Socio-demographic and socio-economic determinants for the utilization of digital patient portals in hospitals: Systematic review and meta-analysis on the digital divide.

Nina Goldberg, Christin Herrmann, Paola di Gion, Volker Hautsch, Klara Hefter, Georg Langebartels, Pfaff Holger, Lena Ansmann, Ute Karbach, Florian Wurster

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Table of Contents

Original Manuscript 5
Supplementary Files 27
Figures 28
Figure 1 29
Figure 2 30
Figure 3 31
Figure 4 32
Figure 5 33
Figure 6 34
Figure 7 35
Multimedia Appendixes 36
Multimedia Appendix 1 37
Multimedia Appendix 2 37
Multimedia Appendix 3 37

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Nina Goldberg[1] MSc; Christin Herrmann[1] MSc; Paola di Gion[2, 3] MD, MA; Volker Hautsch[2]; Klara Hefter[2]; Georg Langebartels[2] MD; Pfaff Holger[1, 4] Prof Dr; Lena Ansmann[5] Prof Dr; Ute Karbach[1] PD, Dr. rer. pol.; Florian Wurster[1] MSc

[1]Chair of Quality Development and Evaluation in Rehabilitation Faculty of Human Sciences & Faculty of Medicine and University Hospital Cologne, Institute of Medical Sociology, Health Services Research and Rehabilitation Science University of Cologne Cologne DE
[2]Department of Digital Clinical Systems Clinical Affairs and Crisis Management Unit University Hospital Cologne Cologne DE
[3]Clinical Ethics Committee University Hospital Cologne Cologne DE
[4]Center for Health Services Research (ZVFK) Faculty of Medicine and Cologne University Hospital University of Cologne Cologne DE
[5]Chair of Medical Sociology nstitute of Medical Sociology, Health Services Research and Rehabilitation Science University of Cologne, Faculty of Human Sciences & Faculty of Medicine and University Hospital Cologne Cologne DE

Corresponding Author:
Nina Goldberg MSc
Chair of Quality Development and Evaluation in Rehabilitation
Faculty of Human Sciences & Faculty of Medicine and University Hospital Cologne, Institute of Medical Sociology, Health Services Research and Rehabilitation Science
University of Cologne
Eupener Straße 129
Cologne
DE

Abstract

Background: Digital patient portals (PP) are platforms that enhance patient engagement and promote active involvement in healthcare by providing remote access to personal health data. Although many hospitals are legally required to offer these portals, adoption varies widely among patients, often influenced by socio-demographic and socio-economic determinants. Evidence suggests that higher income, education, employment status, and specific age groups correlate with increased portal usage, highlighting a digital divide. This study aims to analyze socio-demographic and socio-economic determinants affecting digital patient portal utilization, addressing inconsistencies in existing research and contributing to strategies for reducing digital health disparities.

Objective: Conducting a meta-analysis of the socio-demographic and socio-economic factors contributing to the digital divide in the utilization of digital patient portals.

Methods: A systematic review with meta-analysis was conducted using PRISMA guidelines in the databases PubMed, Web of Science Core Collection and EBSCOHost. Screening involved three reviewers with consensus meetings to resolve discrepancies. Data on socio-demographic and socio-economic factors and statistical outcomes were extracted, and study quality was assessed using the MMAT tool. Results were visualized using forest and funnel plots to assess heterogeneity and publication bias.

Results: A total of 2,225 studies were identified through a systematic review and after title and abstract screening, 17 studies were included in the quantitative and qualitative analysis. The qualitative analysis revealed that younger patients (under 65 years) were significantly more likely to use the digital PP, while the meta-analysis revealed that women had a 17% higher likelihood of utilizing the digital PP compared to men. The relationship between income and digital PP usage was inconsistent, due to different scaling in different studies. A higher level of education was significantly associated with a 37% greater likelihood of using the digital PP in the meta-analysis. Additionally, employed patients were 23% more likely to use the digital PP while married patients had a 13% higher likelihood of using it compared to unmarried patients.

Conclusions: The review confirms that socio-demographic and socio-economic factors significantly influence the utilization of digital PP in hospital care. Marital status shows that social support plays a vital role, with married patients 13% more likely to engage with digital PPs. It is worth noting that social support through connections to society via work or work colleagues can also play an important role as like as a partner at home, with employed individuals being 22% more likely to utilize digital PPs. Overall, socio-demographic factors, like marital status, primarily affect usage patterns, while socio-economic factors, like employment, enable access, emphasizing the need for comprehensive support systems to bridge the digital divide in healthcare. Clinical Trial: The research project MAiBest is listed in the German register of clinical trials (DRKS00033125, https://drks.de/search/de/trial/DRKS00033125).

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TITLE

Socio-demographic and socio-economic determinants for the utilization of digital patient portals in hospitals: Systematic review and meta-analysis on the digital divide

AUTHORS

Nina Goldberg[1], mail: nina.goldberg@uk-koeln.de, ORCID: 0009-0005-1095-5171
Christin Herrmann[1], mail: christin.herrmann@uk-koeln.de, ORCID: 0000-0003-1986-7512
Paola di Gion[2,3], mail: paola.di-gion@uk-koeln.de, ORCID ID: 0009-0008-0265-539X
Volker Hautsch[2], mail: volker.hautsch@uk-koeln.de, ORCID: 0009-0003-8954-8311
Klara Hefter[2], mail: klara.hefter@uk-koeln.de, ORCID: 0009-0007-9307-0137
Georg Langebartels[2], mail: georg.langebartels@uk-koeln.de, ORCID: 0000-0002-2448-2433
Holger Pfaff[1,4], mail: holger.pfaff@uk-koeln.de, ORCID: 0000-0001-9154-6575
Lena Ansmann[5], mail: lena.ansmann1@uk-koeln.de, ORCID: 0000-0002-8628-7166
Ute Karbach[1], mail: ute.karbach@uk-koeln.de, ORCID: 0000-0003-3479-9474
Florian Wurster[1], mail: florian.wurster@uni-koeln.de, ORCID: 0000-0001-5527-9238

Affiliations

[1] University of Cologne, Faculty of Human Sciences & Faculty of Medicine and University Hospital Cologne, Institute of Medical Sociology, Health Services Research and Rehabilitation Science, Chair of Quality Development and Evaluation in Rehabilitation
[2] University Hospital Cologne, Clinical Affairs and Crisis Management Unit, Department of Digital Clinical Systems
[3] University Hospital Cologne, Clinical Ethics Committee
[4] University of Cologne, Faculty of Medicine and Cologne University Hospital, Center for Health Services Research (ZVFK), Cologne, Germany
[5] University of Cologne, Faculty of Human Sciences & Faculty of Medicine and University Hospital Cologne, Institute of Medical Sociology, Health Services Research and Rehabilitation Science, Chair of Medical Sociology

ABSTRACT

Background: Digital patient portals (PP) are platforms that enhance patient engagement and promote active involvement in healthcare by providing remote access to personal health data. Although many hospitals are legally required to offer these portals, adoption varies widely among patients, often influenced by socio-demographic and socio-economic determinants. Evidence suggests that higher income, education, employment status, and specific age groups correlate with increased portal usage, highlighting a digital divide. This study aims to analyze socio-demographic and socio-economic determinants affecting digital patient portal utilization, addressing inconsistencies in existing research and contributing to strategies for reducing digital health disparities. **Objective:** Conducting a meta-analysis of the socio-demographic and socio-economic factors contributing to the digital divide in the utilization of digital patient portals. **Methods:** A systematic review with meta-analysis was conducted using PRISMA guidelines in the databases PubMed, Web of Science Core Collection and EBSCOHost. Screening involved three reviewers with consensus meetings to resolve discrepancies. Data on socio-demographic and socio-economic factors and statistical outcomes were extracted, and study quality was assessed using the MMAT tool. Results were visualized using forest and funnel plots to assess heterogeneity and publication bias. **Results:** A total of 2,225 studies were identified through a systematic review and after title and abstract screening, 17 studies were included in the quantitative and qualitative analysis. The qualitative analysis revealed that younger patients (under 65 years) were significantly more likely to use the digital PP, while the meta-analysis revealed that women had a 17% higher likelihood of utilizing the digital PP compared to men. The relationship between income and digital PP usage was inconsistent, due to different scaling in different studies. A higher level of education was significantly associated with a 37% greater likelihood of using the digital PP in the meta-analysis. Additionally, employed patients were 23% more likely to use the digital PP while married patients had a 13% higher likelihood of using it compared to unmarried patients. **Conclusion:** The review confirms that socio-demographic and socio-economic factors significantly influence the utilization of digital PP in hospital care. Marital status shows that social support plays a vital role, with married patients 13% more likely to engage with digital PPs. It is worth noting that social support through connections to society via work or work colleagues can also play an important role as like as a partner at home, with employed individuals being 22% more likely to utilize digital PPs. Overall, socio-demographic factors, like marital status, primarily affect usage patterns, while socio-economic factors, like employment, enable access, emphasizing the need for comprehensive support systems to bridge the digital divide in healthcare. **Trial Registration**: The research project MAiBest is listed in the German register of clinical trials (DRKS00033125, https://drks.de/search/de/trial/DRKS00033125).

KEYWORDS

Patient Portal, Digital Divide, Hospital, Meta Analysis, Socio-economic, Socio-demographic, e-Health

BACKGROUND

Digital Patient portals (PP) are platforms that offer remote access to personal health data and are meant to empower patients to take a more active role in their own medical care (1). As an example, the ability to make appointments and communicate directly with medical staff via the digital PP can strengthen the sense of personal responsibility in relation to one's own health (2, 3). Overall, evidence shows that the use of such digital PP does enhance patient engagement, education and overall care (4, 5). While many hospitals are being legally required to offer digital PP through national regulations (e.g. HITECH Act in the US or KHZG in Germany), patients can choose whether to make use of it. There is a significant difference between patients in the general adoption of digital applications in healthcare (6, 7), which, besides other factors, contributes to widening social inequality in the health sector and suboptimal health outcomes (8). The usage of digital PP seems to depend particularly on patients' socio-demographic and socio-economic status (9). The most common determinants analyzed in this regard are income, education and employment for socio-economic (10) and age, gender and marital status for the socio-demographic determinants (11). The empirical results show that certain privileged groups of people, with regard to the socio-demographic and socio-economic status are more likely to use a digital PP and therefore benefit disproportionately from the benefits described (12, 13).

This phenomenon is described with the term ‘digital divide’. People with certain perceptions, capabilities and characteristics, are less engaged with the digital transformation and, as a result, are less able to benefit from the emergence of new digital forms of care (14). For example, recent studies show that patient age may play a role in the use of digital PP and that digital PP interfaces should be designed to be accessible to all age groups, as older people require more support (15). The digital divide has already been identified in the literature and can be observed, for example, in patients with lower levels of education or income and as described above in older patients (16, 17). Deursen and Helsper (2015) present a three-level model of the digital divide in healthcare, which serves as a basis for combating digital inequality. The first level describes the gap in terms of lack of access to digital tools and resources for internet access, the second level deals with usage patterns and the third level with the ability to use digital technologies effectively and efficiently to achieve better results on general outcomes. In addition, each of the three levels and therefore the digital divide is influenced by socio-economic and socio-demographic factors (18–20).

Figure 1: Own illustration according to van Deursen & Helsper (2015).

It identifie[illegible]nic a[illegible]graphic[illegible]f the u[illegible] as described [illegible] to develop strategies to overcome the digital divide and inequalities regarding the usage of digital PP (21), it is of considerable relevance to explore the characteristics of users and non-users (22) in order to gain insights into which characteristics are related to the use or non-use of digital PP. However, the evidence is inconsistent regarding the usage behavior of specific socio-demographic and socio-economic groups. Some studies indicate that younger patients may be more likely to use a digital PP (23, 24), while other suggest older patients to be in favor (25). Furthermore, some studies suggest that individuals with a lower level of education (26) are more likely to utilize a digital PP while other studies indicate that individuals with a higher level of education might be in favor (27, 28). The aim of this study is to provide an overview and an analysis of the socio-demographic and socio-economic factors that characterize users and non-users of digital PP. Previous studies have already examined usage behavior regarding socio-demographic and socio-economic factors, but only under the specific light of other dimensions such as digital health literacy (29) or certain diseases (30) with regard to usage behavior. However, no study or review has focused exclusively on socio-demographic and socio-economic factors and on the strength of associations with the use/non-use of digital PP in hospitals and thus on the digital divide. Due to the Inconsistent evidence between the individual studies described above and the disagreement as to how strong the influence of individual sociodemographic and socioeconomic determinants is, a meta-analysis is necessary.

METHODS / DESIGN

A systematic review with meta-analysis was conducted to answer the research question and is reported based on the latest version of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines described by Page et al. (31). See appendix for a detailed list of where to find which items. The study is embedded in the overarching research project MAiBest, which investigates the adoption of a digital PP under the light of the diffusion of innovations theory (32). The research project is listed in the German register of clinical trials (DRKS00033125) and in the international clinical trials registry platform of the world health organization. This review was registered in the PROSPERO database (CRD42024567203).

Search Strategy & Selection Criteria

The search was carried out on March 2024. Following a sensitive search strategy to identify all eligible studies, several databases were searched, including PubMed (including PubMed, PubMed Central, MEDLINE), Web of Science Core Collection and EBSCOHost. The components for the database search were "patient portal" and "socio-economic factors" or “socio-demographic factors”. A discussion of scientific and practical relevance within the research team (NG, FW, CL), resulted in 19 related synonyms for the component "patient portal" and another 21 related synonyms for the component “socio-economic” and “socio-demographic”. A filter was applied to all databases to limit the results to English and German language and up to the year 2010 in order to exclude far outdated evidence on this topical issue. The full search term, including synonyms, Boolean operators, number of results and filters can be found in appendix. Four meetings were held between the researchers to develop a common understanding of the inclusion and exclusion criteria and to eliminate discrepancies. Disagreements were discussed after each step of the literature review and agreement was reached on the included studies at the end. The results were screened in three steps by three researchers (NG, FW, CH) who included or excluded studies according to the criteria in Table 1. In a first step, all titles were screened independently of each other by NG and FW/CH. The abstracts were then screened independently by NG and FW/CH, after which the remaining full texts were assessed by NG and FW/CH. If not enough information was available/given for a decision, the studies were included in the next step. The screening process was conducted with Rayyan software to support collaboration and included publications were stored in a Citavi library.

Table 1: In- and exclusion Criteria

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Inclusion Criteria	**Exclusion Criteria**
1. Patient portal 2. In the hospital setting 3. Patients >18 years 4. Comparison of characteristics of users and non-users 5. peer reviewed publications with quantitative data analysis 6. used by patients	1. No patient portal 2. Outside the hospital setting 3. patients <18 years 4. No comparison of characteristics of users and non-users 5. publications of secondary literature like reviews, comments, essays and publications with qualitative data analysis only 6. used by medical staff only

Data Extraction

Of the included studies, information on the authors, year of publication, country, setting, number of users and non-users, the socio-demographic and socio-economic characteristics, with focus on age, gender, marital status (11) and income, employment and education (10) and the results were extracted. For all studies, statistical results such as confidence intervals, p-values or other relevant effect measurements (e.g. Odds Ratio, standard deviation) were extracted, if the authors provided them. The results were summarized qualitatively and quantitatively. To decide which studies were eligible, the characteristics and extracted data of each study where tabulating and compared in Mircosoft Excel.

Assessment of the risk of bias of the study

The Mixed Methods Appraisal Tool (MMAT) (version 2018) proposed by Hong et al. was used to assess the quality of the included studies (Hong et al. 2018). The MMAT is a specially designed tool that can be used to assess the quality of different types of studies in the same review, including qualitative, quantitative and mixed-methods studies. Following the recommendations for reporting the results of the MMAT (2018 version), the studies were rated on a scale of zero to five stars. Each of the five conditions assessed was given one star if fulfilled, an unclear or unmet condition was given zero. Low quality studies were not excluded for this review, but the quality of the included studies was presented and a possible risk of bias based on the MMAT rating was discussed with the research team.

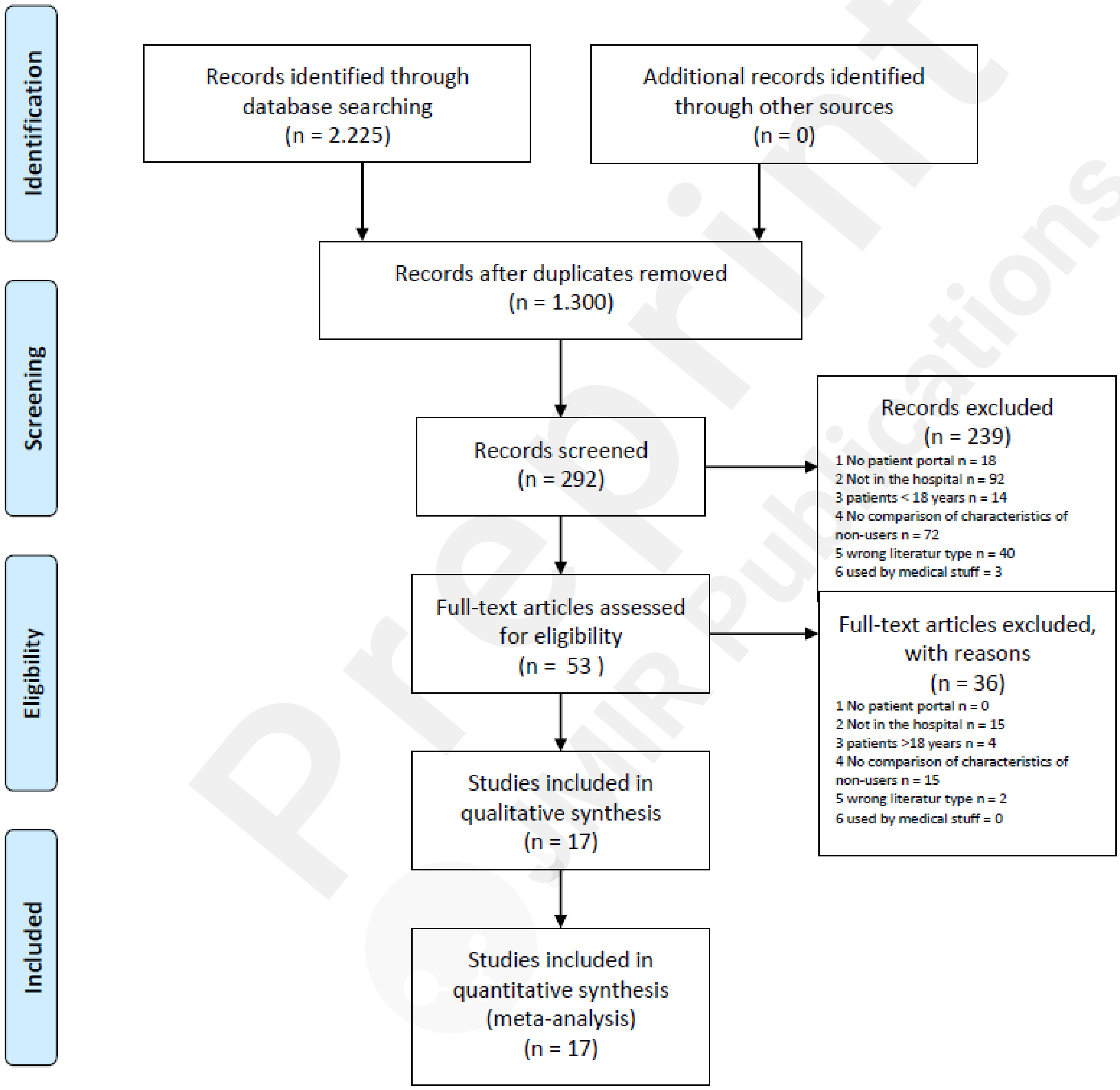
Data analysis

For the systematic review part, a qualitative synthesis was compiled for the content and results of all included studies. For the additional meta-analysis, all statistical analyses were performed with the software RStudio (v. 4.2.2) and the packages *metafor* (33) and *meta*. The risk ratio (RR) is used to interpret the results. Regression coefficients were estimated with 95% confidence intervals using a random effects model (34) and a common effects model to check the sensitivity of the analyses (35). The significance level was set at $P<.05$. Heterogeneity due to differences between studies was assessed using the I^2 statistic (36) and a significant heterogeneity was present if the I^2 was > 50 % (37). A sensitivity analysis was conducted to assess the robustness of the meta-analysis results. Accuracy was reported with 95 % confidence intervals. Forest plots were used to visually represent the presence of heterogeneity. Publication bias was assessed using funnel plots (38) (appendix).

RESULTS

The study selection process and the reasons for excluding studies are shown as a flowchart in Fig. 2. The database searches revealed N = 2,225 studies with n = 1,300 studies remaining after removing duplicates. After title screening, the number of included studies was n = 292 and n = 53 remained after checking the abstracts for eligibility. The final n = 17 studies were included in this systematic review and in the quantitative analysis.

All included studies investigated socio-demographic and socio-economic determinants. Although the hospital setting was an inclusion criterion, the hospital setting varied regarding differences in specialty (e.g., transplant station (28), oncology (21), orthopedics (39)). The number of patients



analyzed varied from a minimum of 235 (40) to a maximum of 424.840 (25). In two studies, two separate patient groups were analyzed and different results were found for the individual determinants. These results from Holte et al. 2021 (39) and Wedd et al. 2019 (28) were considered separately in the following review and meta-analysis and treated as individual studies in the analysis. See Table 2 for study characteristics such as users and non-users of digital PP and the reported socio-demographic and socio-economic factors. The most frequently analyzed characteristics were age (26, 22, 41, 21, 39, 23, 42, 43, 25, 27, 44–46, 24, 40, 47, 28), gender (26, 22, 41, 21, 39, 23, 42, 43, 25, 27, 44–46, 24, 40, 47, 28) and education (26, 22, 39, 23, 42, 25, 27, 28, 40). Eight Studies included the income (26, 22, 41, 39, 42, 25, 40, 47), 6 Studies employment (21, 23, 44, 46, 24, 28) and 5 studies examined marital status (26, 22, 28, 24, 46). The included studies were mainly conducted in North America (26, 22, 41, 21, 39, 23, 42, 43, 25, 27, 44–46, 24, 40, 47, 28). One study was located in Argentina (43), one in United Kingdom (27) and one in the Netherlands (23). No publication bias was detected among the included studies, as indicated by the funnel plots (appendix), except for the meta-analysis with regard to gender. Due to asymmetric distribution, which could indicate a publication bias, an Egger-test (48) was calculated. However, this test is not statistically significant and so there is no indication of publication bias.

A meta-analysis was carried out for the factors that were reported comparably in the studies. No meta-analysis could be calculated for the determinants age and income, as the included studies reported their results in different categories or units of measurement. For the other determinants (gender, education, employment, marital status), not all included studies could be included in the meta-analysis, as not all studies described all factors. For gender, 15 studies (22, 41, 21, 39, 23, 49, 43, 25, 27, 44–46, 24, 40, 28), marital status 5 studies (26, 22, 46, 24, 28), for employment status 6 studies (21, 23, 44, 46, 24, 28) and for education 7 studies (22, 39, 23, 49, 25, 27, 28) could be included in the meta-analysis.

To assess the quality of the included studies, the Mixed Methods Appraisal Tool (MMAT) (Version 2018) by Hong et al. was used (50). The scoring was carried out independently by NG and FW/CH and any discrepancies were discussed in the research team (NG, FW, CH). Nine studies achieved 3 stars (26, 41, 39, 49, 43, 27, 45, 24, 21), 3 studies 4 Stars (23, 44, 47) and 5 studies 5 Stars (22, 25, 46, 40, 28) as an assessment for their quality.

Table 2: Characteristics of the included studies

Characteristics of the included studies											
Authors	**Country**	**Setting**	**N_{User}**	**$N_{Non\text{-}User}$**	**Age**	**Gender**	**Income**	**Education**	**Employment**	**Marital Status**	**MMAT**
Balthazar et al. 2022	**USA**	Female patients undergoing screening	**302**	**45.781**	**User: younger** 53.4 vs 60.3 years, *P* <.001 **User: younger** [OR] 0.94 [CI] 0.93-0.96 *P* <.001	/	**lower average incomes** ($46,782 vs $48,366 *P* =.0252) Median household income was **not** statistically significantly.	**lower** education 35.9% vs 37.7% at or above college *P* =.0167) **lower** education [OR] 0.98 [CI] 0.97-1.00 *P* =.0209)	/	Not statistically significant	* * *
Emani et al. 2018	**USA**	No specific setting	**372**	**281**	85.9 % of users **were less than 65 years** of age compared to 46.2 % of non-user (*P* <.001) **younger** [OR = 3.75, 95 % CI: (2.17, 6.46), *P* <.001]	Not statistically significant	**56 % of users** reported a total household **income of $75,000 or more** compared to 33 % of non-user (*P* <.001) **higher income** [OR = 1.87, 95% CI: (1.17, 3.00), *P* <.01].	**56 % of users** had a **4-year college degree** or more compared to 40% of non-users (*P* <.001). **Not statically significant** in the multivariate model.	/	Not statistically significant	* * * * *
Glosser et al. 2023	**USA**	Kidney transplant adults	**88**	**159**	Not statistically significant	Not statistically significant	**greater than $40,000 were more likely to use the portal** than those with an income less than $40,000 (OR, 2.95 [95% CI, 1.36-6.42] [*P* =.006]). **higher income** (OR, 2.51 [95% CI, 1.08-5.83] [*P* =.033])	/	/	/	* * *
Griffin et al. 2023	**USA**	Retrospective data from adult patients who received cancer treatment	**18.881**	**10.061**	**younger than 40 years** (AOR= 2.56, 95% CI= 2.21 to 2.98, *P* <.001) **between 40 and 65 years** (AOR = 1.81, CI = 1.68 to 1.97, *P* <.001) had higher odds **of using the portal** **Middle age** was associated with **higher odds of portal use** than older age (AOR = 1.27, 95% CI = 1.13 to 1.43, *P* <.001).	**Men had lower odds than women** for using the PP (AOR = 0.85; 95% CI = 0.80 to 0.89 *P* <.001).	/	/	**Patients not working for pay** (AOR = 0.41, 95% CI = 0.38 to 0.45, *P* <.001) and **those who had retired** (AOR = 0.64, 95% CI = 0.59 to 0.70, *P* <.001) had **lower odds of using the portal**	/	* * *
Holte et al. 2021 **Knee**	**USA**	Retrospective study of patients who underwent primary THA or TTEP	**640**	**399**	**User: younger** ([95% CI, 0.09 to 0.27] *P* = <.001)	Not statistically significant	**Users** had a **higher income** than those who not use (*P* = <.001)	Not statistically significant	/	/	* * *
Hip					**Users: younger** ([95% CI, -0.07 to -0.01], *P* =.016)	Not statistically significant	**Users** had a **higher income** than those who not use (*P* = <.001)				

Hoogenbosch et al. 2018	**Netherlands**	In ambulances of the University Medical Center Utrecht (UMCU)	**141**	**298**	**Users: younger** than non-user (*P* =.02)	Not statistically significant	/	Not statistically significant	**Users** were **less often retired** (*P* =<.001)	/	* * * *
Lockwood et al. 2018	**USA**	Cross-sectional survey of patients before and after kidney transplantation	**64**	**176**	Not statistically significant	Not statistically significant	Not statistically significant	**Users: a college education or higher or some college** (*P* =.030)	/	/	* * *
Martinez et al. 2013	**Argentina**	A patient became a user of a PHR if he/she entered at least once in a tertiary care hospital	**35.544**	**86.462**	User: **younger** (*P* = <.001). After adjusting the age = significant association to PHR use (*P* = <.001).	**User: females**. After adjusting the sex remained with the same direction and significant association to PHR use (*P* = <.001).	/	/	/	/	* * *
McFarland et al. 2023	**USA**	The retrieval of radiologic results in the EMR system in the hospital by patients.	**138.841**	**285.999**	User: **were older** (*P* < .001)	User: **likely to be female** (*P* <.001)	User: **higher annual household income** (*P* <.001)	User: **higher levels of educational attainment** (*P* <.001)	/	/	* * * * *
Neves et al. 2021	**United Kingdom**	The patients registered in the portal who had logged in at least once during the study period	**447**	**205**	Not statistically significant	Not statistically significant	/	**higher educational** degree had **higher odds of being a portal user** (crude OR 1.48, 95% CI 1.00-2.20) (adjusted OR 1.58, 95% CI 1.04-2.39)	/	/	* * *
Nielsen et al. 2012	**USA**	Multiple sclerosis patients	**120**	**120**	**Users: younger** (*P* = <.001) Logistic regression: Not statistically significant	Not statistically significant	/	/	**users are employed** (73%) (*P* =.099)	/	* * * *
Ochoa et al. 2020	**USA**	Cross-sectional sample of patients who presented to UF Health.	**5648**	**7835**	Logistic regression: **younger** was statistically significant (user vs. not user)	**User: females** (*P*<.001)	/	/	/	/	* * *
Owolo et al. 2023	**USA**	Patients with a spine-related condition treated surgically	**6409**	**1546**	**Users: younger Age < 65 years** (OR (95% CI) 2.00 (1.69–2.37) *P* = <.001)	**User; female** (51.9% vs. 42.9%) **female** (OR (95% CI) 1.70 (1.49–1.93) *P* = <.001)	/	/	**Users: employed full time** (31.2% vs. 16.1%) **Employed** ((OR (95% CI) 1.39 (1.17–1.65) <0.001	**User: married** (70.7% vs. 55.5%), **In a domestic partnership** (OR (95% CI) 1.91 (1.68–2.18) *P* = <.001)	* * * * *
Plate et al. 2019	**USA**	Patients who underwent primary THA and TTEP	**4623**	**1803**	**Users**: **young** (*P* <.001)	Not statistically significant	/	/	**Users: employed** (*P* <.001)	Users: **more likely to be married** (*P* <.001)	* * *
Tome et al. 2021	**USA**	Adult patients with non-dialysis-dependent CKD were invited to participate in the study if they visited a nephrology clinic	**159**	**76**	In Logistic Regression Model not statistically significant.	In Logistic Regression Model not statistically significant	**lower income = less likely to use the portal** (OR, 0.28; 95% CI, 0.13-0.60 for those making <$25,000 annually and OR, 0.26; 95% CI, 0.12-0.54, for those making $25,000-$50,000 annually compared with ≥$50,000).	**less formal education = less likely to use the portal** (OR, 0.06; 95% CI, 0.01-0.36).	/	/	* * * * *
Ukoha et al. 2019	**USA**	all women who received prenatal care	**2530**	**920**	User: **Younger** (*P* <.001)	/	**low household income = less likely** to use (OR	/	/	/	* * * *

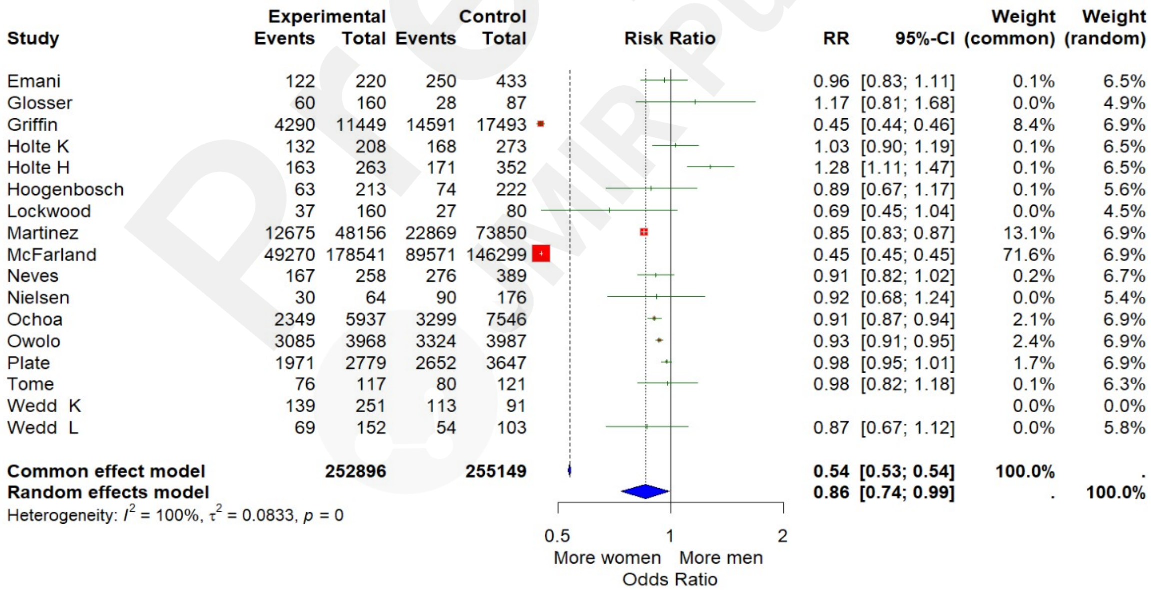
					Multivariable analysis: Not statistically significant		0.91 95% CI 0.79-1.05) Multivariable analysis: Not statistically significant.				
Wedd et al. 2019 **Kidney** ——— **Liver**	**USA**	A cross-sectional study with patients who received a single-organ kidney or liver transplant at a large transplant center	**252**	**203**	Not statistically significant ——— Not statistically significant	Not statistically significant ——— Not statistically significant	/	User: **college or graduate school education (**74.8%, 110/147 vs 34.7%, 51/147; *P* <.001). User: **college or graduate degree** (adjusted risk ratio 1.16; 95% CI 1.01-1.32). ——— User: **college or graduate school education** (71%, 36/51 vs 36.7% 40/109; *P* <.001) User: **college or graduate degree** (adjusted RR 1.36; 95% CI 1.01-1.84)	User: **employed** (72.6%, 130/179 vs 44.4%, 120/ 270; *P* <.001). ——— User: **employed** (73%, 16/22 vs 46.6% 103/221; *P* =.02)	**User: married** (60.5%, 147/243 vs 50.0%, 104/ 208; *P* =.03). ——— Not statistically significant	* * * * *

Age

It was not possible to conduct a meta-analysis due to the inconsistent reporting of patient age in the various studies. The studies used different categories and units of measurement, which led to considerable variability and prevented a direct quantitative consolidation of the data. In a bivariate analysis and multivariate analysis by Balthazar et al. (26), users were significantly more likely to be younger. Also, Holte et al. (39), Hoogenbosch et al. (23), Martinez et al. (43), Plate et al. (24), Ukoha et al. (47), Owolo et al. (46), Ochoa et al. (45) came to the same conclusion: users were statistically significantly younger than non-users. Nielsen et al. (44) had the same results in the univariate analysis (users tend to be younger (*P* = <.001), but these were not statistically significant after logistic regression. In the study by Emani et al. (22), 85.9 % of users compared to 46.2 % of non-users being younger than 65 years. Patients younger than 65 years had also higher odds of using the digital PP described by Griffin et al. (21). In contrast to the other results, the patients enrolled in the digital PP were older in the studies by McFarland et al. (25), Wedd et al. (28), Tome et al. (40), Neves et al. (27) and Lockwood et al. (49). Glosser et al. (41) found no statistically significant results.

Gender

Griffin et al. (21) reported that men had lower odds than women for using the digital PP. The univariate analysis by McFarland et al. (25) showed patients enrolled in the digital PP were more likely to be female and Martinez et al. (43) also confirmed this with a significant association to digital PP use. Ochoa et al. (45) and Owolo et al. (46) also found that women use the digital PP more frequently than men. Emani et al. (22), Glosser et al. (41), Holte et al. (39), Hoogenbosch et al. (23), Lockwood et al. (49), Neves et al. (27), Nielsen et al. (44), Plate et al. (24), Tome et al. (40) and Wedd et al. (28) found no statistically significant results in relation to gender and utilization.



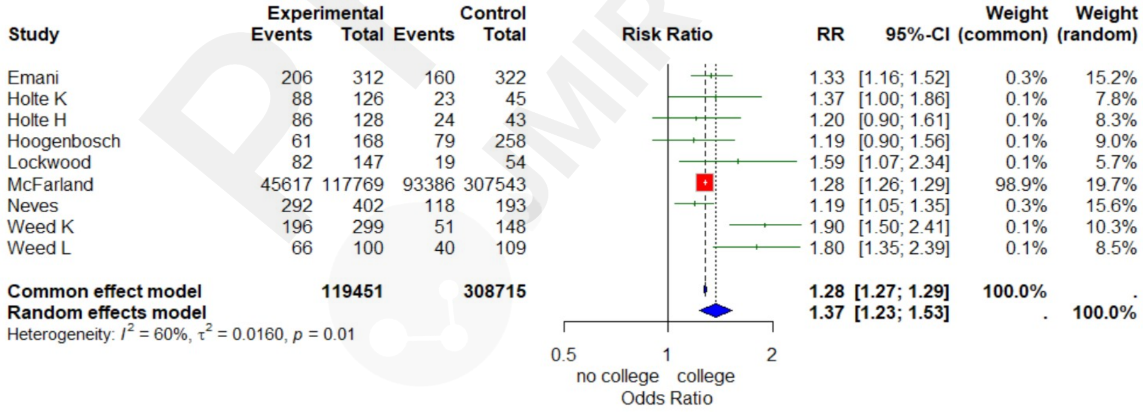
A total of 252,896 of the patients were male and 255,092 females. The male patients formed the experimental group and the female patients formed the control group in the meta-analysis. The RR random effects model was 0.83 (95% CI 0.72-0.97) and was statistically significant (*P*<.001). This means that male patients have a 0.83 (17 %) lower probability of using the digital PP than female patients. According to I², the variance explanation between the studies was 100 %. Since an I² of 100 % indicates a high heterogeneity of the studies and the funnel plot shows a strong asymmetry (appendix), an Egger test was calculated in RStudio. As this did not provide a significant result (*P*=0.076), no sufficient statistical evidence of publication bias can be provided, although slight bias cannot be ruled out (38).

Income

It was not possible to conduct a meta-analysis due to the inconsistent reporting of income data in the various studies. The studies used different categories and income thresholds to represent income, which led to considerable variability and prevented a direct quantitative consolidation of the data. In the analysis by Balthazar et al. (26), users were more likely to live in neighborhoods with lower average household incomes. Ukoha et al. (47) and Tome et al. (40) came to the opposite conclusion: patients with a low income were significantly less likely to enroll in the digital PP. These findings by Balthazar et al. (26) and Ukoha et al. (47) were not statistically significant in the multivariate analysis. Holte et al. (39) and McFarland et al. (25) found that users of the digital PP l had a higher income than non-users. 56 % of users reported by Emani et al. a total household income of $75,000 or more compared to 33 % of non-user. Glosser et al. (41) were also able to show that patients with an income level greater than $40,000 were more likely to use the digital PP than those with an income less than $40,000. Lockwood et al. found no statistically significant result in relation to income and using the digital PP.

Education

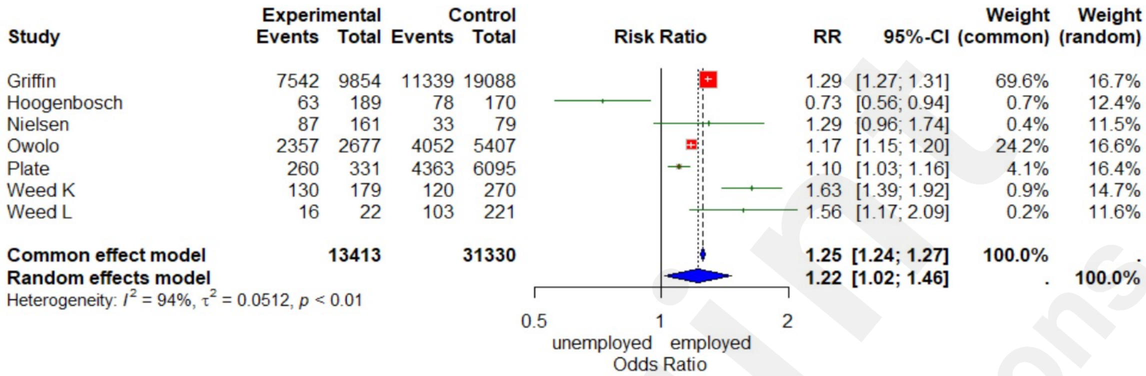
The level of education had a statistically significant influence on the use of the digital PP in 7 out of 9 studies (22, 26, 42, 25, 27, 40, 28). Except for Balthazar et al. (26), who found that users of the digital PP had a statistically significant lower education level than non-users, all concluded that users had a higher level of education (22, 26, 42, 25, 27, 40, 28). Holte et al. (39) and Hoogenbosch et al. (23) found no statistically significant results on the association between education and digital PP use.
In order to standardize the educational levels and make them easier to interpret, the International Standard Classification of Education (ISCED) was used. According to the ISCED-11 definition, an advanced education level is defined as a short-cycle tertiary education or higher (51).



A total of 119,451 patients had an advanced level of education and 308,715 patients below the advanced level. The patients with an advanced education level formed the experimental group and those with an education level below advanced formed the control group. The RR random effects model was 1.37 (95%CI 1.23-1.53) and was statistically significant (*P*=.01). This means that patients with an advanced education level are 1.37 (37 %) more likely to use the digital PP than patients below the advanced education level. According to I², the variance explanation between the studies was 60%. Two studies were excluded from the quantitative analysis because they did not report on the presence or absence of a college degree (40, 26).

Employment

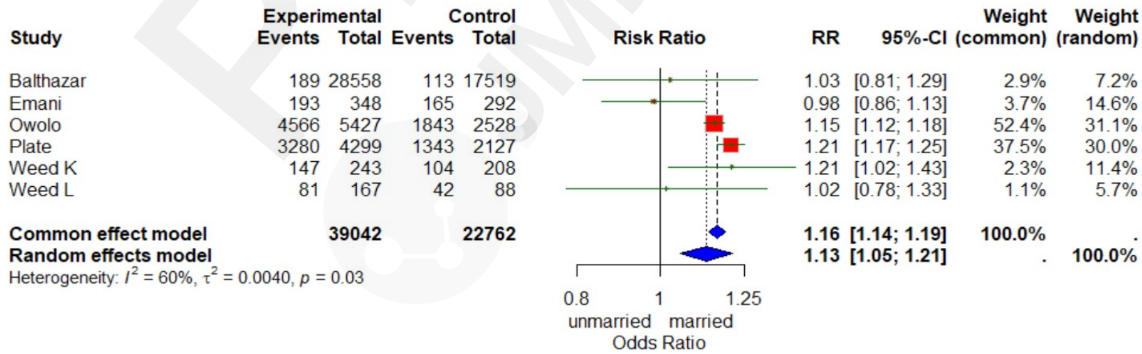
All 6 studies that analyzed employment in relation to usage found a statistically significant relationship (21, 23, 44, 46, 24, 28). In their study, Wedd. et al. collected data from two different groups of patients, which are presented here as two studies (28). All came to the same conclusion that patients who were not employed or retired were statistically significantly less likely to use a digital PP. The majority of users in each study were employed full-time.



A total of 13,412 employed and 31,330 unemployed patients were included. The employed patients formed the experimental group and the unemployed the control group. The RR random effects model was 1.22 (95%CI 1.02-1.46) and was statistically significant (*P*<.01). This means that employed patients are 1.22 (23 %) more likely than unemployed patients to utilize the digital PP. According to I², the e variance explanation between the studies was 94 %.

Marital Status

Marital status was statistically significant in 3 out of 6 cases (28, 46, 24). All 3 studies concluded that married patients or those living in a domestic partnership were more likely to use the digital PP than single people. In their study, Wedd. et al. collected data from two different groups of patients, which are presented here as two studies (28).



A total of 39,042 married and 22,762 unmarried patients were included in the meta-analysis. Married persons formed the experimental group and unmarried persons formed the control group. The risk ratio (R) random effects model was 1.13 (95%CI 1.05; 1.21) and was statistically significant (*P*=.03). This means that married patients are 1.13 (13 %) more likely to use the digital PP than unmarried patients. According to I², the variance explanation between the studies was 60%.

DISCUSSION

This systematic review and meta-analysis confirmed the influence of sociodemographic and socioeconomic factors on the utilization of PP, a central aspect of digitalization in hospital care. The study focused on gender, age and marital status as indicators for socio-demographics and income, education and employment as proxies for socio-economics.

Socio-demographics

With regard to gender, no significant results were found in 10 of the 15 studies. This suggests that the gender-specific effect may be less pronounced than previously assumed in the literature. Although the results of the meta-analysis show that men use the PP 17 % less frequently and therefore may have a greater need for support, this should not be overinterpreted as the sole factor in view of the many non-significant results of the included studies. Regarding the patient’s age no statistically significant results were found in a third of the studies (n = 5 of 14). One possible explanation is that older patients are now also more tech-wise, as more technical knowledge is required in many areas of life. Age and gender do therefore not appear to be central determinants of digital PP usage. In terms of marital status, a significant correlation between the digital PP use and the presence of a partner was consistently shown in all studies. The meta-analysis also showed that married patients were 13 % more likely to use the digital PP than unmarried patients. It can therefore be concluded that marital status is the most influential determinant of the use of digital PP among the socio-demographic factors analyzed.

If living with a partner is associated with a higher probability of use, social support could be a relevant factor for the use of digital PP, because marital status is often used in studies as a proxy for social support (52). One explanation could be that it is rather the amount social support that each patient has, in form of a partner, at their disposal that can close the digital divide. This means that the presence of social support in the home environment could also have an impact on the use of digital PP. At home, people can discuss problems, receive support in using digital PP and be reminded and encouraged to use them. In this case, the social support of a partner could be referred to as emotional, informational and instrumental social support (53). The socio-demographic factors would primarily affect the second level of the ‘three-stage digital divide’ model, as it addresses specific usage patterns.

Socio-economics

Eight of the nine studies that analyzed education level showed an association between higher education (advanced education level) and use of the digital PP. In addition, the results of the meta-analysis also suggest that the likelihood of using the digital PP is 37 % higher if the patient has an advanced education level or higher. Closely related to this, the employment status of patients may be relevant in explaining their use. The meta-analysis showed that the employed group was significantly more likely to use the digital PP (22%). The results on income were highly inconsistent. Based on the evidence that low socio-economic status is associated with poor use of healthcare resources (54) it is expected that the use of digital PP will also be suboptimal in low socio-economic patient groups. It can be argued that access to the internet or digital devices is also influenced by the economic situation of the patient. Level 1 of the 'Third-Level Digital Divide Model' addresses this situation and thus reiterates the considerable importance of establishing support measures for financially disadvantaged patients (18, 19). It is therefore worth noting that while the socio-economic determinants are of great importance, social support through connections to society via work or work colleagues can also play an important role, similar to the socio-demographic determinants. For example, work colleagues can help out with missing digital devices or work devices can

be used. Similar to a partner at home, work colleagues can therefore provide all forms of social support (53) and they can also be trusted persons in health matters through regular contact, as well as being a support person when it comes to using a digital PP.
The fact that the socio-demographic and socio-economic factors analyzed here do not address level 3 “proficiency” of the model is due to the focus on general use by patients and not on effective and efficient use to achieve better outcomes. Based on the results of the meta-analysis, it is assumed that not all determinants affect each level, but that the socio-economic factors affect level 1 of the model and enable access to digital PP. On the other hand, the socio-demographic characteristics tend to affect the usage patterns of patients in relation to digital PP.

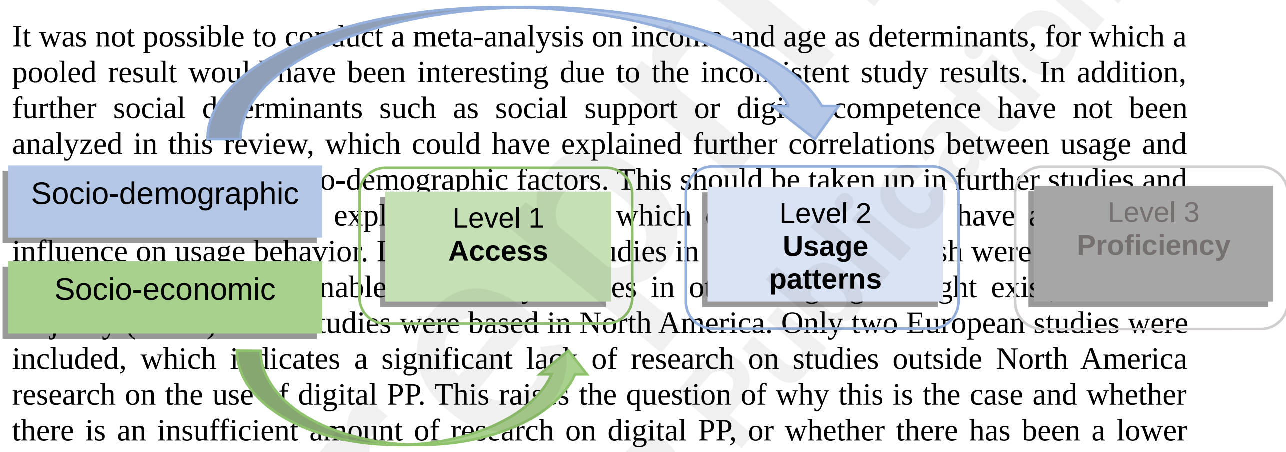


Figure 3: Own illustration according to van Deursen & Helsper (2015)

Limitations

It was not possible to co[illegible]uct a meta-analysis on inco[illegible] and age as determinants, for which a pooled result wou[illegible] have been interesting due to the inco[illegible]istent study results. In addition, further social d[illegible]erminants such as social support or digi[illegible] competence have not been analyzed in this review, which could have explained further correlations between usage and [illegible]o-demographic factors. This should be taken up in further studies and [illegible] expl[illegible] which [illegible] have [illegible] influence on usage behavior. I[illegible]udies in [illegible]sh were [illegible]nable[illegible]es in o[illegible]ght exis[illegible] [illegible]tudies were based in North America. Only two European studies were included, which i[illegible]licates a significant lac[illegible] of research on studies outside North America research on the use [illegible]f digital PP. This rai[illegible]s the question of why this is the case and whether there is an insufficient a[illegible]ount of re[illegible]arch on digital PP, or whether there has been a lower implementation of digital PP in Europe in general. This could be due to differences in data protection. It would be advisable to investigate this in a separate study and work out the differences. It is a matter of fact that in 2019 nearly all hospitals enabled a digital PP in America (55).

Conclusion

The meta-analyses conducted have shown that higher socio-economic status and specific socio-demographic determinants increases the likelihood of using the digital PP. Contrary to what was assumed, the importance of gender and age was lower regarding to the use of digital PP, while marital status, employment and level of education are stronger predictors than assumed. The application of the model by van Deursen & Helsper (2015) highlights that socio-economic status has an impact on level 1 of the model, which describes general access to digital tools and interventions (18). However, social support from partners (marital status) or work colleagues (employment) appears to promote usage of digital PP, as assumed in earlier studies (56). Nevertheless, future studies should also consider other factors such as social support and thus build further bridges between the socio-demographic and socio-economic determinants and factors such as support through social support. This additional bridge could address the proficiency (level 3 of the model), which concerns the effective and competent use of digital innovations. The state of research in Europe on the use of digital PP is lacking behind and needs to be expanded, with the aim of enabling patients to use a digital PP in hospital, with special emphasis of socio-demographic or socio-economic determinants, in order to ensure adequate care in hospital and to further close the digital divide.

DECLARATIONS

Ethics approval and consent to participate

Competing interests

All authors declare no conflict of interest.

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Authors' contributions

UK, GL have acquired the funding. NG and FW planned the study design, NG wrote the first draft, supervised by FW. NG, CH and FW conducted the screening process. All authors critically reviewed and further developed the first draft in equal measure.

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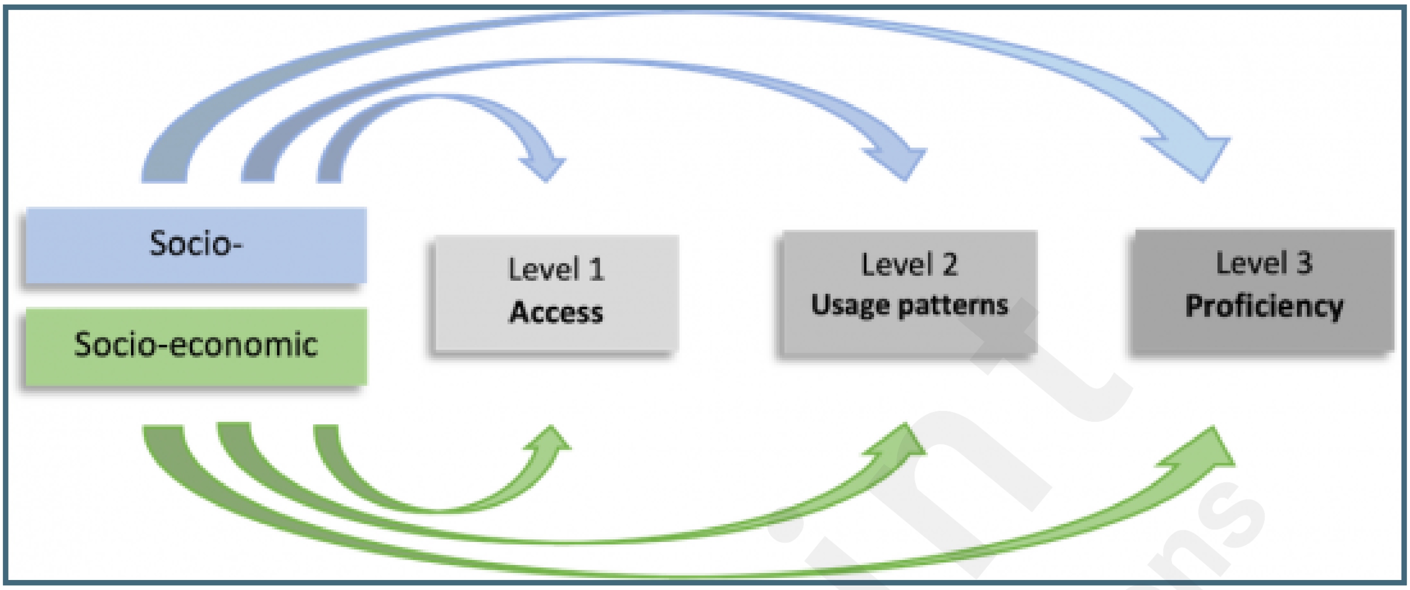
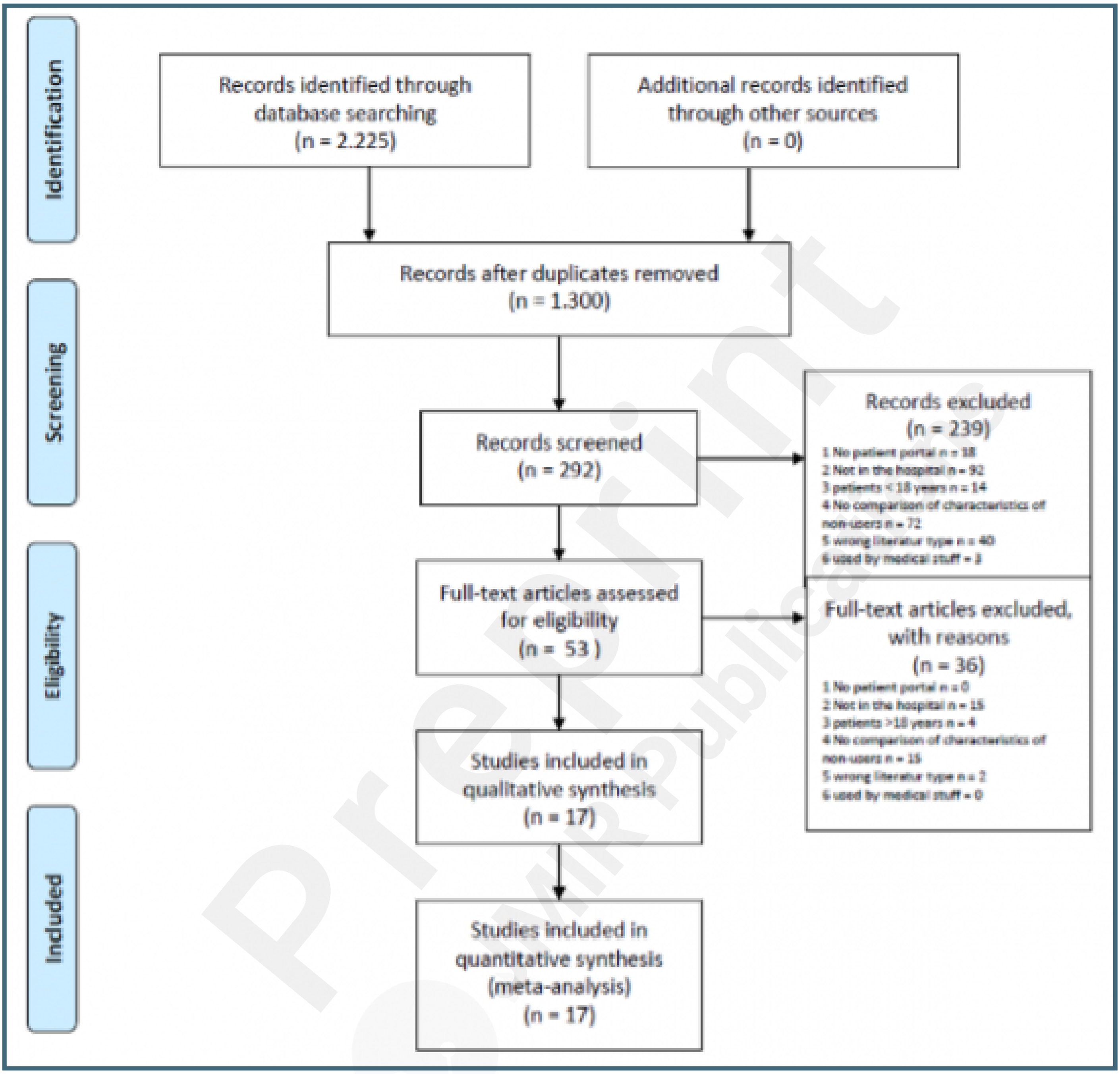
Supplementary Files

Figures

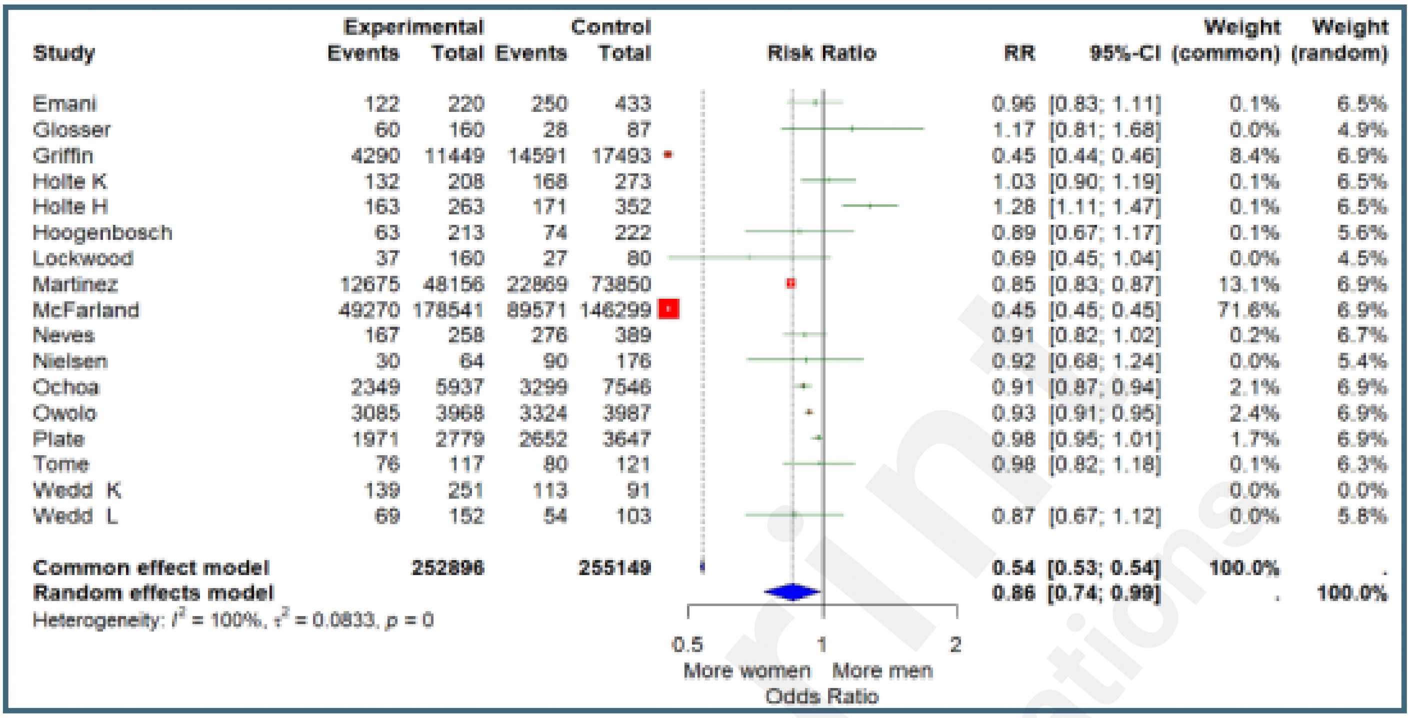
Own illustration according to van Deursen & Helsper (2015).



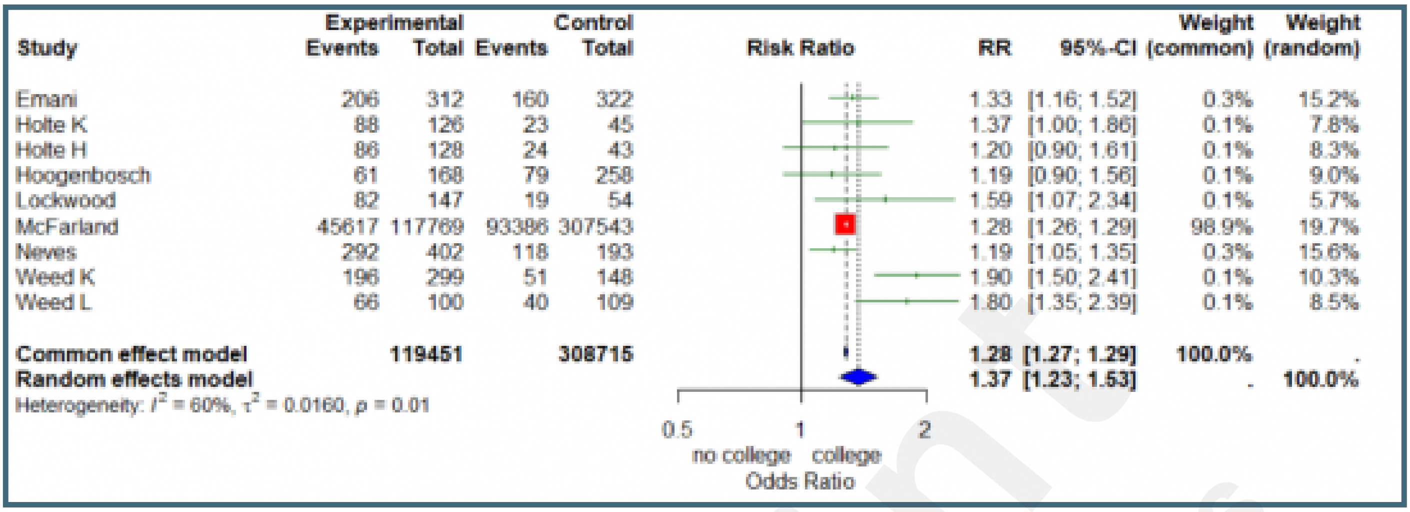
Flow chart.


Identification
Screening
Eligibility
Included
Records identified through database searching (n = 2.225)
Additional records identified through other sources (n = 0)
Records after duplicates removed (n = 1.300)
Records screened (n = 292)
Records excluded (n = 239)
1 No patient portal n = 18
2 Not in the hospital n = 92
3 patients < 18 years n = 14
4 No comparison of characteristics of non-users n = 72
5 wrong literatur type n = 40
6 used by medical stuff = 3
Full-text articles assessed for eligibility (n = 53)
Full-text articles excluded, with reasons (n = 36)
1 No patient portal n = 0
2 Not in the hospital n = 15
3 patients >18 years n = 4
4 No comparison of characteristics of non-users n = 15
5 wrong literatur type n = 2
6 used by medical stuff = 0
Studies included in qualitative synthesis (n = 17)
Studies included in quantitative synthesis (meta-analysis) (n = 17)

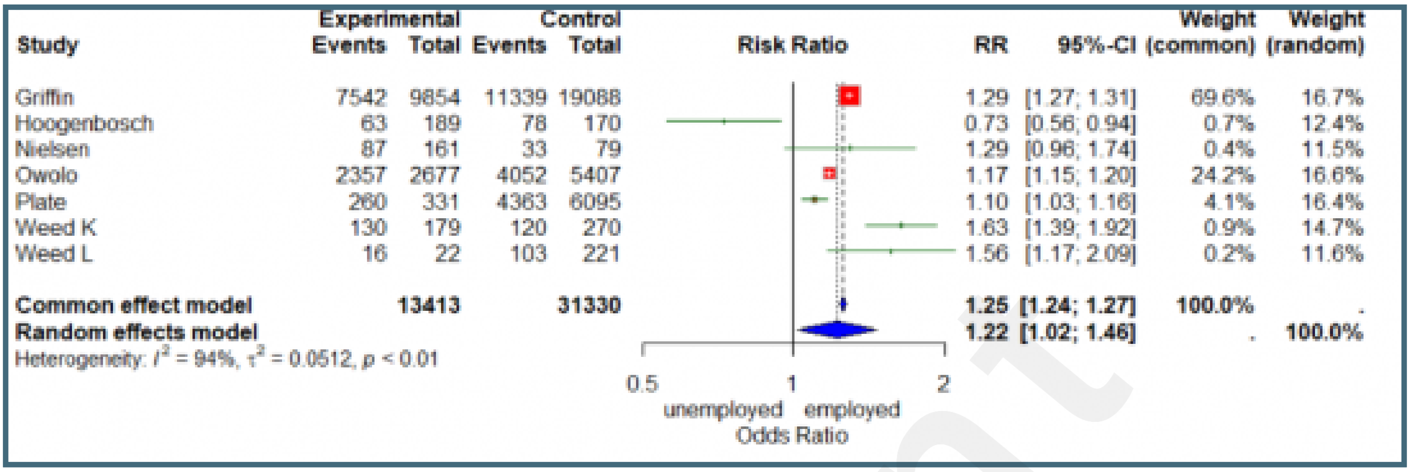
Forst Plot gender.



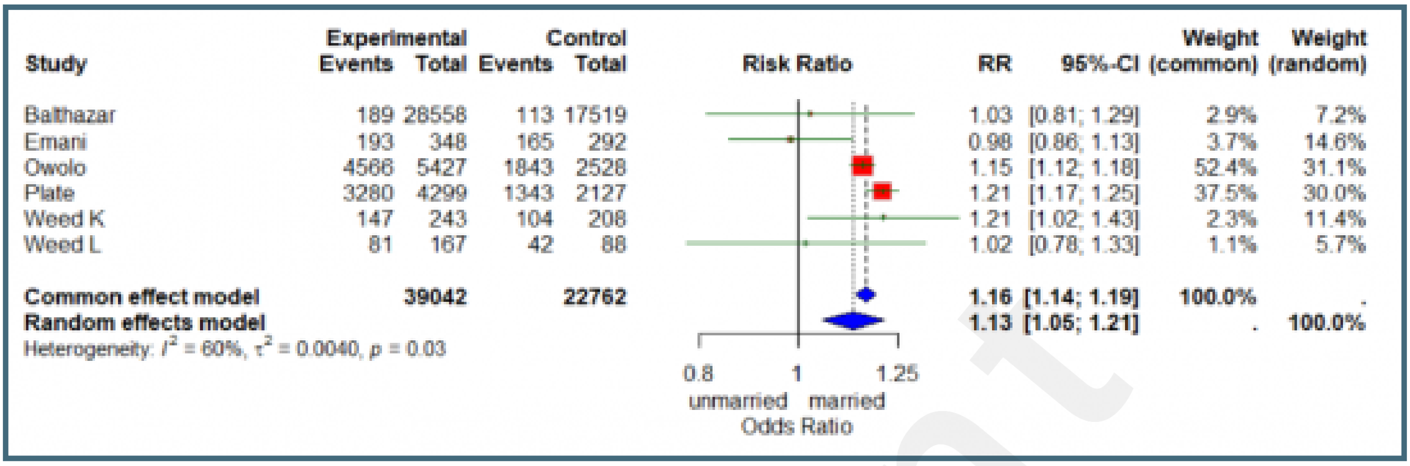
Forest Plot education.



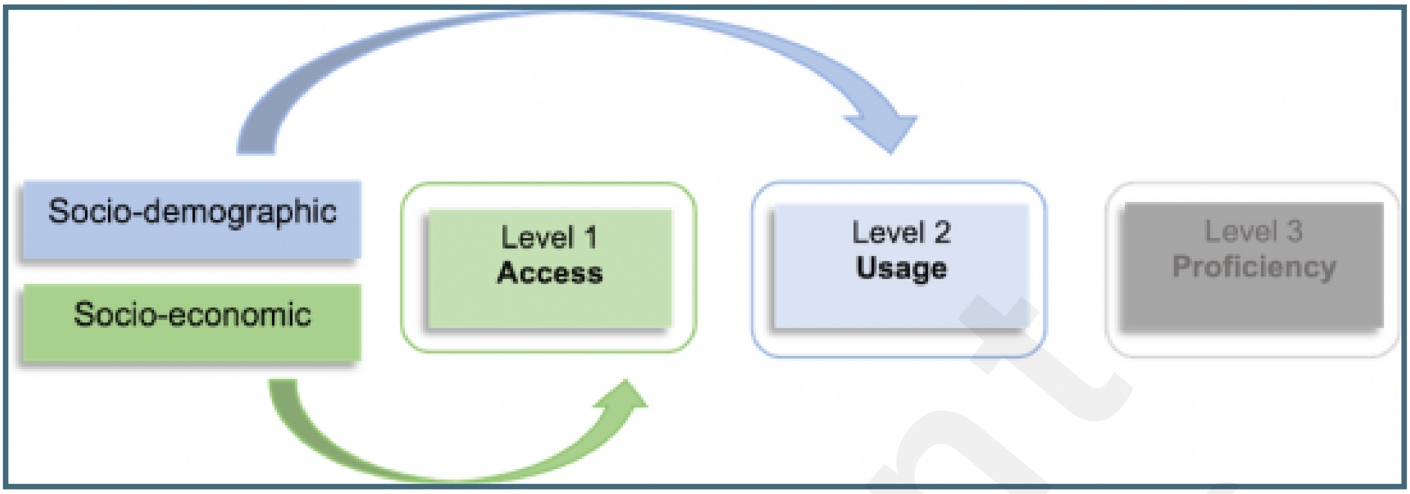
Forest Plot employment.



Forest Plot marital status.



Own illustration according to van Deursen & Helsper (2015).



Multimedia Appendixes

Search strategy.
URL: http://asset.jmir.pub/assets/26a8bf9af660230d5a1d70913855a359.docx

Funnel plots.
URL: http://asset.jmir.pub/assets/b160d66a16551ba4f147addef7fd00da.docx

PRISMA Checklist.
URL: http://asset.jmir.pub/assets/abedd5c8af492bba4c504332c793f721.pdf