The impact of a single-entry intake system on access to outpatient specialist visits: A systematic review

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Abstract

Background: Wait times for specialist consultations is an area where Canada's health system lags behind other countries. Single-entry models (SEM), which combine patients in a shared queue to see the first available specialist, is one strategy used to reduce wait times. The aim of this systematic review is to assess the impact of a single-entry model (SEM) on waiting time, referral volume and patient/provider satisfaction.

Methods: A systematic search was conducted on MEDLINE, EMBASE, Cochrane CENTRAL and CINAHL from inception until December 2019. Studies from OECD countries were included if they reported on the effects of SEM on wait time one (WT1), the time between referral to the first specialist physician or allied health professional assessment. Secondary outcomes such as change in patient volume and satisfaction of providers and patients were reported. A narrative synthesis was conducted using descriptive statistics.

Results: Of the 4540 studies identified, 10 studies met the inclusion criteria. All included studies reported an absolute reduction in WT1 post-SEM implementation. The average percentage reduction in WT1 across specialties was highest in surgery (57%) and urgent internal medicine referrals (40%). Higher pre-implementation wait time was associated with greater benefit from the SEM. Patient and provider satisfaction with SEM was high in all studies. Effect estimates from all included studies were at a high risk of bias.

Interpretation: SEM is a promising option to decrease wait times and improve access to a range of health services, but there is a need for prospective, rigorous evaluations to inform policy.

Trial registration: PROSPERO ID: CRD42018100395

Keywords: Waiting Lists, Health Service Accessibility, Referral and Consultation

Introduction:

Poor access and high specialist wait times is a pervasive problem facing many healthcare systems.[1] In comparison to its international peers, Canada struggles to provide timely access to care.[2] In a 2016 Commonwealth Fund survey, Canada performed the worst in wait times to specialist appointment; only 38% of Canadians waited <4 weeks to see a specialist, compared to 69.9% of Americans. In fact, Canadian wait times are twice as long than they were 25 years ago, currently averaging 19.8 weeks between referral and appointment in 2018 compared to 9.3 weeks in 1993.[3]

Currently, most outpatient clinicians use a "multiple-queue, multiple server" model to manage their referrals and wait lists, whereby each clinician has their own separate queue.[4] As such, clinicians of the same specialty and region may have varying referral and wait lists, potentially leading to inequitable and suboptimal patient outcomes. In contrast, "single-entry models" (SEM) assemble patients referred to specific specialists in a given jurisdiction into a single queue, thereby facilitating patients to see the first available specialist. SEM consists of a centralized intake (i.e. referrals are received through a single point of entry) or a pooled referral system (i.e. merging of multiple waiting lists), along with a centralized coordinated approach to triage (i.e. appointments arranged based on urgency).[6]

SEM is based on queuing theory[5], and has been proven successful in operational fields such as the airline industry.[6] The benefits of SEMs in healthcare are thought to occur due to rebalancing of supply (i.e. clinician availability) and demand (i.e. the number of referrals).[4] In addition, sicker patients may be seen faster with a central intake system, whereby the patient is referred to an available provider based on urgency. Though SEMs may prevent duplicate appointments and cancelled appointments, they may also limit choice and reduce satisfaction.[4]

A prior review has suggested that SEMs may reduce wait times for surgeries.[6] In this systematic review, we evaluate the impact of SEM implementation on the wait time from initial referral to physician or allied health specialist appointment, as well as on referral volume and patient/provider satisfaction.

Methods:

Search

A systematic literature search was conducted on MEDLINE, EMBASE, Cochrane CENTRAL and CINAHL from inception to December 2019. All keywords were searched and mapped onto subject headings where appropriate. References of included articles were also screened for inclusion. The search was extended from Damani et al. (2017) to include medical and allied health appointments.[6] The full search strategy is listed in Appendix A. PRISMA guidelines were followed for study design and reporting, and this review was registered on PROSPERO (CRD42018100395). Given the study design, ethics approval was not required.

Study Selection

Three reviewers (M.M., M.E.N., S.V.) conducted title and abstract screening followed by full-text review. Discrepancies were resolved through consensus or by consulting a fourth author (N.M.I.). Original studies were included if they met all of the following inclusion criteria: (a) inclusion of outpatients who were referred to specialists for medical, surgical or allied health services, (b) articles that implemented SEM, (c) studies which measured the wait time from referral to the specialist appointment (WT1), both for pre-SEM implementation and post-implementation timepoints. Studies that only reported an absolute reduction of WT1 pre- to post-implementation were also included. To facilitate generalizability with the Canadian healthcare system, studies were excluded if they were not conducted in OECD countries.[20]

Data Collection

All data collection was completed on Microsoft Excel ® (Redmond, Washington). Two independent reviewers (M.M., A.M.C) collected the following demographics: first author, year of publication, country of implementation, speciality setting, healthcare setting (i.e. private vs. public), insurance mandate (i.e. single-payer vs. multi-tier), study design, type of single-entry model, sample size, implementation process, implementation fidelity (i.e. how studies ensured uptake and ongoing use of the new approach; the "degree of adherence to the described implementation strategy"[8]), and whether studies reported on optional or mandatory implementation. Collected outcome data included pre-implementation and post-implementation WT1, change in patient volume as well as pre-implementation and post-implementation patient

and provider satisfaction. When certain study data was not available, authors were contacted for clarification. Corresponding authors of individual studies were contacted via e-mail in the case of missing information. However, sample size for three papers were not included despite contacting authors.[10,11,15] Any discrepancies were resolved though consensus.

Risk of Bias

The Risk of Bias in Non-randomized Studies – of Interventions (ROBINS-I) tool was used to assess quality and risk of bias of the included studies. The ROBINS-I tool is designed to assess the risk of bias in non-randomized studies that compare the effects of two or more interventions.[9] We assessed the risk of bias using all seven domains in the ROBINS-I tool, reported in Table 2. For each domain, risk of bias assessment was conducted according to the following scale: low, moderate, serious, critical or no information. This was completed by two reviewers (M.M., A.M.C).

Data Analysis

For all outcomes, data was reported using means, frequency and proportions as needed. Study characteristics and outcome data such as wait time and patient and physician satisfaction were reported. For data extracted from figures, the pre-implementation values were extracted from the figure at last follow-up, which was compared to post-implementation data at last follow-up. The relationship between baseline WT1 and the absolute reduction in WT1 was investigated using the coefficient of determination based on a linear relationship. P-values were included if reported, with a p-value less than 0.05 considered statistically significant. Microsoft Excel ® was used to compile and analyze all collected data.

Results:

From a literature search of 4,527 unique studies, title and abstract screening excluded 4,510 studies (Figure 1). Of the 17 remaining articles, a total of 10 articles met inclusion criteria and were included in the systematic review.[5,10-18]

Study Characteristics

Table 1 summarizes the characteristics of the included studies. Eight studies were from Canada[5,10,11,13-14,16-18], one from Australia[12] and one from England.[15] The studies were published from 2004-2017, with the majority published after 2010.[5,11-13,17-18] Overall, nine articles utilized a simple pre- compared to post-implementation study design[5,10-12,13-17] and one was cross-sectional.[18] Three studies evaluated the use of SEM in surgery (orthopedics and general surgery),[10,15,18] five in internal medicine (gastroenterology, rheumatology, cardiology, general internal medicine and nephrology),[5,12,14,16,17] one in chronic pain[11] and one in physiotherapy.[13] All studies were conducted in a single-payer health care system[5,10-11,13-18,] except one which was performed in a two-tier system.[12] Three studies required mandatory SEM implementation[12,13,16] while seven reported on optional SEM implementation.[5,10,11,14,15,17,18] The implementation process for SEM was described in all studies. However, implementation fidelity was only described in three articles.[5,10,13] Nine studies used quantitative analysis[5,10-12,14-18] and one study used a mixed-methods approach.[13]

Risk of Bias:

Effect estimates from all included studies were at a high risk of bias (Table 2). Eight of the included studies had a serious risk of bias[5,11-17] and two studies had a critical risk of bias[10,18]. There was serious or critical risk of bias in the following categories: bias due to confounding (n=10), bias in selection of participants into the study (n=1) and bias due to missing data (n=1). Three categories generally had low risk of bias: bias in classification of intervention (n=10), bias in measurement of outcome (n=9) and bias in selection of the reported results (n=8).

SEM Implementation: Effects on Wait Time and Volume

Table 3 summarizes main outcomes of the included studies. All included studies reported a reduction in WT1 (Figure 2).[5,10-18] Statistically significant reduction in WT1 was reported in six studies.[5,12-14,16-17] The pre- to post-implementation improvement in WT1 was highest in the Clark et al. study at 274 days and lowest for Wittmeier et al. at 5.5 days.[11,13] When categorized by speciality, the average absolute reduction was highest in surgery, at 150 days on average, and lowest for urgent referrals to internal medicine at 12 days (Figure 3). However, the average percentage reduction in WT1 across specialties was highest in both surgery (57% relative reduction) and urgent referrals to internal medicine (40% relative reduction). Moderate and

routine referrals to internal medicine were associated with a lower percentage reduction in WT1 (36% and 17% relative reduction, respectively; Figure 4).

Pre-implementation wait times was associated with absolute reduction in WT1 (R^2=0.5978) (Figure 5). For every 1 day increase in the pre-implementation wait time, it is expected that the absolute reduction in WT1 will increase by 0.5 days (Figure 5).

Of the three studies reporting on mandatory implementation of SEM, the range of WT1 improvement was five to 47 days.[12,,13,16] The other seven studies that allowed for optional involvement had a range of improvement in WT1 of six days to nine months. [5,10,11,14,15,17,18]

Patient volume was measured in four studies with variable results.[13,14,16,17] One study found no change in referral volume for rheumatology and hematology practices, but did find an increased referral volume for endocrinology, gastroenterology and general internal medicine practices post-SEM implementation.[16] In a cardiology study, patient volume increased by 50% in the first year after SEM implementation and another 19% in the second.[14] In Schacter et al., there was a 22% reduction in referral volume in nephrology.[17] Lastly, Wittmeier et al found that the referral volume stayed the same after implementation of SEM in a group of children with neurodevelopmental conditions, but that referral volume increased for pediatric orthopedic clinics.[13]

Patient and Physician Satisfaction:

Appendix 1 summarizes patient and physician satisfaction in the included studies. Three studies described patient satisfaction after implementation of an SEM,[10,13,18] with only one study providing data for pre- and post-implementation.[13] All studies reported positive patient satisfaction or improvement in satisfaction with SEM models. Van den Heuvel et al. found that patients who had the same surgeon for assessment and surgery (group 1) rated importance of same surgeon higher (98.4%) than the group that did not have the same surgeon for surgery and assessment (48.3%).[18] Regardless of whether patients had the same surgeon assess and perform the surgery, confidence remained high in both groups (group 1: 100%, group 2: 86.2% (p=0.009). As well, both groups felt that service was faster and better with a common waiting

list.[18] Wittmeier et al. found that patient satisfaction was high both pre- and post-implementation of a central intake system (96.5% and 98%, respectively).[13] As well, caregivers reported that implementation of SEM provided more transparency for accessing services, more accurate information on wait times, more availability, improved communication and a reduction in service duplication.[13]

One study provided data on provider satisfaction post-implementation.[5] Providers deemed referrals as higher quality (pre:1/3 of rheumatologists rated referrals are poor quality, post: 19% of referrals were rated as poor quality), and more complete (pre: 75% were not satisfied with completeness of referral, post: 68% rated completeness of referral as moderate and 19% as high) after implementation of a central intake model.[13]

Interpretation:

This systematic review indicates that implementation of a SEM generally leads to decreased wait times to first specialist outpatient visit. The average percent reduction in WT1 improved significantly for surgery, urgent referrals, and for children with complex needs, suggesting that a centralized intake system may be more helpful for higher priority referrals. When examining the relationship between the pre-implementation wait time and the reduction in wait time pre- to post-implementation, there was a significant relationship when analyzed via absolute terms. As such, on absolute terms, patients waiting longer at baseline could expect to see significant reductions in their wait times following introduction of SEM.

In 2017, a systematic review published by Damani et al. showed that SEMs improve access to elective surgical procedures.[6] For surgical services, they identified that SEMs result in a decrease in patient waiting times, increased proportion of patients meeting wait time benchmarks and a decrease in the length of waiting lists.[6] In comparison, our review supports the implementation and evaluation of SEMs beyond surgical care and adds further information on approaches to implementation, referral volumes, and satisfaction.

The range in effects observed for referral volume could be due to differences in the complexity of referrals, the nature of the field, local referral patterns, education on appropriate referrals and

the referring physicians' comfortability and satisfaction with the new model.[13,14,16,17] When reported, patient and provider satisfaction improved following implementation of SEM.[5,10,13,18] One study reported that the quality of referrals improved post-implementation, however it is not clear if this is due to a standardized referral form that was given to referring physicians post-implementation or due to the SEM.[5] In comparison, the review by Damani et al. found that SEMs may leave specialists and referring physicians feeling a sense of reduced personal ownership over the referral system.[6]

Another model, termed the specific timely appointment for triage (STAT) model, has been proposed and investigated for reducing wait times to appointments.[19] This model is based on assumptions of referral volume of a practice. STAT slots are protected in clinicians' schedules, which are informed based on patient demand. Each physician creates a certain number of STAT time slots depending on anticipated referral demand. As a result, new patients are booked into STAT slots and are potentially seen faster.[19] Another complementary option that makes specialist knowledge and advise more accessible to primary care is e-consultations.[20,21]

The limitations of available data identified through this review deserve consideration. Only three studies reported on patient satisfaction and one on provider satisfaction. Sustainability of SEMs was not adequately assessed in all studies. Unsustainable models can lead to poor quality of care, financial consequences and worse patient outcomes.[22] Communication among stakeholders and engagement between those involved at all levels of the organization were cited as key factors for developing a sustainable system.[10,16] In particular, Wittmeier et al. found that gathering and facilitating communication amongst stakeholder's facilitated change and implementation of a central intake system.[13] Furthermore, few studies reported on implementation fidelity and when they did, efforts to ensure fidelity (or adaptation) were not adequately described.[5,10,18] Likewise, the only indication of cost-effectiveness in our review is from the study by Leach et al., who mentioned that their SEM system was cost-neutral.[15]

Our review identified serious or critical risk of bias across included studies. Specifically, there was high risk of confounding across all studies. Eight articles utilized a simple pre- compared to post-implementation study design which did not allow us to conclude that the differences from

pre-implementation to post-implementation were due to any other variable other than the implementation of SEM. Sample sizes for three papers were not included. As such, weighted averages were unable to be calculated because either sample sizes were unknown or sample sizes for specific categories (urgent, routine, moderate referrals) were not specified. Given heterogeneity in study design, outcome measurements, and populations, meta-analysis was not conducted. Finally, we cannot exclude the likelihood of publication bias.

Conclusion:

While this review has shown that SEM has the potential to decrease WT1, there remains uncertainty regarding the efficacy, cost-effectiveness, and sustainability of SEM. It remains uncertain if SEM can be applied to all specialty-types and across diverse settings (e.g. rural environments, marginalized populations and developing nations). Lastly, it is unknown whether improvements in WT1 through the implementation of a SEM significantly impacts health outcomes. Studies that evaluate SEM should feature methodological or statistical methods to control bias.

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Figure 1: PRISMA Flow Diagram

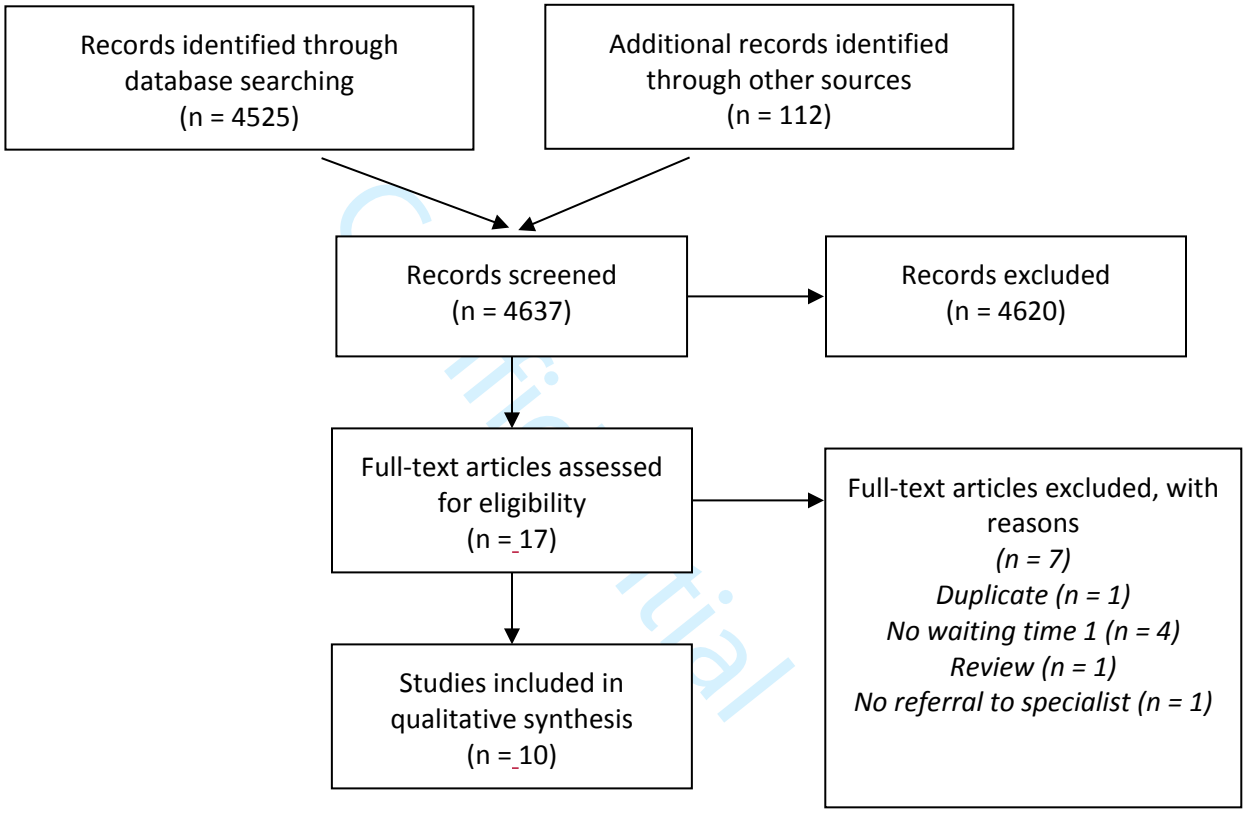
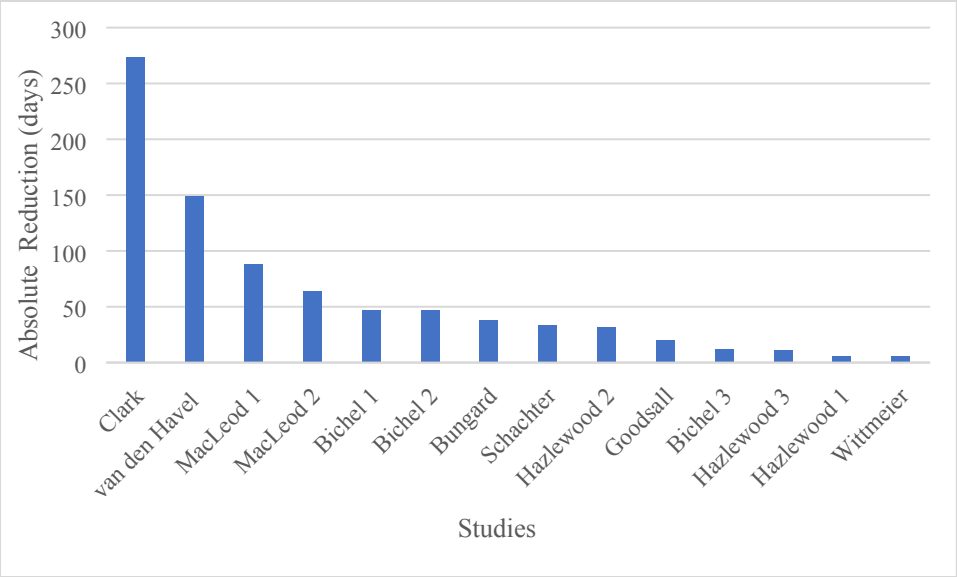
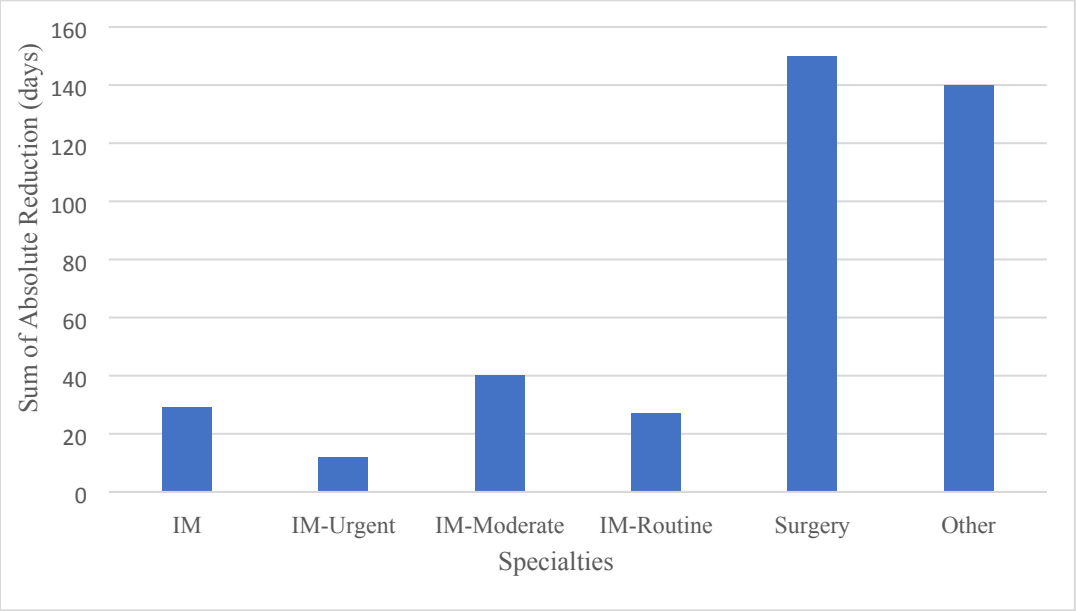


Figure 2. Absolute Reduction of Wait Times Across Included Studies



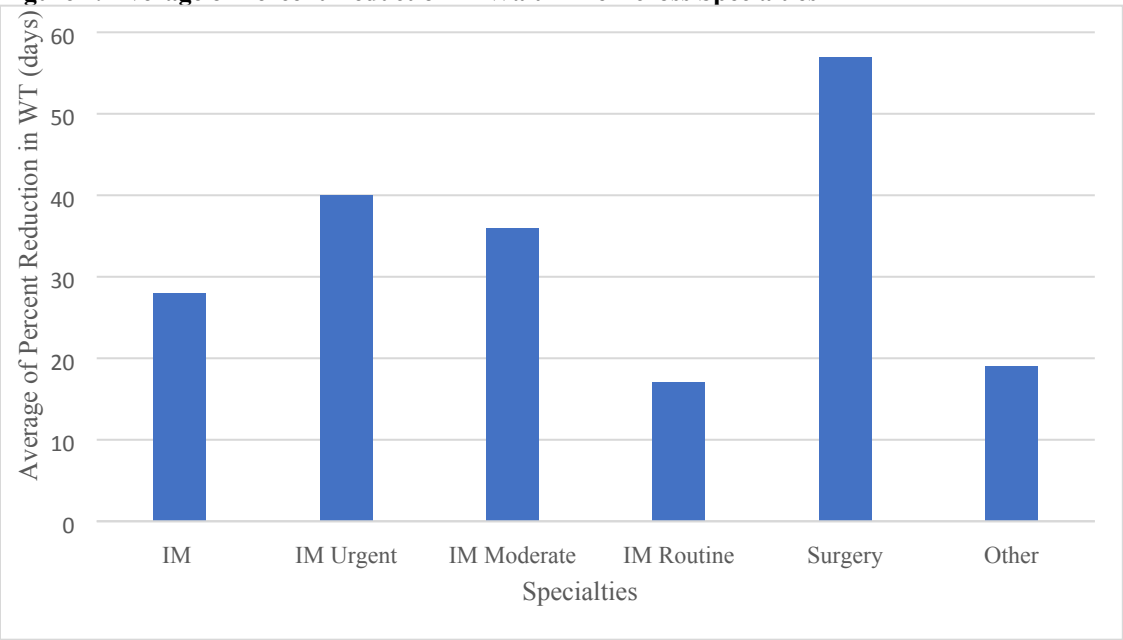
*Total number of studies:9
*Figure does not include Leach et al.[15]
*MacLeod 1: knee surgery; MacLeod 2: hip surgery[10]
*Hazlewood 1: routine referrals; Hazlewood 2: moderate referrals; Hazlewood 3: urgent referrals[5]
*Bichel 1: routine referrals; Bichel 2: moderate referrals; Bichel 3: urgent referral[16]

Figure 3. Average of Absolute Reduction of Wait Time Across Specialties



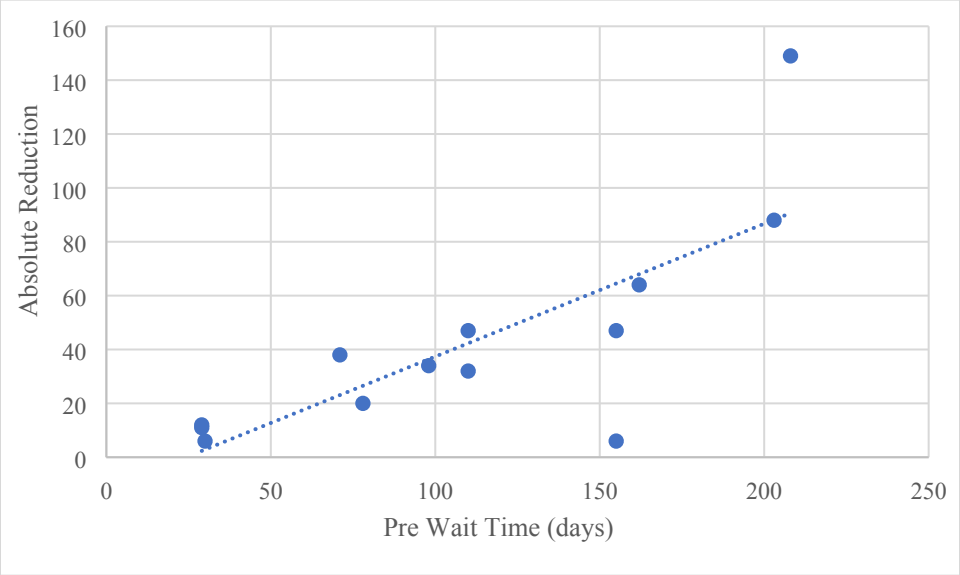
*Total number of studies:9.
*IM= Internal Medicine
*Figure does not include Leach et al.[15]
*Other: chronic pain and physiotherapy[11,13]

Figure 4. Average of Percent Reduction in Wait Time Across Specialties



*Total number of studies:8
*IM= Internal Medicine
*Figure does not include Leach et al.[15]
*Figure does not include Clark (could not calculate percent reduction in WT1)[11]

Figure 5. Relationship Between Pre-Implementation Wait Time and Absolute Reduction in Wait Time



*Total number of studies:8
*Figure does not include Leach et al[15]
*Figure does not include Clark[11]

Table 1: Demographics of Included Studies

Author	Publication Year	Country	Study Design	Sample Size	Health System Setting	Specialty /Setting	Characteristics of SEM	Optional or Mandatory	Implementation Process	Implementation Fidelity
MacLeod et al.	2009	Canada	Simple pre-post with non-equivalent groups, time-series	N/A	Single-payer	Surgery: Hip and knee	Central intake	Optional	The HKRP is a centralized intake model and referrals are registered and triaged by an advanced practice physiotherapist. Six hospitals within TC LHIN implemented HKRP. It is a single wait list and there is technology to support referral management.	The TC LHIN is accountable for HKRP. They monitored wait lists under the Wait Times Strategy and worked collaboratively with hospitals to improve TC LHIN wait list management processes.
Clark	2015	Canada	Simple pre-post with non-equivalent groups, time-series	N/A	Single-payer	Chronic Pain	Central intake	Optional	All referrals were triaged by a nurse and admin. Waitlists at 3 different sites were centralized, duplicates were identified and a single waitlist was formed.	N/A
Goodsall et al.	2017	Australia	Simple pre-post with non-equivalent groups, time-series	1118 referrals	Two-tier	Gastroenterology	Single-point-of-entry	Mandatory	A pooled waiting list and centralized intake and triage with a "week on" roster for staff specialists was implemented. Intake and triage are categorized into "urgent" and "routine". Patients are seen by the next available provider and a rapid access clinic has been established for urgent cases.	N/A
Hazlewood et al.	2016	Canada	Simple pre-post with non-equivalent	8414 referrals	Single-payer	Rheumatology	Central intake	Optional	CReATe Rheum is a centralized referral system. Referrals are sent via a single fax number. A standardized referral form was given to RP (referring	The two senior rheumatologists were involved in providing training to other

			groups, time-series						physician) but the form was not enforced if all required information was given in the referral letter. A nurse with over 15 years of experience and 2 clerical support persons processed referrals to physicians. Any concerns with referrals were directed to two senior rheumatologists. They were also involved in providing training to other rheumatologist to ensure easy transition to the new system. A multiuser database was developed to track referrals and missing information was obtained by sending a standardized form to RP. Evaluation both after short-term implementation (2 years) and long-term impact (until 2013) were conducted.	rheumatologists to ensure easy transition to new system.
Wittmeier et al.	2016	Canada	Single pre-post with non-equivalent groups, time-series	1399 patients	Single-payer	Physiotherapy	Central intake	Mandatory	A central intake system was implemented by the Child Health Physiotherapy team at the Health Sciences Centre in Winnipeg for children requiring complex needs.	N/A
Bungard et al.	2009	Canada	Simple pre-post with non-equivalent groups, time-series	3096 patients	Single-payer	Cardiology	Single-point-of-entry	Optional	Cardiac EASE (Jan 2004-Dec 2006) is a single-point of entry model. Referrals were tracked through the MedTech database. All referrals were sent via fax to one EASE intake service location and reviewed by EASE NP. Patients and referring GP were offered the choice of enrolling in EASE. Cardiologist involvement was voluntary and most chose to participate. No	N/A

									advertising of the program. There was prompt feedback to the referring physician.	
Leach et al.	2004	England	Simple pre-post with non-equivalent group, time-series	N/A	Single-payer	Surgery: spinal	Pooled list	Optional	A managed generic waiting list was implemented for initial outpatient appointment and subsequent surgery and a computerized MR booking system was integrated with outpatient follow-up appointments. As part of the managed generic waiting list, a consultant screened all new outpatient GP spinal referrals to assess suitability for a pooled waiting list and patients are referred to next available physician. The same process applies for the managed generic waiting list for surgery.	N/A
Bichel et al.	2009	Canada	Simple pre-post with no equivalent groups, time-series	8289 patients	Single-payer	Internal Medicine	Central access and triage	Mandatory	The Conference Model preceded and allowed for the development and implementation of the Central Access and Triage (CAT) system. This involved pooling referrals by speciality, using standardized information requirements and policy for confirmation of receipt of referral, and acceptance and appointment. Wait times were measured in weeks until appointment based on triage priority.	N/A
Schacter et al.	2013	Canada	Prospective, pre-post with non-equivalent	920 patients	Single-payer	Nephrology	Central triage	Optional	A physician-led Provincial change strategy was implemented. Wait time issue was brought up in a preliminary survey at a BC nephrology	N/A

			groups, time-series						conference in 2009. In addition, through modified Delphi process, wait time targets were established through in-person meetings and surveys. Targets consider comorbidities, eGFR, BP and albuminuria. A priority score from 1-4 was assigned for referred conditions. Finally, the benchmark targets were approved by BC Nephrologists at the BCPRA Medical Advisory Committee meeting and were then disseminated to all nephrologists in BC. A hard-copy reference sheet was provided to be used during triage of new patients.	
Van den Heuvel et al.	2012	Canada	Cross-sectional	94 patients	Single-payer	Surgery: hernia clinic	Common waiting list	Optional	Patients were put on a common waiting list awaiting next available physician. Clinic was run by 4 surgeons, fellows, residents and students. All administrative data was inputted into one database. Triaged by surgeon.	Letter sent to GP informing them of the new initiative. Patients received letter with date and time of appointment along with information about the hernia clinic, health questionnaire and QoL questionnaire.

Table 2 Risk of Bias Assessment Utilizing ROBINS-I Tool

Article	Bias due to confounding	Bias in selection of participants into the study	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of the reported result	Overall bias
MacLeod et al (2019)	Serious	Critical	Low	Low	Moderate	Low	Low	Critical
Clark (2015)	Serious	Low	Low	Moderate	Moderate	Low	Low	Serious
Goodsall et al (2017)	Serious	Moderate	Low	Moderate	Moderate	Low	Low	Serious
Hazlewood et al (2016)	Serious	Low	Low	Moderate	Serious	Low	Low	Serious
Wittmeier et al (2016)	Serious	Low	Low	Moderate	Moderate	Low	Moderate	Serious
Bungard et al (2009)	Serious	Low	Low	Moderate	Low	Low	Low	Serious
Leach et al (2004)	Serious	Moderate	Low	Low	Low	Moderate	Low	Serious
Bichel et al (2009)	Serious	Low	Low	Moderate	Moderate	Low	Low	Serious
Schachter et al (2013)	Serious	Moderate	Low	Moderate	Moderate	Low	Low	Serious
van den Heuvel et al (2012)	Critical	Low	Low	Moderate	Moderate	Low	Moderate	Critical

Author	Pre WT1 (mean ±SD)	Post WT1	Absolute Reduction (days)	Percent Reduction	Patient Volume	Control Group Pre WT1	Control Group Post WT
MacLeod et al.	Knee: 203 days; hip: 162 days	knee: 115 days ; hip:98 days	knee: 88; hip:64 (days)	knee: 43.3; hip: 39.5	N/A	N/A	N/A
Clark	Around 24 to more than 48 months	9 month overall reduction	274	N/A	N/A	N/A	N/A
Goodsall et al.	78 days	58 days (p<0.01)	20 (days)	25.6	N/A	N/A	N/A
Hazlewood et al.	Routine referrals: 155 ± 88 days; moderate referrals: 110 ± 57 days; urgent referrals: 29 ± 46 days	Routine referrals: 149 ± 65 days (p =0.11); moderate referrals:78 ± 56 days (p < 0.001); urgent referrals: 18 ± 23 days; (p= 0.01)	routine: 6; moderate: 32; urgent:11	routine:3.87; moderate:29.1; urgent:37.9	N/A	N/A	N/A
Wittmeier et al.	Children with complex needs (neurodevelopmental conditions): 29.8 ± 17.9 days	Children with complex needs: 24.3 ± 17.0 (p<0.0001) days	5.5	18.5	Complex needs: referral volume same. Comparison: increasing referral volume	Comparison group (orthopedic conditions): 20.4(14.3)	Comparison group: comparison: 22.1(13.1) (p<0.0001)
Bungard et al.	71±45 days	33±19 days (p<0.0001)	38	53.5	Increase by ~50% from 2004 to 2005 and 19% from 2005 to 2006	N/A	N/A
Leach et al.	Number of patients waiting more than 26 weeks: 85; number of patients waiting more than 13-26 weeks: 95	Number of patients waiting more than 26 weeks: 0; number of patients waiting more than 13-26 weeks: 10	Number of patients waiting more than 26 weeks: 65; number of patients waiting more than 13-26 weeks: 76	Number of patients waiting more than 26 weeks: 72.2; number of patients waiting more than 13-26 weeks: 86.3	N/A	N/A	N/A
Bichel et al.	Urgent referral mean: 29 (± 46) days, moderate-level: 110 (± 57) days, routine-level: 155 (± 88) days	Urgent referral: 17 (± 14) days (p < .05), moderate-level: 63 (± 42) days (p < .00005), routine-level: 108 (± 37) days (p=N/A)	urgent referral mean: 12; moderate-level: 47; routine-level: 47	Urgent referral mean: 41.4; moderate-level: 42.7; routine-level: 30.3	Increase in referral volume: Endocrine 75%, Gastroenterology 50%, General Internal Medicine 26% . No change in referral volume: Rheumatology and Hematology in referral volume	N/A	N/A
Schacter et al.	98(IQR44,157) days	64(IQR21,120) days (p = <.001). Improved the most for high priority	34	34.7	N/A	N/A	N/A

Table 3: Outcomes of Included Studies

		patients					
Van den Heuvel et al.	208 days ± 139 days	59 days ± 70 days	149	71.6	N/A	N/A	N/A

Appendix 1: Patient and Provider Satisfaction Across Included Studies

Author	Pre-Implementation Patient Satisfaction	Post-Implementation Patient Satisfaction	Pre-Implementation Provider Satisfaction	Post-Implementation Provider Satisfaction
MacLeod et al.	N/A	Improves patient satisfaction	N/A	N/A
Clark	N/A	N/A	N/A	N/A
Goodsall et al.	N/A	N/A	N/A	N/A
Hazlewood et al.	N/A	N/A	Rheumatologists: 1/3 rated referrals poor quality, 1/3 rated referrals moderate. 75% of rheumatologists were not satisfied with completeness of information provided by referring physician	Rheumatologists: 72% rated referral quality as moderate, 9% rated referral quality as high. Completeness of information: moderate in 68% of referrals, high in 19% of referrals
Wittmeier et al.	96.6% satisfaction	98% satisfaction	N/A	N/A
Bungard et al.	N/A	N/A	N/A	N/A
Leach et al.	N/A	N/A	N/A	N/A
Bichel et al.	N/A	N/A	N/A	N/A
Schacter et al.	N/A	N/A	N/A	N/A
Van den Heuvel et al.	N/A	78.3% (two-thirds) of patients felt that service was faster in specialized centre, 88.6% of patients felt that service was better in specialized centre. Importance of same surgeon in group 1 (same surgeon for assessment and surgery):98.4%, in group 2 group (different surgeon for assessment and surgery):48.3%. Confidence in operating	N/A	N/A

		surgeon (group 1: 100%; group 2: 86.2%)		

Appendix A MEDLINE Search Strategy

1 Waiting Lists/

2 Health Care Rationing/

3 "Appointments and Schedules"/

4 Systems Theory/

5 exp TRIAGE/

6 wait* list*.tw.

7 queu*.tw.

8 single-entry.tw.

9 central* intake.tw.

10 common intake.tw.

11 single point-of-entr*.tw.

12 pooled.tw.

13 pooling.tw.

14 (generic adj3 list*).tw.

15 (common adj3 list*).tw.

16 (one adj3 point adj access).tw.

17 triag*.tw.

18 1 or 3 or 6

19 2 or 4 or 5 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17

20 18 and 19