electronic Patient-Reported Outcome (ePRO) platform**](https://bmjopen.bmj.com/content/10/11/e038223.abstract)

Articles Information Summary:

The article presents a prospective, longitudinal study protocol aimed at evaluating symptom burden in outpatients with advanced cancers using an electronic Patient-Reported Outcome (ePRO) platform. The study focuses on patients with various advanced cancers, including lung, stomach, liver, colorectal, esophagus, and breast cancer. The primary objective is to monitor changes in symptom intensity over a four-week follow-up period, using validated assessment tools such as the MD Anderson Symptom Inventory and other relevant scales for anxiety, depression, insomnia, and quality of life. The study also evaluates the feasibility of employing the ePRO system, patient satisfaction, and the reasons for any lack of symptom improvement.

The research addresses the high symptom burden experienced by cancer patients, which can negatively impact their quality of life and treatment outcomes. By utilizing the widely adopted WeChat platform for data collection, the study aims to overcome barriers to traditional symptom reporting methods. The findings from this study are expected to contribute to improved symptom management practices in clinical settings, enhance patient engagement, and potentially lead to better health outcomes for patients with advanced cancers. The study protocol has been approved by the Institutional Research Board, and results will be disseminated through academic channels, emphasizing the importance of integrating ePRO systems into routine oncology care.

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| Summarized Finding and Features | Features that may be adjusted to our application |
| * Patient Self-Reporting: 50% completed self-reports within 24 hours of follow-up messages; over 70% completed reports after calls; at least 70% completed all reports within 4 weeks.(User engagement) * Qualitative Research: Aim to understand why symptoms did not improve within 4 weeks. * Symptom Analysis: Determine alert scores for each PRO symptom based on changes during the 4-week follow-up. * Withdrawal Reasons: Major communication difficulties, inability to participate, cognitive impairment, incorrect data provision, withdrawal requests, or other assessed conditions. * Insomnia Scoring: Scores range from 0 to 28, indicating levels from no insomnia to severe insomnia. * Patient Alert: Reminders for patients with worsening symptoms to visit the symptom management clinic. * Follow-Up Schedule: Seven follow-ups on Days 1, 3, 7, 10, 14, 21, and 28 after the initial visit. * Information Privacy: Completion progress visible on physician sites while maintaining privacy. | 1. Follow up time could be set after the first time of user finishing the health report like 3 days, 5 days etc. And following up the scores during each time for better symptom control and usage of the system 2. Scoring range of symptoms would need to be clear enough and instructions on which level is what situation for better decision making of patients while filling in 3. (User engagement)Report finishing should be able to save and wait till later to finish as not all patients can finish in one short period of time.(Reminder of remaining questions and warm words) 4. Notifications or reminders of symptoms can be sent when worse body conditions of patients are detected through system 5. Provide more language selection to avoid withdraw of using because of communication difficulties |

**Articles 3 (2021):** [**Who is more likely to adopt and comply with the electronic patient‑reported outcome measure (ePROM) mobile application?**](https://link.springer.com/article/10.1007/s00520-021-06473-6)

Articles Information Summary:

The article explores the adoption and compliance of an electronic patient-reported outcome measure (ePROM) mobile application among cancer patients undergoing active treatment. Conducted as a prospective cohort study at Samsung Medical Center in Seoul, Korea, the study involved 580 participants aged 18 and older who were receiving chemotherapy or radiation therapy. Patients were encouraged to use the ePROM app to report their symptoms weekly for three weeks. The results indicated that 71.9% of the participants adopted the app, but only 27.4% demonstrated good compliance. Factors influencing adoption included greater expectations regarding the app's ease of use and usefulness, while satisfaction with its usefulness was linked to compliance.

The findings highlight the challenges of real-world implementation of ePROM systems, noting that while many patients adopted the app, a significant portion struggled with compliance. Patients reported that the app helped them recognize and manage symptoms, but some expressed fatigue from the number of questions presented. The study emphasizes the need for improved education and support for patients using such digital tools, including potential feedback from healthcare providers to enhance motivation for symptom reporting. Overall, the authors advocate for strategies to optimize ePROM adoption and compliance in clinical practice, ensuring that patients benefit from timely symptom monitoring and management.

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| Summarized Finding and Features | Features that may be adjusted to our application |
| * Patient Preferences: Older, rural, and less educated patients preferred ATI (automated telephone interface) over WBI(web-based interface); younger, educated, tech-savvy individuals favored mHealth apps. * Exclusions: iPhone users were excluded due to the app being Android-only; patients expected to finish treatment within 3 weeks were also excluded for adequate observation time. * ePROM App Features: Functions included symptom assessment, summary reports of symptom severity, and self-management information, with reporting every 7 days for 21 days and no reminders provided. * Adoption and Compliance: Three groups: 28.1% no adoption, 44.5% poor compliance, and 27.4% good compliance, with the latter group reporting higher satisfaction. * Factors Influencing Adoption: Key factors: ease of use and perceived usefulness; barriers for older, less educated users included psychological resistance and perceived difficulty. * Recommendations for Compliance: Provide technology training, utilize visual aids, enhance educational programs on symptom tracking, and offer motivation and support. * Challenges: Many users ceased app use within the first 10 days, highlighting low compliance as a significant issue during typical 3-week cancer treatment durations. | 1. Important to provide guidance and necessary information for patients before starting to use the app (User Manual for app/Intro Video) (Following learning curve for different questions and phrases ex: during or after questionnaire message can be sent during the using process) (User engagement) 2. App will need to be available for both android and apple system users 3. Similar following up timeline for users example every 7 days sending reminders for the patient to do the questionnaire again for better symptoms detection. 4. Attractiveness would need to be increased like dolls or comic characters to encourage user to continue using the app 5. Visual aids like progress bars may encourage active engagement with the app and provide a better sense for patients about which part and step they are in (encourage or rewards to motivate them to continue the process in the learning process) (User engagement) 6. More actions would need to be considered about when most of the users might be Older, rural, and less educated |

**Articles 4 (2023):** [**Patient and clinician-reported experiences of using electronic patient reported outcome measures (ePROMs) as part of routine cancer care**](https://link.springer.com/article/10.1186/s41687-023-00544-4)

Articles Information Summary:

The article investigates the experiences of patients and clinicians using electronic patient-reported outcome measures (ePROMs) as part of routine cancer care within the MyChristie-MyHealth initiative at The Christie NHS Foundation Trust in the UK. It highlights the importance of collecting direct patient feedback regarding health status, quality of life, and symptoms, which can lead to improved communication, better symptom management, and enhanced patient involvement in their care. The study involved 100 patients with lung and head and neck cancers, revealing that nearly all participants found the ePROMs service easy to understand and complete, with a significant percentage reporting improved communication with their oncology teams and feeling more involved in their care.

The findings indicate that regular use of ePROMs is not only feasible but also acceptable to both patients and clinicians, with patients expressing that the service aided in understanding their symptoms better. Clinicians reported that ePROMs supported communication and made consultations more patient-focused, though some noted the need for better integration of ePROM data into electronic patient records to streamline access during consultations. The study concludes that while ePROMs have the potential to enhance cancer care, ongoing evaluation and optimization of the service are necessary to address barriers and improve the experiences of both patients and clinicians.

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| Summarized Finding and Features | Features that may be adjusted to our application |
| * Patients could complete ePROMs independently or with technical assistance from proxies or the Christie ePROM team. * Patient Alert: Notification system based on symptom severity:  1. Green: No symptoms - no action needed. 2. Blue: Mild symptoms - self-care advice link. 3. Orange: Moderate symptoms - seek medical attention within a week. 4. Red: Severe symptoms - urgent advice within 24 hours, with hotline details.  * ePROM results were not integrated into electronic patient records; clinicians accessed them via a separate platform. * Study aimed to assess ePROMs' impact on clinical decision-making, patient communication, and engagement. * Patient feedback:  1. 100% found ePROMs easy to understand. 2. 99% felt they were easy to access; completion time was appropriate. 3. 82% reported improved communication with their oncology team. 4. 88% felt more involved in their care. 5. 81% sought medical advice sooner due to ePROM use.  * 18 patients received self-care advice; 14 found it helpful. * Clinicians noted integration issues made ePROM access time-consuming. * The study didn’t explore barriers to routine ePROM collection. | 1. The system would need to provide functions that allow caregivers and assistance from others for completing the questionnaire 2. Notifications of report result could be sent, like SMS message can be sent to caregivers or nurses to gain attention of patient’s status according to different ranges of scores after finishing questionnaire, along with hotline details of hospitals for patient’s convenience. 3. ePROM system and questionnaire need to be simple, easy to understand and have appropriate completion time. 4. ePROM and questionnaire results should be able to help patients with their body conditions and improve communication with their oncology team with useful self-care advice through health report 5. The ePROM system shouldn’t cause time consuming issues when helping clinicians work for patients, which leads to simplified and summarized information of patients for clinicians’ insight   Burden if patients would need to press one more time on choosing roles when logging in, may decrease willingness |

**Articles 5 (2023):** [**Features of Cancer mHealth Apps and Evidence for Patient Preferences: Scoping Literature Review**](https://cancer.jmir.org/2023/1/e37330)

Articles Information Summary:

The article examines the features and functions of mobile health (mHealth) applications designed to assist cancer patients in managing their conditions. As cancer treatment increasingly resembles chronic disease management, with a rise in oral anticancer therapies, mHealth apps have emerged to support patients in medication adherence, symptom tracking, and overall disease management. This scoping review identifies and categorizes 41 distinct mHealth apps, highlighting their functionalities, which commonly include symptom tracking, medication reminders, and educational resources. However, the review notes a lack of patient input in the design of these apps, which may limit their effectiveness in meeting patient needs.

The findings indicate that, while many cancer mHealth apps are available, there is significant variability in their features, and very few studies have focused on understanding patient preferences regarding these features. The most frequently reported app feature was a symptom tracker, followed by medication tracking and educational content. The review emphasizes the need for more research into patient preferences to enhance the design and functionality of mHealth apps, ultimately aiming to improve patient engagement and self-management in cancer care. By establishing a clearer understanding of which app features are most valued by patients, developers can create tools that better align with their needs and improve overall health outcomes.

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| Summarized Finding and Features | Features that may be adjusted to our application |
| * Primary Objective: Review literature on features and functions of mHealth apps for cancer self-management. * mHealth App Categories: Appointment tools (reminders for healthcare visits).Self-monitoring functionality (tracking symptoms and medication).Communication capabilities (SMS messaging with healthcare team)(logo/link that can be used to jump to WhatsApp for communication ) * Access and Cost: Less than 50% of cancer care apps are free (42.8%); access is a concern for self-management. * App Focus: Four apps tailored for specific cancer types (breast, gastrointestinal, oral, prostate).Three apps support oral chemotherapy; others assist with mixed treatments, radiation, or surgery. * Participant Demographics: Mean participant ages ranged from 52 to 57 years; one study reported an age range of 40 to 79 years. * Common Features: Features varied from 2 to 11, with a median of 4; symptom trackers were most reported (6 studies). * Emotional support features were limited, found in only 2 apps. * Educational Tools: Education features aimed to meet a broader range of information needs, including symptom management. * Medication Tracking: Medication tracking features were infrequent, present in only 2 studies, highlighting a gap in adherence support. * Clinical Trials: Increasing clinical trials focus on enhancing patient medication management through mHealth apps, though challenges remain. | 1. Ensuring free app for download can increase percentage of willingness 2. Include different appointment tools and communication capabilities can be a good option for increasing function and user experience 3. More consideration should be applied on our age range like the elders 4. Educational tools like guiding videos for help the patients to gain better information on how to use the app 5. Emotional support can be conducted which is shorten in many similar apps like comic dolls and patient favorable pictures, background music |

**Articles 6 (2024):** [**Patient-Reported Outcome Measures in Cancer Care An Updated Systematic Review and Meta-Analysis**](https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2822297)

Articles Information Summary:

The article examines the integration of patient-reported outcome measures (PROMs) into oncology care and their impact on various patient-related outcomes. The systematic review includes 45 randomized clinical trials (RCTs) involving 13,661 participants, focusing on how PROMs can provide a patient-centered perspective by directly capturing patients' symptoms and health-related quality of life (HRQoL) without clinician interpretation. The findings indicate that the addition of PROMs is likely associated with reduced overall mortality and improved HRQoL at 12 weeks, demonstrating moderate certainty. However, the impact on HRQoL at longer durations (24 and 48 weeks) and on healthcare utilization metrics such as emergency department visits and hospital admissions was not statistically significant.

The review highlights the importance of PROMs in enhancing communication between patients and healthcare providers, facilitating early identification of patient needs, and potentially improving treatment outcomes. Despite the positive associations observed, the study underscores the considerable variability in the PROMs used across the included trials, which limits the ability to generalize findings and draw firm conclusions regarding long-term benefits. The authors advocate for standardization in the collection and reporting of PROMs to enhance the reliability and comparability of future studies, ultimately aiming to improve cancer care outcomes through the integration of patient perspectives.

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| Summarized Finding and Features | Features that may be adjusted to our application |
| * Outcome Categories for PROMs:  1. Patient-reported: HRQoL, symptom burden, psychological measures. 2. Clinician-reported: Mortality, therapy completion, complications.  * Study Characteristics: Included design, country, setting, disease type/stage, and PROM intervention details. * Key Findings:  1. PROMs can help identify patient needs and prevent poor outcomes, especially patient-reported symptoms. 2. Variability in data collection timeframes limits evidence certainty. 3. Oncology clinicians are comfortable managing symptoms but struggle with HRQoL and mental health issues. 4. Heterogeneity of PROM interventions prevents conclusions on optimal collection strategies. 5. In 45 RCTs, variability in selected outcomes and timing limits insight into mental health impacts. 6. Implementing PROMs in routine practice might start with focusing on patient-reported symptoms. | 1. Incorporating patient-reported outcomes into clinical workflows can enhance early identification of patient needs and improve overall care. 2. Standardizing data collection timeframes across studies can strengthen the reliability of evidence and facilitate better comparisons. 3. Providing training for oncology clinicians on managing HRQoL and mental health issues can enhance their confidence and improve patient support. 4. Implementing a flexible approach to PROM interventions can accommodate diverse patient populations and improve the effectiveness of symptom management. 5. Utilizing a unified framework for measuring outcomes in RCTs can provide clearer insights into the mental health impacts of cancer care. 6. Focusing on patient-reported symptoms in the initial implementation of PROMs can lead to more meaningful engagement and better health outcomes. |

**Articles 7 (2019):** [**Electronic Systems for Patients to Report and Manage Side Effects of Cancer Treatment: Systematic Review**](https://www.jmir.org/2019/1/e10875/)

Articles Information Summary:

The article provides a systematic review of various electronic systems designed to help cancer patients report and manage the side effects of their treatments. It highlights the growing importance of electronic patient-reported outcomes (ePROs) as tools that facilitate real-time symptom monitoring and improve communication between patients and healthcare providers. The review identifies 41 distinct ePRO systems, outlining their features, functionalities, and the degree to which these systems support both patient self-management and clinician oversight. Key features include the ability for patients to track their symptoms, receive tailored self-management advice, and communicate with healthcare teams. The analysis aims to understand how specific system features contribute to patient engagement and improve patient-centered outcomes.

In the second part of the review, the authors explore patient engagement with these electronic systems and the associated health outcomes. They note significant variability in how engagement is defined and measured across studies, which complicates comparisons and assessments of effectiveness. The findings indicate that while many systems demonstrate positive impacts on patient-reported outcomes such as quality of life and symptom management, inconsistencies in study design and outcome measures make it challenging to draw definitive conclusions. The authors call for standardized reporting and evaluation methods to better assess the effectiveness of ePRO systems in clinical practice, ultimately suggesting that these tools hold promise for enhancing patient care in oncology.

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| Summarized Finding and Features | Features that may be adjusted to our application |
| Electronic Systems in Cancer Treatment   * Assistance: Electronic systems help manage cancer treatment side effects and improve patient-centered outcomes. * Self-Management: Many systems provide tailored self-management advice and encourage patient engagement.   Key Features   * Monitoring:   1. 58% allow healthcare providers to monitor patient data.   2. 46% enable patients to monitor and review their own data.   Advice and Communication:   * 41% provide symptom management advice; less than a third offer educational information. * Communication features between patients and providers are limited (15%), and among patients themselves (10%).(Not be considered) * Study Findings * Engagement: 73% of patients complete self-reports at clinic visits; self-care advice is accessed by 85%.(Reduce time for clinic visits and give them a consideration before going to doctors on what they would like to ask) * Impact: Systems like CaSSY show positive effects on fatigue. * Recommendations for Evaluations   System Description: Use a taxonomy of features.   * Feasibility and Engagement Measures: Assess user engagement and feasibility. * Patient-Centered Outcomes: Focus on quality of life and symptom improvement, including self-efficacy. * Health Economics: Evaluate cost-effectiveness.   Patient Engagement Metrics   * Average time to complete MD Anderson Symptom Inventory: 7 minutes. * Average time to complete EuroQoL 5D-5L: 4 minutes. * Self-care advice accessed by 85% of patients, with an average of 20 views across 34 symptoms. * Alerts issued: 59 (55 yellow, 4 red).   Monitoring and Alerts:   * Summary reports delivered to clinicians. * Self-management advice provided for three symptoms. * Alerts to contact healthcare teams for severe symptoms. * Wireless interfaces for surgeons to access patient data. * Triggered email alerts for symptom worsening. | 1. Professional symptom management device should be provided and follow up emails or messages can be sent to patients after completion of questionnaire 2. The average time for finishing once of the questionnaire should be controlled within 5 to 10 minutes so it doesn’t take too much time 3. Questionnaire and apps could be recommended for patients to use and do during the waiting time at clinic and can give the report to the doctor to have a quick view of patient’s status 4. Chat rooms or chat groups could be created for patient’s communication (Function to be discussed about on) 5. Continuing with previous questionnaire should be able to save and continue later as not all users can finish the questionnaire in one time 6. Continuing with previous, system should allow care workers and nurses to help finishing the questionnaire with the patient’s answers |

**Articles 8 (2024):** [**Examining the Effectiveness of Electronic Patient-Reported Outcomes in People With Cancer: Systematic Review and Meta-Analysis**](https://www.jmir.org/2024/1/e49089/)

Articles Information Summary:

The article investigates the impact of electronic patient-reported outcomes (ePROs) on health-related outcomes in cancer patients. This systematic review includes 19 studies from 15 randomized controlled trials (RCTs) that assess the effectiveness of ePRO interventions in improving health-related quality of life (HRQOL), symptom management, and healthcare utilization. The findings indicate that integrating ePROs into cancer care can significantly enhance HRQOL at three months and six months, particularly when tailored patient advice and clinician alert systems are utilized. The review highlights that about 60% of the studies reported positive effects on HRQOL, suggesting the potential benefits of ePROs in facilitating patient-clinician communication and improving overall patient management.

Despite the positive results, the review emphasizes the variability in the interventions and outcome measures used across the included studies, which poses challenges in drawing definitive conclusions. The meta-analysis shows an average improvement in HRQOL, but it also notes that not all studies found significant differences in secondary outcomes such as symptom control, hospital admissions, and patient satisfaction. The authors call for further research to standardize methodologies and explore the specific components of ePRO interventions that contribute to their effectiveness, aiming to optimize their implementation in clinical practice for better patient care outcomes in oncology.

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| Summarized Finding and Features | Features that may be adjusted to our application |
| Control Groups:   * Third control group had participants complete the intervention without clinical feedback. * Most studies defined control as standard care with regular oncology appointments; 2 studies lacked a definition.   Disease Diagnosis and Stage   * Included breast cancer, colorectal cancer, Hodgkin disease, and non-Hodgkin lymphoma (Stages 0 to IV).   Measured Outcomes  Key outcomes:   * Satisfaction with care * Chemotherapy completion * Emergency visits and hospital admissions * Symptoms, patient survival, and quality of life (primary outcome)   Alert and Communication   * Alerts managed via 24-hour pager systems; clinicians contacted patients for severe symptoms within one hour. * Patients could request consultations and report concerns.   Self-Management Advice   * 60% of interventions provided tailored self-management advice based on symptoms. * Some used algorithms to guide advice based on symptom severity. * Data Collection and Fidelity * No studies reported on intervention fidelity; 2 noted data collection errors related to questionnaires.   Electronic Patient-Reported Outcomes (ePRO)   * ePROs sent alerts via email in 40% of studies; 1 study had 24-hour monitoring. * Reports mostly sent to designated clinicians; only 1 study integrated ePRO responses into electronic records.   Report Review Timing   * 40% of studies provided real-time reports; others reviewed them before consultations or weekly.   Participant Demographics   * 80% of studies included more female participants, potentially affecting engagement and effectiveness for male participants.   Clinical Implications   * Symptom reporting aids clinicians in managing larger patient populations. | 1. Provide Clear Instructions: Ensure that comprehensive guidance and informational resources are available for patients before they start using the ePRO system (e.g., User Manual, introductory videos). 2. Cross-Platform Accessibility: The ePRO system should be compatible with both Android and iOS devices to accommodate all users. 3. Regular Reminder System: Implement a consistent follow-up schedule, such as sending reminders every 7 days, to encourage patients to complete their questionnaires and improve symptom tracking. 4. Enhance User Engagement: Increase the app's attractiveness by incorporating engaging elements such as animated characters or gamification features to motivate ongoing use. 5. Incorporate Visual Feedback: Utilize visual aids like progress bars or dashboards to enhance user engagement and provide patients with a clear understanding of their progress and the steps they need to complete. 6. Consider User Demographics: Develop additional training materials and support structures to address the needs of older, rural, and less educated patients, ensuring the system is user-friendly and accessible for all demographics. |

**Articles 9 (2020):** [**Patient preferences for visualization of longitudinal patient-reported outcomes data**](https://academic.oup.com/jamia/article/27/2/212/5610614?login=true)

Articles Information Summary:

This article aims to design effective visualization formats for longitudinal patient-reported outcomes (PRO) data that are both comprehensible and meaningful to end users, particularly those with limited health literacy. Through a two-phase iterative design and evaluation process, the researchers gathered feedback from both experts and end users to refine symptom report formats. In Phase I, they assessed initial designs based on expert input and user surveys, leading to modifications such as the introduction of emojis and changes in graphical formats. Phase II involved further evaluation with a larger group of participants, including Spanish speakers, to ensure broader applicability and comprehension of the visualizations.

Results indicated a strong preference among participants for a combined bar graph format that incorporated emojis, as it not only improved comprehension but also made the reports more engaging. The findings emphasized the importance of involving target end users in the design process to capture their literal interpretations and preferences accurately. Ultimately, the study concluded that tailored visualizations, particularly those that consider the needs of individuals with low health literacy, have significant potential to enhance patient-provider communication.

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| Summarized Finding and Features | Features that may be adjusted to our application |
| * Modifications made to symptom reports included the addition of emojis, changes to date and font formats, and simplification of the y-axis scale. * In Phase II, 35 end users evaluated refined designs, with 94.3% preferring reports that included emojis, particularly a bar graph format that enhanced comprehension. * Systematic collection of patient-reported outcomes (PROs) aids in condition detection, management, and aligning patient-provider understanding, especially for individuals with low health literacy. * Participants provided feedback on report designs, emphasizing preferences for simplicity, larger font sizes, and engaging elements like emojis for visual appeal. * A significant majority (33 out of 35) favored reports containing emojis, with the bar graph combined with emojis being the most preferred format. * Interview participants recommended using bright colors to convey symptom severity, such as green or blue for less severity. * Participants expressed a willingness to share symptom reports with healthcare providers, citing benefits for communication and clarity in treatment. * Educational background and literacy levels showed no strong correlation with comprehension of reports, indicating that design considerations should focus on user preferences rather than demographic indicators. * The study highlights the importance of including target end users in the design process to ensure comprehensibility and relevance of visualizations for longitudinal PRO data. | 1. Emoji pictures can be conducted on the choice selection area for better understanding of meaning of each choice 2. Larger font size, bright colors like green or blue as background color are considered better than dark colors as they give more relaxed feelings to patients (Interface Design) 3. Patient reports can be shared between caregivers, doctors and patients for better benefits in treatments and communication 4. Questionnaire finishing time length should be considered, normally no more than 15 minutes between 10-15 is considered appropriate 5. Questionnaire should be easy to understand, and voicing choice can be conducted due to consideration of different levels of educational background/literacy and health literacy 6. Layout for date displaying can be conducted, like directly showing out month, year and day is better than having a calendar highlighting number of days |

**Example of emoji bar graph**



