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## Medication self-management toolkits for adults with multiple sclerosis: A scoping review



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## ABSTRACT

**Background:** Multiple sclerosis (MS) is an autoimmune disease that is often treated with multiple medications. Managing multiple medications, also known as polypharmacy, can be challenging for persons with MS. Toolkits are instructional resources designed to promote behaviour change. Toolkits may support medication self-management for adults with MS, as they have been useful in other populations with chronic conditions.

**Objective:** The main purpose of this review was to identify and summarize medication self-management toolkits for MS, as related to the design, delivery, components, and measures used to evaluate implementation and/or outcomes.

**Methods:** A scoping review was conducted following guidelines by JBI. Articles were included if they focused on adults (18 years or older) with MS.

**Results:** Six articles reporting on four unique toolkits were included. Most toolkits were technology-based, including mobile or online applications, with only one toolkit being paper-based. The toolkits varied in type, frequency, and duration of medication management support. Varying outcomes were also identified, but there were improvements reported in symptom management, medication adherence, decision-making, and quality of life. The six studies were quantitative in design, with no studies exploring the user experience from a qualitative or mixed-methods design.

**Conclusions:** There is limited research on medication self-management toolkits among adults with MS. Future development, implementation, and evaluation mixed-methods research are needed to explore user experiences and overall design of toolkits.

**Abbreviations:** MS, Multiple sclerosis.

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## 1. Introduction

Multiple Sclerosis (MS) is a chronic autoimmune disease that affects the central nervous system (brain and spinal cord).<sup>1</sup> The immune system attacks nerve fibers and myelin, which alters the nerve impulses in the brain.<sup>1</sup> Common issues include fatigue, weakness, unsteady gait, challenges with vision (blurred, double, loss of vision), and cognitive changes.<sup>2</sup> Based on a report published in 2020, at least one in 3000 people globally currently live with MS (2.3 million persons in total), with approximately twice as many women as men.<sup>3</sup> The most common type of MS is ‘relapsing remitting’, where individuals experience relapses of worsening symptoms, followed by remissions.<sup>1</sup>

Treatment and management of MS often involves pharmacotherapy and non-pharmacological therapy (e.g., physical therapy and psychosocial interventions).<sup>4,5</sup> Medications are often prescribed to manage symptoms and course of disease progression.<sup>6</sup> Pharmacotherapy often includes the use of disease modifying drugs (DMDs), which can include oral medications (e.g., teriflunomide, fingolimod, cladribine), injectable medications (e.g., interferon beta, glatiramer acetate, peginterferon beta-1a), and intravenously infused medications (e.g., alemtuzumab, ocrelizumab, natalizumab).<sup>6–9</sup> In addition to DMDs, other medications may be prescribed to assist with symptoms such as muscle spasticity, pain (e.g., nociceptive, neurogenic, psychogenic), bladder dysfunction, and mood disorders.<sup>10</sup> Thus, the treatment and management of MS, as per practice recommendations, may include multiple co-occurring medications (known as polypharmacy).<sup>11–13</sup>

The prevalence of polypharmacy (often referred to as five or more medications) ranges from 15% to 59% among people with MS,<sup>14</sup> with the wide range in prevalence reported due to limited research and heterogeneous study methods.<sup>14</sup> Similar to the general population,<sup>15,16</sup> polypharmacy in the MS population has been associated with lowered medication adherence (not taking medications as prescribed), worsening of symptoms, risk of relapse, increased MS-related medical costs, and a lower quality of life.<sup>10,17</sup> Approximately one in five persons with MS do not take medications as prescribed.<sup>18</sup> A recent literature review identified several factors influencing adherence, including individual characteristics (e.g., cognitive function, duration of disease, comorbidities), drug characteristics (e.g., side effects, adverse events, injection-related reactions), healthcare experiences (e.g., provider relationship, patient education, shared decision-making), and costs (e.g., financial burden of DMDs).<sup>19</sup> Qualitative research suggests that persons with MS are concerned with the effectiveness and side effects of DMDs, convenience of medications, and method of administration.<sup>20,21</sup> Injectable DMDs and related anxiety are a particular concern for this population (e.g., bruising, scar tissue),<sup>20,21</sup> and have shown to influence medication non-adherence.<sup>22,23</sup>

Given the reported challenges experienced by persons with MS in managing their medications, understanding what resources are available

to support medication adherence, and more broadly medication self-management, are critical. Self-management is comprised of three core tasks including medical, emotional, and role management, in addition to eight core skills including problem-solving, decision-making, seeking information from informal and formal supports, self-tailoring, goal-setting, optimizing social interaction, and engaging in activities.<sup>24,25</sup> Providing patient education is a key component of medication self-management to foster the tasks and skills.<sup>26</sup>

Toolkits are one approach that may support people with their medications.<sup>27</sup> A toolkit is an instructional resource consisting of educational materials or knowledge translation tools/strategies that are used to promote user knowledge and behaviour.<sup>28</sup> A systematic review conducted by Yamada and colleagues (2015) found that toolkits can be effective as a knowledge translation strategy.<sup>29</sup> Specifically, of the eight studies identified as moderate to strong methodological quality, six studies were found to be either partially or mostly effective in changing clinical outcomes. While most studies targeted healthcare professionals, one of these eight studies evaluated the effectiveness of a self-management toolkit for patients with arthritis.<sup>30</sup> Goepfinger and colleagues (2009) found significant benefits at four and nine months (e.g., self-reported health distress, activity limitations, depression, pain, fatigue, self-efficacy, exercise, range of motion, communication with a doctor) post-introduction of the toolkit.<sup>30</sup> While the toolkit included a medication component, the study did not examine medication-specific outcomes.<sup>30</sup>

In theory, the use of toolkits may be useful for enhancing patient skills, support, and medication self-management among persons with MS. Previous research has shown positive effects of education and behavioural interventions with medication adherence among the general population.<sup>31</sup> Within the MS population, a narrative literature review by Ben-Zacharia and colleagues (2018) found that shared decision-making (based on education and patient preferences) and engagement approaches had positive impacts on medication adherence.<sup>32</sup> However, not much is known about what toolkits exist to target medication self-management for people with MS.

The objective of this scoping review was to determine what is currently reported in the literature on medication self-management toolkits for adults with MS. The specific aims included: identifying how the toolkits were designed and delivered, identifying the components of the toolkits, and lastly, identifying measures used to evaluate implementation and/or outcomes of the toolkits. A scoping review methodology was chosen to achieve these study objectives, as this type of review allows for a broad range of literature to be explored in a rigorous and transparent manner.<sup>33,34</sup> A scoping review was chosen over a systematic review, as the purpose was to identify and map the current evidence on toolkits for medication self-management among the MS population.<sup>34</sup> Moreover, a scoping review allows for the examination of characteristics relating to toolkits for persons with MS, identification of current gaps in the literature, as well as areas that may need future work.<sup>34</sup>

## 2. Methods

This scoping review was guided based on the methodology outlined by the 2020 JBI methodology for scoping reviews.<sup>33</sup> The Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping review (PRISMA-ScR) was used to guide the reporting of results (S1 Appendix).<sup>35</sup> A protocol for this scoping review was registered on Open Science Framework (10.17605/OSF.IO/U2AP9).

To be included in this scoping review, studies needed to focus on adults (18 years or older) with MS (at least 50% of study population). They also needed to include a toolkit that included components of self-management (at least one of the three self-management core tasks or at least one of the eight self-management core skills outlined above).<sup>24,25</sup> We defined a toolkit as an instructional resource consisting of educational materials or knowledge translation tools/strategies used to promote behaviour change, teach, and enhance user knowledge.<sup>28</sup> Toolkits needed to support some component of medication management (e.g., medication knowledge, medication related self-efficacy, medication adherence).

Articles were excluded if any of the following criteria were met: opinion pieces (books, editorials, commentaries), conference abstracts and proceedings, protocols, clinician administered programs or interventions, and articles in which the full text could not be found. Opinion pieces were excluded to eliminate articles with personal biases. Conference abstracts and proceedings, articles in which the full text could not be found, and protocols were excluded to eliminate articles in which results were not published and those without sufficient detail to extract. Clinician administered programs and interventions were excluded because of their focus on self-management support.

A comprehensive literature search was conducted using databases from inception until May 16th, 2022. The following databases were used to identify relevant studies: MEDLINE (OVID), EMBASE (OVID), Cumulative Index to Nursing and Allied Health Literature (CINAHL, EBSCO), PsycInfo (OVID), and Web of Science. Between June 29th and July 8th, 2022, a grey literature search was conducted on the following websites: World Health Organization, Government of Canada, MS Society of Canada, National MS Society, MS Society UK, Health Canada, and TSpace (University of Toronto thesis and dissertation repository). Relevant knowledge syntheses identified during the selection process were also hand searched for articles meeting the inclusion criteria.

The original search strategy was developed by LC and SJTG in consultation with a University of Toronto health sciences librarian. The search strategy consisted of using keywords and subject headings to combine three key concepts: MS, medication, and self-management. The search strategy was then manually tailored for each database. Search strategies for all databases can be found in the supplementary material (S2 Appendix).

All articles from the database searches were imported into EndNote, and following Bramer's method for de-duplication, the duplicates were removed.<sup>36</sup> After de-duplication, the articles were imported into Covidence (a web-based review management tool) for screening. Using an agreement test, the titles and abstracts of 20 articles were screened by all reviewers (AH, LC, MA, SRC, SJTG) in Microsoft Excel. Once the screeners had a minimum agreement of 80%,<sup>37</sup> the remaining titles and abstracts were divided among the team to be independently screened by two reviewers. Any disagreements were resolved through discussion, with a third reviewer being involved to assist with decisions when needed. After the completion of the title and abstract screening, the same reviewers (LC, AH, MA, SRC, SJTG) screened five full texts for a second agreement test. After a minimum agreement of 80% was reached, reviewers independently double screened the full-text articles (LC, SRC, AH, MA) using Covidence. Disagreements were resolved through discussion with a senior team member (SJTG) to assist with consensus when needed.

The data were extracted into a study-specific, data extraction form in Microsoft Excel. Two team members (AH, MA) extracted the data, while one team member (LC) completed a spot check of one third of the articles to ensure accuracy and consistency of the extracted information. No revisions were made to the form during this process.

Data were extracted on: general information (title, authors, journal, year of publication, funding), study characteristics (objective, type of population, method of data collection, study design, theoretical orientation, eligibility criteria, outcomes, country, setting), toolkit and delivery characteristics (name, description, design/content, format, frequency, duration, method of delivery), study and population characteristics (sample size, age, sex, gender, ethnicity/race, income, education, marital status, household composition, employment status, geographical location, reason for hospitalization, comorbidities, residence during study period), study outcomes and findings (results and key findings, conclusions), and qualitative findings, if applicable (themes, conceptualization of themes).

Following extraction, the data were synthesized using descriptive approaches. We produced descriptive summaries of the study characteristics, population characteristics, intervention characteristics, and intervention outcomes. The TIDieR checklist<sup>38</sup> was used to guide the structure of the results for articles that involved interventions. No critical appraisal of the articles or interventions was conducted, as it is not a requirement for scoping reviews.<sup>39</sup>

## 3. Results

The database search yielded 4647 records and was reduced to 2833 after deduplication. 2811 records were excluded during the title and abstract screening and 23 articles were retrieved for full-text screening. Seven articles were excluded during full text review. The remaining six articles were included in this scoping review.<sup>40-45</sup> The PRISMA flow diagram highlighting the study selection process can be found in Fig. 1.

Table 1 shows the characteristics of all included studies. All studies used quantitative methods.<sup>40-45</sup> One study had open text in the survey to gain qualitative input from participants.<sup>40</sup> Quantitative study designs included randomized controlled trials ( $n = 2$ ),<sup>43,45</sup> multi-methods with two phases including a cross-sectional component and retrospective cohort component ( $n = 1$ ),<sup>44</sup> prospective quasi-experimental study ( $n = 1$ ),<sup>42</sup> and an observational cross-sectional study ( $n = 1$ ).<sup>40</sup> Studies were conducted in four countries: the Netherlands ( $n = 3$ ),<sup>40-42</sup> Iran ( $n = 1$ ),<sup>44</sup> Germany ( $n = 1$ ),<sup>45</sup> and the United States ( $n = 1$ ).<sup>43</sup>

All six articles directly reported the age and sex of participants,<sup>40-45</sup> but none reported gender. Four of the six studies had a mean age above 45 years old.<sup>40-43</sup> All study populations included a greater percentage of female participants compared to male.<sup>40-45</sup> Four studies reported on the education level of the participants, which varied across the studies.<sup>42-45</sup> Only one article reported marital status of participants, with 48% being married.<sup>45</sup> Other sociodemographic characteristics such as race, ethnicity, income level of participants, household composition, employment status, and geographical location were not reported.

Four different toolkits were identified in the scoping review,<sup>40-45</sup> with three of the six included articles related to one of the toolkits (MSmonitor).<sup>40-42</sup> The 'Education program on MS relapse management' was a paper-based toolkit with an in-person component,<sup>45</sup> while the other three were online.<sup>40-44</sup> The online toolkits consisted of two web-based programs (MSmonitor,<sup>40-42</sup> and Web-based intervention support system (WISS),<sup>43</sup> and one smartphone-based program (Smartphone-based Application for Self-Management in MS).<sup>44</sup> Three toolkits (MSmonitor,<sup>40-42</sup> Education program on MS relapse management,<sup>45</sup> and Smartphone-based application for self-management in MS<sup>44</sup>) seemed to address all three core tasks of self-management: medical (e.g., adherence, medication-taking behaviour), emotional (e.g., coping strategies, depression, anxiety), and role management (e.g., problem-solving, communicating with healthcare professionals). Based on the information reported, the WISS seemed to only address medical management.<sup>43</sup> Features of each toolkit are briefly described below (see Table 2).

Köpke et al. (2009)<sup>45</sup> reported on a toolkit that included an in person education program and a printed brochure sent to participants. The education program included a 4-h educational course that covered seven topics. The course was taught using various mediums including presentations, booklets, information sheets, and guided discussions. Prior to the education

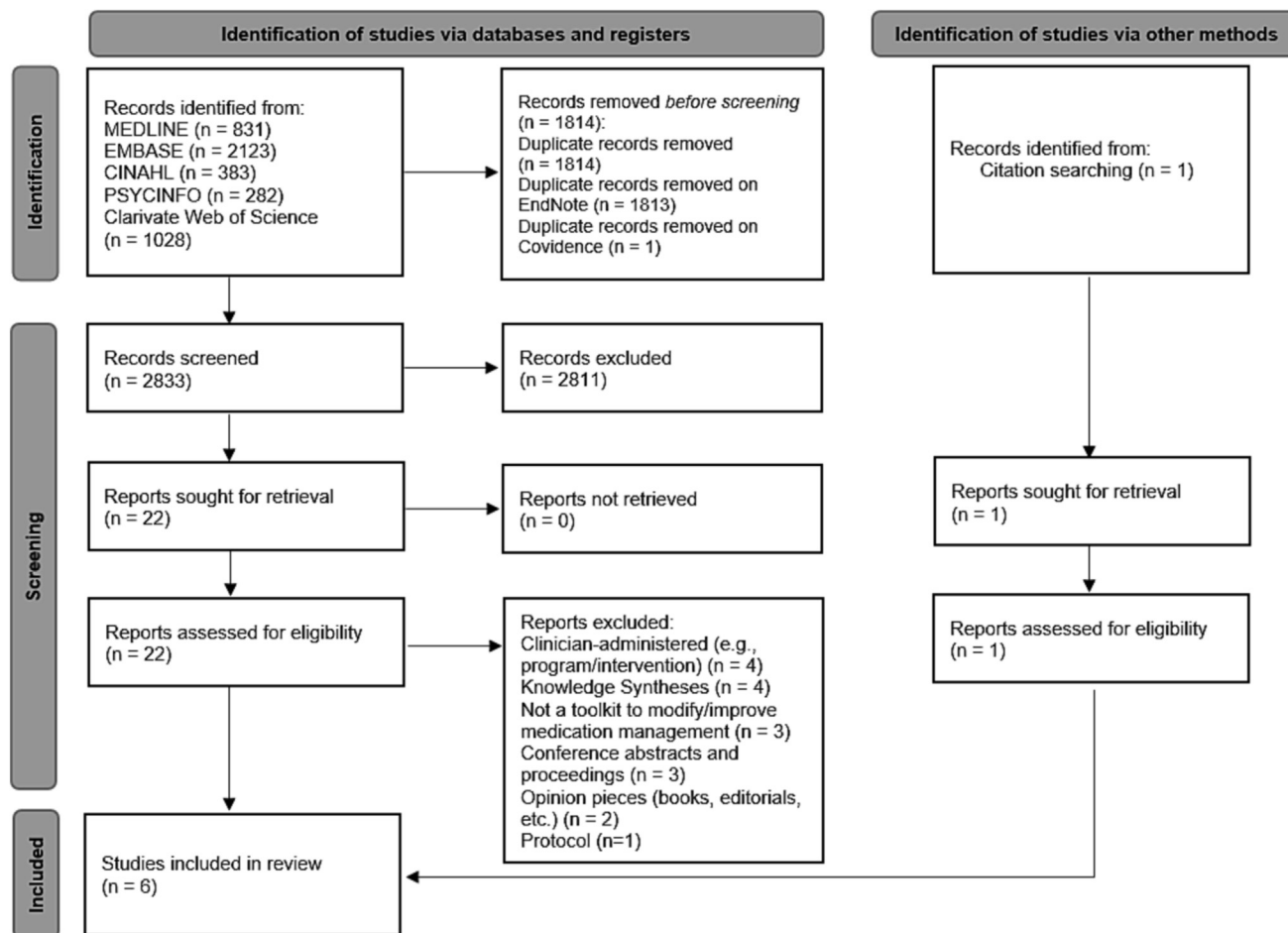


Fig. 1. PRISMA flow diagram of included articles.

session, a 40-page brochure was also sent to participants. The brochure summarized the evidence on relapses and relapse management for MS through text and pictograms.

Developed through consultation of clinicians and patients, MSmonitor was an interactive, web-based program for individuals with MS described by the same research team in three studies.<sup>40–42</sup> The MSmonitor included questionnaires, inventories, and diaries. Depending on the preferences of the clinicians and patients using the toolkit, additional components may have included e-consultation with a personal e-logbook for recording items or additional experiences not covered by the standardized questionnaires.

WISS was a web-based decision support system designed to help adults with MS with continuation of their medication.<sup>43</sup> The program was delivered to individuals with MS taking interferon beta-1a by centre representatives to improve health-related behaviour (e.g., medication-taking). It shared real-time data and provided tailored intervention contents based on the transtheoretical model during telephone calls with patients.

The 'Smartphone-based Application for Self-Management in MS'<sup>44</sup> included two panels: one for patients and one for physicians. Each panel had its own functionality that allowed patients and physicians to communicate and update medical records. Medical records included clinical data on medications and patient symptoms. Patients also accessed educational content on MS, information on MS care centres, and functions like medication time reminders through their own panel.

The 'Education program on MS relapse management' was delivered by a nurse and a trained person with MS,<sup>45</sup> whereas the WISS was delivered by call centre representatives,<sup>43</sup> and the remaining two did not report the profession of the intervention provider (Table 2). The duration of each program varied from three months<sup>43</sup> up to one year.<sup>40</sup> The frequency also

varied, ranging from one time interaction<sup>42,45</sup> to ongoing daily up to monthly with the MSmonitor.<sup>40–42</sup> The WISS was tailored to the patient's schedule.<sup>43</sup>

The outcome measures and results varied in the included articles. Only two studies examined usability and user satisfaction of toolkits.<sup>40,44</sup> Both the 'Smartphone-based Application for Self-Management in MS' and MSmonitor were reported to have good satisfaction and good usability.<sup>40,44</sup> Suggestions for improvement on the MSmonitor toolkit included more patient-oriented accessibility (e.g., easier login, add open diary, less technical content, more user/patient friendly).<sup>40</sup>

Two studies led by Jongen et al. (2016 and 2020) reported that patient knowledge on management of MS improved after MSmonitor usage.<sup>40,42</sup> Improved self-management of MS symptoms was also reported as an outcome in two studies led by Jongen,<sup>40,41</sup> with another showing no changes in the short-term.<sup>42</sup> Two articles examined self-reported patient autonomy in MS treatment.<sup>42,45</sup> One article reported that autonomy remained unchanged in the short-term after MSmonitor usage.<sup>42</sup> Köpke et al. (2009) found the Relapse Management Course improved autonomous decision-making in the intervention group.<sup>45</sup>

Liang et al. (2006) examined medication adherence as an example of health-related behaviour,<sup>43</sup> and found that WISS improved medication adherence.<sup>43</sup> Quality of life was mentioned as an outcome of toolkit implementation in two studies.<sup>41,45</sup> Jongen et al. (2015) reported improvements in quality of life based on changes in the Leeds Multiple Sclerosis Quality of Life scale within six months of using the MSmonitor.<sup>41</sup> Conversely, Köpke et al. (2009) found no differences in self-reported quality of life between their intervention and control groups.<sup>45</sup> However, participants self-rated their course of disease better than the control group.<sup>45</sup> Finally, two studies reported improvements to quality of healthcare, including improvements to



**Table 1**  
Characteristics of Included Articles ( $n = 6$ ).

Author (Year)	Country	Objective	Method Study Design	Participants	Sample Size	Key Conclusions
Jongen et al. (2015) <sup>41</sup>	Netherlands	<ul style="list-style-type: none"> <li>To develop an interactive web-based program for self-management and professional multidisciplinary care in MS</li> <li>To explore the role of MSmonitor in self-management</li> </ul>	Quantitative Not reported	Persons with MS	470	<ul style="list-style-type: none"> <li>MSmonitor may improve self-management by patients with MS</li> <li>Increase in health-related quality of life is associated with repeated use of the Modified Fatigue Impact Scale-5 Item Version (MFIS-5), and Leeds Multiple Sclerosis Quality of Life (LMSQoL) questionnaires in the program</li> <li>Use of the Activities Diary function correlated with better self-management of fatigue</li> </ul>
Jongen et al. (2016) <sup>40</sup>	Netherlands	<ul style="list-style-type: none"> <li>To assess utilization of and satisfaction with MSmonitor and its components and functionalities</li> </ul>	Quantitative with open text for suggestions in survey Observational cross-sectional study (survey)	Persons with MS that started using MSmonitor at least 1 year before the date of the survey	55	<ul style="list-style-type: none"> <li>The use of MSmonitor was highly satisfactory and improved patient insight into MS symptoms and disabilities</li> <li>Functions with high utilization and high satisfaction were the Multiple Sclerosis Impact Profile (MSIP), Medication and Adherence Inventory, and e-consult. Activities diary is another highly utilized component</li> </ul>
Jongen et al. (2020) <sup>42</sup>	Netherlands	<ul style="list-style-type: none"> <li>To explore short-term changes in self-efficacy, self-management, autonomy, and participation in persons with MS using MSmonitor</li> </ul>	Quantitative Prospective, quasi-experimental study (survey)	Persons with MS Excluded persons with clinically isolated syndrome, or with serious cognitive impairment, or with limited understanding of Dutch language, or in nursing homes	45	<ul style="list-style-type: none"> <li>Short-term improvements to self-efficacy, self-management, autonomy, or participation should not be expected with MSmonitor usage</li> </ul>
Köpke et al. (2009) <sup>45</sup>	Germany	<ul style="list-style-type: none"> <li>To evaluate an education program that aims to involve patients with MS in decisions on relapse management</li> </ul>	Quantitative Randomized controlled trial	Persons with MS with at least one relapse during the past 12 months or at least two relapses during the past 24 months, and no major cognitive deficit	150	<ul style="list-style-type: none"> <li>Evidence-based patient education program led to more autonomous decision-making in patients with relapsing MS</li> </ul>
Liang et al. (2006) <sup>43</sup>	United States	<ul style="list-style-type: none"> <li>To describe the development of a Web-based intervention support system (WISS) to improve health related behaviour through provision of tailored interventions based on the transtheoretical model</li> </ul>	Quantitative Randomized controlled trial	Persons with MS taking interferon beta-1a	366	<ul style="list-style-type: none"> <li>Integration of behavioural theories with web-based decision support systems can contribute to better healthcare delivery</li> </ul>
Mokhberdezfuli et al. (2021) <sup>44</sup>	Iran	<ul style="list-style-type: none"> <li>To develop a smartphone-based application for self-management in MS that can support informational and functional needs of patients</li> </ul>	Quantitative Multi-methods Phase 1 - Cross sectional study (survey) Phase 2 - Retrospective cohort study	Phase 1: Neurologists who worked in three teaching hospitals and persons with MS Phase 2: Neurologists and persons with MS different from Phase 1	192 Phase 1–126 Phase 2–66	<ul style="list-style-type: none"> <li>The application was successfully designed through the study and was able to collect patient data and facilitate consultation</li> </ul>

delivery through the implementation of the WISS and better neurological and nursing care after implementation of the MSmonitor.<sup>40,43</sup> None of the studies reported on costs or cost-effectiveness.

#### 4. Discussion

In this scoping review, we identified and summarized the literature on medication self-management toolkits for adults with MS. The key takeaways from this review include the following: (1) there are few published self-management toolkits available to assist with medication management among persons with MS; (2) three of the four toolkits leveraged the use of technology (e.g., smartphone-based applications, web-based programs); and (3) most studies ( $n = 5$ ) used only quantitative data with an absence of qualitative inquiry exploring patient user experiences.

The first main finding from this review was that there are limited studies overall on medication self-management. After a comprehensive search, only four different toolkits were identified that were designed to support medication management. Of the four toolkits identified, there was significant variability in the overall design, delivery (method and by whom), and duration. For example, the MSmonitor involved daily to monthly

interactions,<sup>40–42</sup> compared to a one time interaction with the 'Education program on MS relapse management',<sup>45</sup> and the WISS was tailored to the patient's schedule.<sup>43</sup> The toolkits also varied in whether a healthcare professional or educator was involved or whether independently used by patients. Similarly, van de Hei et al. (2021) also found heterogeneity in their literature review on toolkits for asthma and chronic obstructive pulmonary disease.<sup>27</sup> While van de Hei et al. (2021) identified the adherence of medications improved with personalized medication management toolkits among persons with asthma and/or chronic obstructive pulmonary disease, they also noted a wide variation in content, effects on clinical outcomes, and methodological quality.<sup>27</sup> Specific strategies identified in van de Hei et al.'s (2021) review included various components of reminders, education, motivation, feedback on medication use, simplifying the medication regimen, and shared decision-making.<sup>27</sup> Multi-components were the most commonly identified interventions, which were categorized as either pharmacy care interventions (e.g., led by pharmacists) or self-management support interventions (e.g., led by other healthcare professionals, educators or researchers).<sup>27</sup> Notably, van de Hei also identified a gap in toolkits being tailored and adapted to the unique adherence-related barriers for patients, and highlighted the importance of tailoring given the complexity of factors

**Table 2**  
Toolkit characteristics and outcomes.

Author (Year)	Toolkit Name and Goal	Format (Physical or Online) and Setting	Target Population	Content & Components of Self-Management	Delivery and Duration	Results and Conclusions
Jongen et al. (2015) <sup>41†</sup>	MSmonitor An interactive web-based program to promote self-management and multidisciplinary care among persons with MS	Online - Web-based program Hospital	Persons with MS	Psychometrically validated questionnaires, inventories, diaries, electronic consult, personal e-logbook  <u>Self-Management:</u> <sup>††</sup> Medical, emotional, role	Delivery: Web-based program that can be used on computers, tablets, and smart phones  Duration: Not reported	<ul style="list-style-type: none"> <li>Quality of life improved in all three subgroups of patients based on completion of activities diary</li> <li>Frequency of activities diary usage was correlated with degree of fatigue improvement</li> </ul>
Jongen et al. (2016) <sup>40†</sup>	MSmonitor An interactive web-based program to promote self-management and multidisciplinary care among persons with MS	Online - Web-based program Not reported	Persons with MS	Psychometrically validated questionnaires, inventories, diaries, electronic consult  <u>Self-Management:</u> Medical, emotional, role	Delivery: Web-based program that can be used on computers, tablets, and smart phones  Duration: At least 1 year	<ul style="list-style-type: none"> <li>46% of the participants reported gaining better insight into their symptoms or disabilities, 18% could better handle their symptoms or disabilities</li> <li>54%–68% responded with better quality of nursing care, only 23%–30% responded with better quality of neurological care</li> </ul>
Jongen et al. (2020) <sup>42†</sup>	MSmonitor An interactive web-based program to promote self-management and multidisciplinary care among persons with MS	Online - Web-based program Hospital	Persons with MS	Psychometrically validated questionnaires, inventories, diaries  <u>Self-Management:</u> Medical, emotional, role	Delivery: Web-based program that can be used on computers, tablets, and smart phones  Duration: 4 months	<ul style="list-style-type: none"> <li>Self-efficacy, autonomy and participation were unchanged for intervention and control groups</li> <li>Only change to the intervention group was increase in self-management knowledge (control group remained the same)</li> </ul>
Köpke et al. (2009) <sup>45</sup>	Relapse Management Course An education program that aims to involve patients with MS in decisions to improve autonomous management of relapses	Physical Hospital	Persons with MS with at least one relapse during the past 12 months or at least two relapses during the past 24 months	Topics: Personal experiences, relapses, relapse therapy, oral corticoid therapy, options, reflection, evaluation  Materials: presentations, leaflets, posters, education booklet, group work, information sheet, guided discussion  <u>Self-Management:</u> Medical, emotional, role	Delivery: Delivered by a nurse and a specially trained patient with MS  Duration: One 4-h session	<ul style="list-style-type: none"> <li>More relapses were reported in control group than intervention group, but proportions of relapses were similar between groups</li> <li>Participants in the intervention group were more likely to choose less invasive treatment options</li> <li>More participants in the intervention group reported relapses with a perceived active role in treatment decision making</li> <li>Intervention group rated their course of disease (or changes to their diseases) better than control group</li> </ul>
Liang et al. (2006) <sup>43</sup>	Web-based Intervention Support System (WISS) A web-based system designed to motivate continuation of medications in patients and improvements to health-related behaviour	Online - Web-based system Not reported	Persons with MS taking interferon beta-1a	Tailored information, intervention calls  <u>Self-Management:</u> Medical	Delivery: Call centre representatives trained on how to use WISS through telephone or online surveys  Duration: 3 months	<ul style="list-style-type: none"> <li>Discontinuation rate of interferon beta-1a in the control group is higher than the intervention group</li> <li>Patients in the intervention group moved to stages where interferon beta-1a is less likely to be discontinued</li> </ul>
Mokhberdezfuli et al. (2021) <sup>44</sup>	Smartphone-based Application A smartphone-based application developed to improve self-management in MS	Online - Smartphone-based application Not reported	Persons with MS and neurologists	Topics: personal information, overall reaction to the software, screen, terminology and system information, learning, system capabilities  <u>Self-Management:</u> Medical, emotional, role	Delivery: Application was installed on the patients' smartphones  Duration: Not reported	<ul style="list-style-type: none"> <li>Good satisfaction and good usability reported by users</li> </ul>

<sup>†</sup> The MSmonitor toolkit was examined in three different studies by Jongen et al., reflecting different components of the MSmonitor, objectives, methods, results, and conclusions.

<sup>††</sup> Self-management components were classified by medical (e.g., adherence, medication-taking), emotional (e.g., coping strategies, mood), and role (e.g., problem-solving, interacting with healthcare professionals, family/friends).

contributing to adherence. In the present review, the MSmonitor was the only toolkit we identified that was described to be designed within the principles of ‘autonomy’ and was adaptable to preferences of clinicians and patients.<sup>40–42</sup>

Secondly, and not surprisingly, we found that the toolkits identified in this review leveraged the use of technology. Three of the four toolkits were delivered online,<sup>40–44</sup> with two web-based programs (MSmonitor<sup>40–42</sup> and WISS<sup>43</sup>), and one smartphone-based application.<sup>44</sup> Usability of the toolkits were investigated by Jongen et al. (2016)<sup>40</sup> and Mokhberdezfuli et al. (2021),<sup>44</sup> and focused on what functions need to be included and whether persons were satisfied with the existing toolkit. However, there are factors to consider other than satisfaction and functionality that may pose barriers to the use of digital toolkits. A recent literature review by Gromisch et al. (2020) reported on several factors that affect usability of mobile health technology by persons with MS.<sup>46</sup> The review highlighted that visual, fine motor, and cognitive function are important considerations when delivering programs through technology.<sup>46</sup> For example, persons with MS often experience visual impairments,<sup>47</sup> which have implications on the font size and overall toolkit display.<sup>48,49</sup> Furthermore, visual challenges coupled with fine motor issues experienced by persons with MS<sup>50</sup> would also affect the size of the device (e.g., mobile phone, tablet, or laptop) and the amount of information displayed. It is important to consider the cost and usability of such web-based programs and phone-based applications by persons with MS, as technology is increasingly involved in health management. Overall costs and cost-effectiveness of these toolkits were not explored in the included studies, which would be an important area for future research. Cost-effectiveness analyses allows for the quantification of relative costs and benefits to inform resource allocation.<sup>51,52</sup> Given the challenges with financial resources in healthcare, there is a need for planning and measuring costs with the design and implementation of health interventions for optimal feasibility and sustainability within clinical settings.<sup>44</sup>

Given the functional challenges (e.g., visual, motor, and sensory) that may be experienced by persons with MS, it is important that toolkits are co-designed by end-users and ongoing feedback is obtained.<sup>53</sup> Qualitative methods can help us to better understand the experiences of the end user both when designing and evaluating tools.<sup>54</sup> Of the six studies included, only one study included open text in their survey for feedback.<sup>40</sup> Qualitative studies are important as they allow us to understand how individuals perceive the toolkits and explore the acceptability and feasibility. Additionally, qualitative data would provide important contextual information that may inform tailoring toolkits depending on individual needs.<sup>54,55</sup> While a lack of qualitative studies exists on this topic at the time of this review, it should also be noted that there is a lack of studies overall, which likely contributed to the small number of articles identified. Due to the unique issues faced by persons with MS, both qualitative and quantitative articles are needed to understand and obtain a more holistic picture of the use of toolkits for medication self-management in persons with MS.

#### 4.1. Strengths and limitations

Our search may not have included all the terms relevant to medication self-management as there are no subject headings specific to this concept. However, to minimize this risk, we consulted with a health science librarian and content experts on our team in self-management and medications to ensure subject heading and key words were comprehensive. We excluded conference abstracts and proceedings which meant that certain studies that reported their results in other settings may have been excluded. While it is a strength of our study to include grey literature, the scope of grey literature reviewed was relatively limited and it is possible articles were missed.

## 5. Conclusion

Overall, this scoping review identified six articles describing medication self-management toolkits for persons with MS that have been reported in

the literature. Given the limited research to date, future development, implementation, and evaluation mixed-methods research are warranted.

## CRediT authorship contribution statement

**Sara J.T. Guilcher:** Conceptualization, Methodology, Investigation, Formal analysis, Validation, Resources, Writing – original draft, Writing – review & editing, Supervision, Project administration, Funding acquisition. **Lauren Cadel:** Conceptualization, Methodology, Investigation, Validation, Data curation, Formal analysis, Writing – original draft, Writing – review & editing, Supervision, Project administration, Funding acquisition. **Andrea He:** Investigation, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Stephanie R. Cimino:** Investigation, Data curation, Formal analysis, Supervision, Writing – original draft, Writing – review & editing. **Maham Ahmed:** Investigation, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Chester H. Ho:** Writing – review & editing, Funding acquisition. **Sander L. Hitzig:** Writing – review & editing, Funding acquisition. **Lisa M. McCarthy:** Writing – review & editing, Funding acquisition. **Tejal Patel:** Writing – review & editing, Funding acquisition. **Aisha K. Lofters:** Conceptualization. **Tanya L. Packer:** Funding acquisition, Conceptualization, Writing – review & editing.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

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## References

- Loma I, Heyman R. Multiple sclerosis: pathogenesis and treatment. *Curr Neuropharmacol* 2011;9:409–416.
- McGinley MP, Goldschmidt CH, Rae-Grant AD. Diagnosis and treatment of multiple sclerosis: a review. *JAMA* 2021;325:765–779.
- Multiple Sclerosis International Federation. *Atlas of MS3rd ed.* . 2020.
- Khan F, Pallant J. Chronic pain in multiple sclerosis: prevalence, characteristics, and impact on quality of life in an Australian community cohort. *J Pain* 2007;8:614–623.
- Khan F, Amatya B, Kesselring J. Longitudinal 7-year follow-up of chronic pain in persons with multiple sclerosis in the community. *J Neurol* 2013;260:2005–2015.
- James KA, Everall AC, Cadel L, et al. Exploring medication self-management in community-dwelling adults with chronic medication experience: a concept mapping study. *RSAP* 2022;18:2854–2866.
- Finkelsztejn A. Multiple sclerosis: overview of disease-modifying agents. *Perspect Medicin Chem* 2014;6:65–72.
- Disease modifying drugs (DMDs). <https://mstrust.org.uk/about-ms/ms-treatments/disease-modifying-drugs-dmds> 2022.
- The FDA-approved long-term treatments for MS. <https://mymsaa.org/publications/about-ms/fda-approved/> 2018.
- Thelen J, Zvonarev V, Lam S, Burkhardt C, Lynch S, Bruce J. Polypharmacy in multiple sclerosis: current knowledge and future directions. *Mo Med* 2021;118:239–245.
- National Institute for Health and Care Excellence (NICE). Multiple Sclerosis in Adults: Management. United Kingdom: National Institute for Health and Care Excellence (NICE). 2022.
- Freedman MS, Devonshire V, Duquette P, et al. Treatment optimization in multiple sclerosis: Canadian MS working group recommendations. *CJNS* 2020;47:437–455.
- Rae-Grant A, Day GS, Marrie RA, et al. Practice guideline recommendations summary: disease-modifying therapies for adults with multiple sclerosis. Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology, 90 ; 2018. p. 777–788.

14. Frahm N, Hecker M, Zettl UK. Polypharmacy among patients with multiple sclerosis: a qualitative systematic review. *Expert Opin Drug Saf* 2020;19:139–145.
15. Franchi C, Ardoino I, Ludergnani M, Cukay G, Merlino L, Nobili A. Medication adherence in community-dwelling older people exposed to chronic polypharmacy. *J Epidemiol Community Health* 2021;75:854.
16. Davies LE, Spiers G, Kingston A, Todd A, Adamson J, Hanratty B. Adverse outcomes of polypharmacy in older people: systematic review of reviews. *JAMDA* 2020;21:181–187.
17. Tan H, Cai Q, Agarwal S, Stephenson JJ, Kamat S. Impact of adherence to disease-modifying therapies on clinical and economic outcomes among patients with multiple sclerosis. *Adv Ther* 2011;28:51–61.
18. Nicholas JA, Edwards NC, Edwards RA, Dellarole A, Grosso M, Phillips AL. Real-world adherence to, and persistence with, once- and twice-daily oral disease-modifying drugs in patients with multiple sclerosis: a systematic review and meta-analysis. *BMC Neurol* 2020;20:281.
19. Kołtuniuk A, Chojdak-Lukasiewicz J. Adherence to therapy in patients with multiple sclerosis-review. *Int J Environ Res Public Health* 2022;19.
20. van Capelle Ceuninck, Ad Meide Hvd, Vosman FJH, Visser LH. A qualitative study assessing patient perspectives in the process of decision-making on disease modifying therapies (DMT's) in multiple sclerosis (MS). *PLoS One* 2017;12, e0182806.
21. Lynd LD, Henrich NJ, Hategeka C, et al. Perspectives of patients with multiple sclerosis on drug treatment: a qualitative study. *Int J MS Care* 2018;20:269–277.
22. Arroyo E, Grau C, Ramo-Tello C, Parra J, Sanchez-Solino O, Group GAPS. Adherence to disease-modifying therapies in spanish patients with relapsing multiple sclerosis: two-year interim results of the global adherence project. *Eur Neurol* 2011;65:59–67.
23. Devonshire V, Lapierre Y, Macdonell R, et al. The global adherence project (GAP): a multicenter observational study on adherence to disease-modifying therapies in patients with relapsing-remitting multiple sclerosis. *Eur J Neurol* 2011;18:69–77.
24. Audulv A, Ghahari S, Kephart G, Warner G, Packer TL. The taxonomy of everyday self-management strategies (TEDSS): a framework derived from the literature and refined using empirical data. *Patient Educ Couns* 2019;102:367–375.
25. Cadel L, Cimino SR, Rolf von den Baumen T, James KA, McCarthy L, Guilcher S.J.T. Medication management frameworks in the context of self-management: a scoping review. *Patient Prefer Adherence* 2021;15:1311–1329.
26. de Seze J, Borgel F, Brudon F. Patient perceptions of multiple sclerosis and its treatment. *Patient Prefer Adherence* 2012;6:263–273.
27. van de Hei SJ, Dierick BJH, Aarts JEP, Kocks JWH, van Boven JFM. Personalized medication adherence management in asthma and chronic obstructive pulmonary disease: a review of effective interventions and development of a practical adherence toolkit. *J Allergy Clin Immunol Pract* 2021;9:3979–3994.
28. Barac R, Stein S, Bruce B, Barwick M. Scoping review of toolkits as a knowledge translation strategy in health. *BMC Med Inform Decis Mak* 2014;14:121.
29. Yamada J, Shorkey A, Barwick M, Widger K, Stevens BJ. The effectiveness of toolkits as knowledge translation strategies for integrating evidence into clinical care: a systematic review. *BMJ Open* 2015;5, e006808.
30. Goepfinger J, Lorig KR, Ritter PL, Mutatkar S, Villa F, Gizlice Z. Mail-delivered arthritis self-management tool kit: a randomized trial and longitudinal followup. *ArthritisRheum* 2009;61:867–875.
31. Costa E, Giardini A, Savin M, et al. Interventional tools to improve medication adherence: review of literature. *Patient Prefer Adherence* 2015;9:1303–1314.
32. Ben-Zacharia A, Adamson M, Boyd A, et al. Impact of shared decision making on disease-modifying drug adherence in multiple sclerosis. *Int J MS Care* 2018;20:287–297.
33. Peters MDJ, Marnie C, Tricco AC, et al. Updated methodological guidance for the conduct of scoping reviews. *JBI Evid Synth* 2020;18:2119–2126.
34. Munn Z, Peters MDJ, Stern C, Tufanaru C, McArthur A, Aromataris E. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Med Res Methodol* 2018;18:143.
35. Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med* 2018;169:467–473.
36. Bramer WM, Giustini D, de Jonge GB, Holland L, Bekhuis T. De-duplication of database search results for systematic reviews in EndNote. *J Med Libr Assoc* 2016;104:240–243.
37. Tricco AC, Lillie E, Zarin W, et al. A scoping review on the conduct and reporting of scoping reviews. *BMC Med Res Methodol* 2016;16:15.
38. Hoffmann TC, Glasziou PP, Boutron I, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ* 2014;348, g1687.
39. Peters MD, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc* 2015;13:141–146.
40. Jongen PJ, Sinnige LG, van Geel BM, et al. The interactive web-based program MSmonitor for self-management and multidisciplinary care in multiple sclerosis: utilization and valuation by patients. *Patient Prefer Adherence* 2016;10:243–250.
41. Jongen PJ, Sinnige LG, van Geel BM, et al. The interactive web-based program MSmonitor for self-management and multidisciplinary care in multiple sclerosis: concept, content, and pilot results. *Patient Prefer Adherence* 2015;9:1741–1750.
42. Jongen PJ, Ter Veen G, Lemmens W, Donders R, van Noort E, Zeinstra E. The interactive web-based program MSmonitor for self-management and multidisciplinary care in persons with multiple sclerosis: quasi-experimental study of short-term effects on patient empowerment. *JMIR* 2020;22, e14297.
43. Liang H, Xue Y, Berger BA. Web-based intervention support system for health promotion. *Decis Support Syst* 2006;42:435–449.
44. Mokherdezfili M, Ayatollahi H, Naser Moghadasi A. A smartphone-based application for self-management in multiple sclerosis. *J Healthc Eng* 2021;2021:6749951.
45. Kopke S, Kasper J, Muhlhauser I, Nubling M, Heesen C. Patient education program to enhance decision autonomy in multiple sclerosis relapse management: a randomized-controlled trial. *Mult Scler* 2009;15:96–104.
46. Gromisch ES, Turner AP, Haselkorn JK, Lo AC, Agresta T. Mobile health (mHealth) usage, barriers, and technological considerations in persons with multiple sclerosis: a literature review. *JAMIA Open* 2021;4:00aa067.
47. Jasse L, Vukusic S, Durand-Dubief F, et al. Persistent visual impairment in multiple sclerosis: prevalence, mechanisms and resulting disability. *Mult Scler* 2013;19:1618–1626.
48. Giunti G, Mylonopoulou V, Rivera Romero O. More stamina, a gamified mHealth solution for persons with multiple sclerosis: research through design. *JMIR Mhealth Uhealth* 2018;6, e51.
49. Van Kessel K, Babbage DR, Reay N, Miner-Williams WM, Kersten P. Mobile technology use by people experiencing multiple sclerosis fatigue: survey methodology. *JMIR Mhealth Uhealth* 2017;5, e6.
50. Winberg C, Kylberg M, Pettersson C, et al. The use of apps for health in persons with multiple sclerosis, Parkinson's disease and stroke - barriers and facilitators. *Stud Health Technol Inform* 2017;242:638–641.
51. Weinstein MC, Stason WB. Foundations of cost-effectiveness analysis for health and medical practices. *N Engl J Med* 1977;296:716–721.
52. Sohn H, Tucker A, Ferguson O, Gomes I, Dowdy D. Costing the implementation of public health interventions in resource-limited settings: a conceptual framework. *Implement Sci* 2020;15:86.
53. Boyd H, McKernon S, Mullin B, Old A. Improving healthcare through the use of co-design. *N Z Med J* 2012;125:76–87.
54. Meyer J. Qualitative research in health care. Using qualitative methods in health related action research. *BMJ* 2000;320:178–181.
55. Patton MQ. *Qualitative Research & Evaluation Methods*. SAGE Publications. 2002.