Health Policy xxx (2020) xxx–xxx

Contents lists available at ScienceDirect

Health Policy

journal homepage: www.elsevier.com/locate/healthpol

A novel methodology to measure waiting times for community-based specialist care in a public healthcare system

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ARTICLE INFO

Article history:
Received 18 November 2019
Received in revised form 21 May 2020
Accepted 7 June 2020

Keywords:
Public healthcare system
Waiting time
Computerized appointment scheduling systems
Health maintenance organizations
Physician
Specialist

ABSTRACT

Background: Monitoring waiting time (WT) in healthcare systems is essential, since long WT are associated with adverse health outcomes, reduced patient satisfaction and increased private financing.
Objective: To describe a methodology developed for routine national monitoring of WT for community-based non-urgent specialist appointments, in a public healthcare system.
Methods: The methodology is based on data from computerized appointment scheduling systems of all Health Maintenance Organizations (HMOs) in Israel. Data included first 50 available appointments for community-based specialists and actual number of visits. Five most frequent specialties: orthopedics, ophthalmology, gynecology, dermatology and otolaryngology, were included.

WT offered to HMO members for non-urgent care was calculated for two scenarios: s̈pecificp̈hysician and änyp̈hysician in the region. Distribution of offered WT was calculated separately for each specialty and geographical region, combined to create the nationwide distribution.
Results: The methodology was tested on data extracted between December 2018-June 2019. Estimated national median WT for s̈pecificp̈hysician, ranged from 9 days (ophthalmology/gynecology) to 20 days (dermatology), with large variation between geographic regions. WT were 26–56 % shorter for änyẗhan for s̈pecificp̈hysician.
Conclusions: This novel method offers a solution for ongoing national WT measurement, using computerized scheduling systems. It integrates two scenarios for appointment scheduling and allows identification of differences between specialties and regions, setting the ground for interventions to strengthen public healthcare systems.

1. Introduction

In 2001, the Institute of Medicine report identified timeliness as one of the fundamental properties of high quality healthcare. [1] The amount of time that a patient needs to wait for a clinician appointment or a treatment, is a key indicator of overall system performance. However, timeliness is still the least studied and least understood dimensions of quality care [2]. Many factors hamper the accurate assessment of waiting times, and efforts are needed to develop systems that can provide ongoing monitoring with existing resources.

Long waiting times (WT) may negatively affect health outcomes [3,4] and patient experience with clinical care, including perceived quality of care [5], as well as being associated with anxiety and deterioration of health [6]. Longer WT in publicly-funded health systems could increase purchase of private insurance [7] and increase the national health expenditure.

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https://doi.org/10.1016/j.healthpol.2020.06.006
0168-8510/

Controlling WT is a major policy concern in publicly funded health systems across OECD countries. The majority of OECD countries monitor and publish national WT statistics and have some form of WT guarantee or target of maximal WT [8]. Most countries measure WT for elective procedures, based on administrative data, for example in the Netherlands hospitals are required to report WT for procedures on a monthly basis [9]. In Canada, WT for visits to specialists and for diagnostic and surgical procedures are measured by physician surveys [10]. In the USA, WT for primary and specialist care is measured by s̈ecret shoppersẅho describe a non-urgent clinical scenario and ask for the first available appointment [11]. The Veteran Affairs (VA) health administration measures actual WT in a retrospective approach across primary and specialty care. [12]

Comparison of methodologies for measurement of WT demonstrates substantial differences among countries. Some healthcare systems use a retrospective measurement approach, like the current system at the VA. [12] Others favor a prospective approach, i.e. time to the first available appointment, as in a survey of 15 US cities [11], or time to the third available appointment, which is used for example as an access measure at Cincinnati Children's Hospital [13]. The Netherlands moved from retrospective, to prospective WT measurement in 2009, and now also uses the third available appointment for outpatient clinics [14]. A third possibility is a combined measure, for example New Zealand measures time to first specialist appointment – in a prospective approach, as well as retrospective collection of patient flow data [15]. Routine monitoring should be based on operational databases, which are preferred over surveys. Retrospective measures permit estimation of actual waiting time if databases include the time of the first attempt to set an appointment and the time of the corresponding actual visit.

Attempts to develop national indices for WT often encounter challenges due to different information technology (IT) systems and measurement approaches. This study aimed to provide an example of how Israel has developed national WT indices, based on administrative databases, while overcoming differences in measurement approaches among healthcare providers

1.1. The Israeli context

In Israel, a national health insurance system provides citizens with universal coverage and guarantees all citizens the right to health services ät a reasonable time, distance and quality.̈ [16] Four competing Health Maintenance Organizations (HMOs) provide their members with access to a statutory benefits package. Most specialized ambulatory care is provided in community settings [17].

Long WTs for consultations and surgical procedures, and progressive increase of private financing were the focus of public concern in Israel in recent years: In a public survey carried out in 2012, 28 % of respondents reported waiting more than one month for an appointment with a specialist [18] and between 2012–2018, the proportion increased from 28 % to 33 %. One in three respondents reported seeing a specialist in the private sector, with d̈esire to reduce WTq̈uoted as the leading reason for shifting from the public to the private health system. [19] Respondents with higher education or those living in central Israel had a higher chance of visiting a community-based specialist [18].

In recent years, the issue of significant variation in access to specialist care among specialties and between geographic areas, and its deleterious effects on equity and efficiency, led the Ministry of Health (MOH) to accelerate efforts geared towards the creation of a national WT measurement scheme. The first step towards the establishment of a national WT measurement was directed towards community-based specialty care.

This paper describes the national project, initiated by the Israeli MOH, to develop a methodology for measurement of WT for non-urgent community-based specialists and presents WT by region and specialty over a period of 7 months.

2. Methods

2.1. Setting and design

All Israeli HMOs have Computerized Appointment Scheduling Systems (CASS), utilized by 65%–97% of the specialist practices. Information about available appointments for non-urgent care is available to HMO members for self-scheduling on the internet sites or with the help of staff members at designated Call Centers. Appointments for urgent health conditions are provided by the HMOs in diverse ways and are not transparent to the public as available appointments. At the time of the study, one HMO had implemented both a retrospective and prospective measurement approach to WT, while the other three HMOs measure the first or second available appointments offered to their members, in a prospective approach.

After studying the existing measurement approaches and computerized infrastructures of the HMOs, it was decided to measure wait time for regular, non-urgent care utilizing a prospective approach. The measurement algorithm was based on administrative data from Computerized Appointment Scheduling Systems (CASS) from all four HMOs in Israel, covering the whole population (except for those in active military service). A unified data structure was defined to guide data extraction from the HMOs CASS. It was decided to focus at the first stage on the five most frequent specialties - orthopedics, ophthalmology, obstetrics and gynecology, dermatology and otolaryngology, which comprise 66–70 % of community-based encounters with specialists [19,20] and do not require a physician referral. All 6040 community-based physician practices in the above specialties were included. Community-based specialist care refers to specialist clinics belonging to HMOs, and not outpatient clinics at hospitals.

The process is illustrated here using data from the whole month of December 2018, and was then applied to January-June 2019. For each consecutive day over the period, the first 50 available appointments were extracted from the CASS of each physician practice (a specialist can work in more than one practice, each with a separate appointment schedule). This process produced a total of 5,651,393 available appointments for analysis. Concomitantly, the number of actual patient visits at each physician's practice during the same time period was collected.

2.2. The measurement approach

A multidisciplinary team of experts in medicine, computer sciences, statistics, mathematics, and queuing theory, participated in the methodological j̈ourney.̈ An algorithm was developed, in order to measure WT for available appointments, offered by HMOs to their members for non-urgent care (offered wait time). The algorithm was designed for two distinct scenarios of appointment scheduling: a) Available appointments with a s̈pecificör ñamedp̈hysician, and b) Available appointments with änyp̈hysician in a determined specialty and a determined region, an option intended to shorten WT. Since patients look for available appointments within a reasonable distance from their place of residence, analysis was carried out both at town level and at the wider level of ñaturalärea (the smallest official classification of the country, consisting of 52 geographical areas). Calculations were based on real data from actual appointment books of all relevant physicians.

The following assumptions were utilized to estimate the distribution of offered WT: 1) A s̈teady state" assumption which states that supply equals demand. In other words, the number of actual

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visits that took place at a particular physician's practice in a given period of time (supply) is equal to the number of patients who look for available appointments for that physician in the same period of time (demand). Since we did not have demand data, demand was estimated from supply. 2) The daily demand, or the daily number of patients who look for available appointments at a specialist practice, is identical for all the days in that period and is equal to the daily average of actual number of visits that took place at this physician's practice in this period of time. These assumptions are further examined in the discussion.

All wait times referred to in the methods and results are *offered* wait times, that is available appointments offered to patients seeking appointments.

2.3. Development of the algorithm

The first 50 appointments available on each day of the study period (ëxecution datë) were collected from each of the 6040 appointment schedules. The decision to collect this number of the first available appointments was based on the assumptions mentioned above and on the finding that the maximal number of patients admitted per day across 99.9 percent of all appointment books was less than 50. On each execution date, WT for all available appointments were calculated as the difference, in days, between the available appointment date and the execution date. This first step of the algorithm is illustrated in Fig. 1. For convenience of the illustration, it presents only the first 10 available appointments in one physician's practice appointment book, for 3 selected execution dates in December 2018. The calculated results are presented for each available appointment date in the book, for example: On 2nd December, WT to the first available appointment (which is on 6th December) is 4 days, while WT to the sixth available appointment, on 10th December, is 8 days.

The second step of the algorithm is to determine how many available appointments, offered to HMO members, can be utilized in the WT calculation.

For the ïspecificp̈hysician scenario, the daily demand is calculated by dividing the total number of actual visits to the physician by the number of days in the period (n = 31). Under the steady state assumption (demand = supply), the number of the first available appointments that should be utilized for the calculation from the physician's appointment book each day (supply), is equal to the daily demand. For änyp̈hysician scenario, demand is calculated as the number of actual visits for all the physicians of the selected specialty in the region (city level or ñatural areaḷevel), divided by the number of days in the demonstration period (n = 31). The supply, or the number of the first available appointments that should be utilized, from all appointment books each day, in each geographical region (supply), is equal to the above calculated demand. In both scenarios, calculation was done separately for each specialty.

Fig. 2 demonstrates the process of determining supply and demand sizes in WT calculation, in an illustrative region with two specialists. It is demonstrated for both ïspecificänd änyp̈hysician scenarios, on a single execution date (01/12/2018). The yellow and green colors represent the two physician practices.

The number of the first available appointments taken from each appointment book was based on each physician's average daily demand. In the ïspecificp̈hysician scenario, the first five available appointments were extracted from the ÿellowp̈hysician (no. 1) and the first three available appointments were extracted from the p̈reenp̈hysician's (no. 2) appointment book. In the änyp̈hysician scenario, the number of the first available appointments that were utilized from both appointment books was based on the average daily demand of the two physicians working in the district: In the illustration, the average daily demand for both physicians is eight. For this scenario only two of the soonest available appointments were extracted from the ÿellowp̈hysician, while six of the soonest available appointments were extracted from the p̈reenp̈hysician's appointment book.

The same process should be performed for each execution date. As seen in Fig. 3, in the ïspecificp̈hysician scenario five available appointments were extracted from the yellow physician and three were extracted from the green physician's appointment book on each extraction date. In the änyp̈hysician scenario the algorithm used eight appointments on each extraction date, but different numbers of available appointments were extracted from each physician's practice appointment book on each date, considering the shortest waiting times that were calculated in the region.

The third phase of the algorithm is to calculate the distribution of WT, expressed in days, for all execution dates for each specialty and geographical region. The histogram in Fig. 4 demonstrates the distribution of WT for an illustrative case of two physician practices in a given region. As expected, the right tale is longer and higher for ïspecificp̈hysician than for änyp̈hysician, since patients have to wait for longer periods in the case of a specific physician. In the änyp̈hysician scenario, more appointments are available sooner (shorter WT), compared with specific physician.

The last phase of the algorithm is to calculate WT distribution at a national level. In order to do so, WT distributions of all ñaturaläreas, were summarized both at the district and at the

Execution date	Available appointments in a physician's practice appointment book											
01/12/2018	Available date	02/12/2018	04/12/2018	04/12/2018	04/12/2018	06/12/2018	06/12/2018	06/12/2018	06/12/2018	07/12/2018	07/12/2018	.../
	Waiting time (days)	1	3	3	3	5	5	5	5	6	6	.../
02/12/2018	Available date	06/12/2018	06/12/2018	06/12/2018	07/12/2018	07/12/2018	10/12/2018	10/12/2018	10/12/2018	11/12/2018	11/12/2018	.../
	Waiting time (days)	4	4	4	5	5	8	8	8	9	9	.../
. . .												.../
31/12/2018	Available date	31/12/2018	01/01/2019	02/01/2019	02/01/2019	02/01/2019	03/01/2019	07/01/2019	12/01/2019	12/01/2019	12/01/2019	.../
	Waiting time (days)	0	1	2	2	2	3	7	12	12	12	

Fig. 1. Representation of WT calculation for three selected execution dates extracted from one physician practice appointment book.

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Physician	Available waiting time in days in physicians' appointment books Execution date: 01/12/2018													Actual no. of visits in Dec. 2018	Average daily demand in Dec. 2018
1	1	3	3	3	5	5	5	5	8	8	10	10	...	155	5
2	0	0	2	2	2	2	4	4	4	4	7	7	...	93	3
	Specific Physician														
1+2	0	0	1	2	3	3	3	5							5 , 3
	Any Physician														
1+2	0	0	1	2	2	2	2	3							8

Fig. 2. Scheme of supply and demand size determination, in ŝpecificv̈s änyp̈hysician scenario, on a single execution date (01/12/2018). The yellow and green colors (in the web version) represent two illustrative physician practices (no. 1 no. 2). Dark shades of yellow and green represent the first available appointments equal to demand for each physician; light shades refer to all other available appointments for that physician.

Physician	Available waiting time in days in physicians' appointment books								Execution date	Average daily demand in Dec. 2018
	Specific physician									
1+2	0	0	1	2	3	3	3	5	01/12/2018	5 , 3
1+2	1	2	4	4	4	4	5	5	02/12/2018	5 , 3
1+2	0	1	1	6	7	7	8	8	03/12/2018	5 , 3
...									...	
1+2	0	1	1	2	2	2	2	3	31/12/2018	5 , 3
	Any physician									
1+2	0	0	1	2	2	2	2	3	01/12/2018	8
1+2	1	2	4	4	4	4	4	4	02/12/2018	8
1+2	0	1	1	3	3	3	5	6	03/12/2018	8
...									...	
1+2	0	1	1	2	2	2	2	2	31/12/2018	8

Fig. 3. Extraction of available appointments, according to demand, in a determined specialty, district and period of time: ŝpecificv̈s änyp̈hysician scenarios.

national level. Distributions at each geographic level were used to calculate diverse statistical indices.

3. Results

5,651,393 available appointments were collected between December 2018 and June 2019 from all computerized appointment books of 6040 physician practices, covering five medical specialties, from all Israeli HMOs.

3.1. Wait time by specialty: "specific" versus "any" physician

At the national level, median WT for ŝpecificp̈hysician scenario ranged over the study period from 9 days, in ophthalmology and gynecology, to 20 days in dermatology. Median WT for änyp̈hysician scenario ranged from 3 days, in gynecology, to 13 days in dermatology (see Figure S1 in Supplementary material). Median WT was much shorter in the änyp̈hysician scenario compared to the ŝpecificp̈hysician scenario. The gap was largest for gynecology (mean difference for 7-month period: 56 %; range 35–67 %) and smallest for orthopedics (mean: 26 %; range 21–30 %).

Mean WT at the national level for ŝpecificp̈hysician ranged from 14.0 days (otolaryngology) to 24.2 days (dermatology). For änyp̈hysician, mean WT ranged from 4.3 (gynecology) to 14.9 days (dermatology). As expected, mean WT are longer, compared with median WT, since the mean takes into account a l̈ong tail'̈that includes appointments with experts in high demand, for whom patients are willing to wait longer. Full details of means and medians are presented in Table S1 (Supplementary material).

3.2. Wait time by geographic area: district and city level

Israel is divided into 6 districts. Analysis of WT by district demonstrated considerable geographical variation, with longest waiting times in the Southern, compared with the other districts, in 3 out of 5 specialties examined. For example, between April to June 2019, median WT for consultation with a specific ophthalmologist was twice as long in the Southern district, compared with Tel Aviv district (16 versus 8 days, respectively) (see Table S2 in Supplementary material). The 75th percentile of WT for a specific physician in Orthopedics was 42 days in the Southern district, compared with 14 days in the Northern district. In the city of Be'er-Sheva, the c̈apitalöf the Southern district, the 75th percentile of

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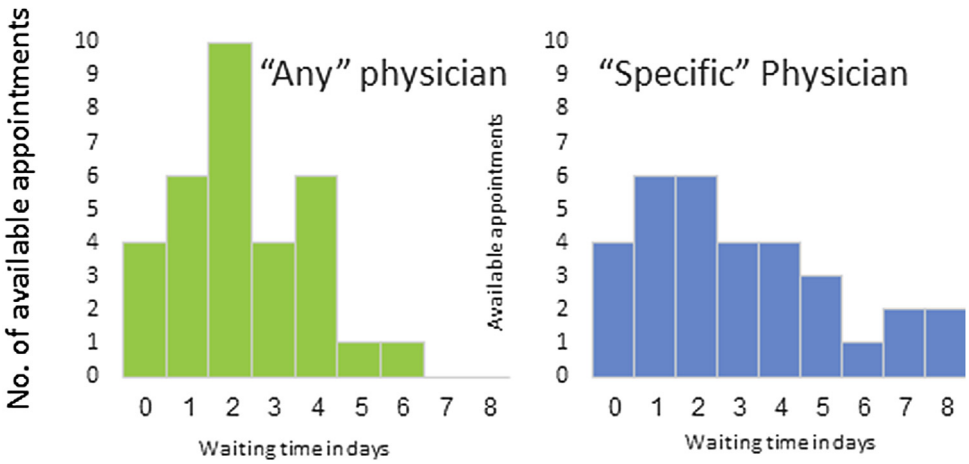

Fig. 4. WT histograms for a given specialty and district, in änyÿs. špecificp̈hysician scenarios.

WT for a specific physician, was 59 days, i.e. one in four consumers had to wait for more than 59 days to see an eye doctor for non-urgent care. Analysis of WT at all geographical levels, from national level to city level, presents shorter WT for änyp̈hysician scenario than špecificp̈hysician scenario. For example, in the city of Haifa, median wait for any physician (ophthalmology) was 7 days, (75th percentile of 9 days), and for a specific physician was 8 days, (75th percentile of 19 days). Other cities showed greater differences such as Jerusalem where the median wait for any physician (ophthalmology) was 3 days, compared to 13 days for specific physician (data from April-June 2019).

3.3. *Wait time over time: from December 2018 to June 2019*

Analysis of wait times over time, from winter to summer months, showed similar patterns of differences between specialties, between districts, and between specific vs any physician (Figure S1 Supplementary material).

4. Discussion

This study presents the step-by-step development of a methodology that creates, for the first time, the basis for a national measurement of offered wait time for community-based specialty care. The method is based on a common denominator that utilizes the existing CASS of the four healthcare providers. It provides information of great importance to patients, caregivers and policy makers, enabling transparency within the healthcare system and providing the opportunity to improve access to care.

Long waiting times may reflect socioeconomic inequalities. Moscelli et al. demonstrated socioeconomic inequalities in WT for non-emergency coronary revascularization in the British National Health Service, a publicly funded health system. Only a fraction of the inequalities were explained by patient choice. [21] Siciliani and Verzulli found that more educated patients had lower waiting times for specialist consultation and nonemergency surgery [9]. In Israel, the expected waiting time for surgeries was longer for patients with more comorbidities and those in the geographic periphery [22]. Long WT can also increase socioeconomic inequalities, when the weakest segments of the population find it more difficult to find private or other pathways to shorten WT [23]. In a representative survey carried out in Israel during 2018, 32 % of respondents belonging to the lower quintile of income reported forgoing some kind of medical care during the year prior to the survey due to long WT. [19]

Our study demonstrated considerable variations in offered WT between geographic districts, for example much longer WT for consultation with an ophthalmologist in the Southern district, compared with Tel Aviv district. Applying the methodology to data extracted from December 2018 through June 2019 showed similar trends over three periods of time. These geographical differences, along with the difference in offered WT across cities, highlight the need for a transparent reporting of these findings to decision makers and the public. Regional differences in WT may illustrate potential disparities in provision of health services. Unique socio-demographic characteristics of the local populations might also explain different patterns of disease prevalence or health-seeking behavior.

The methodology presented in this study should be compared with existing WT metrics that utilize a prospective approach. The approach of calculating WT based on the first available appointment or the third next available appointment can cause bias, since it is sensitive to last minute cancellation and other unexpected events. Both the first or third available appointments might, therefore, under-estimate offered WT. On the other hand, fourth or fifth available appointment can over-estimate offered WT, since less than 4 patients were looking for available appointments each day in a third of the physician practices in our study. Our approach uses all first available appointments for each physician (supply), and utilizes for calculation an amount equal to the average daily number of visits (demand). Since no physician had daily average demand greater than 50 appointments, it was deemed that this approach produced the best estimation of real WT distribution. The number of available appointments introduced into the algorithm can be customized to different health systems.

When comparing offered WT with actual WT, two situations may act in opposing directions: people do not necessarily choose the first available offered appointment (as calculated in offered WT measurement), and may prefer a delayed appointment, due to time preferences, physician's requests, follow-up visits etc. This situation can lengthen actual WT compared with offered WT. On the other hand, HMOs invest a lot of effort in order to shorten long WT, for example by reaching out to patients on the waiting list, and offering a quicker appointment (for example in another city), and sending automated reminders to confirm arrival or cancellation. These efforts can shorten actual, compared with offered, WT. Nevertheless, measurement of offered WT is important in its own right, most accurately representing patients' experience when trying to book a specialist appointment, and should be one of the basic elements for measuring healthcare systems' performance.

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Some assessments of waiting time rely on survey data, as has been previously conducted in Israel and elsewhere. [11,18,19] Comparison of WT estimated by the proposed methodology to WT reported by a consumer survey of a representative Israeli sample that took place in parallel months [19], yielded similar results. This strengthens the contribution of the methodology presented here as a continuous, less expensive, easier to use alternative, compared with consumer surveys for the estimation of WT. While a well-organized survey may minimize biases in estimation of WT, a complete administrative database produces better accuracy, at lower costs.

Another contribution of the methodology is its ability to estimate WT for two possible appointment scheduling scenarios - s̈pecificör änyp̈hysician. Longer wait for a chosen doctor might cause patients to prefer änyd̈octor, thus seeing a different doctor on each visit in order to reduce WT. There is a tradeoff between continuity of care and waiting time. High continuity of care is typically associated with better health outcomes but has also been associated with longer WT. [24] Few studies have addressed this difference. Fyie et al. [25] reported that patients selecting a particular surgeon led to what they termed 'voluntary delays' in surgery or consultation, though this type of delay was not tracked in the system. A Canadian patient satisfaction survey reported that median wait time was longer for patients requesting a specific physician compared to any physician [26]. However, to the best of our knowledge, the ability to calculate waiting times, based on administrative data, separately for s̈pecificv̈ersus änyp̈hysician, is unique.

Although developed in a given setting of one nation's public healthcare system, the methodology described here is very flexible and can be adapted to diverse settings. When adapting the algorithm, each healthcare provider (or regulating authority) can decide on the reasonable distance that a patient can travel for a specialist, and widen or narrow the geographic units of reference, accordingly. The method can also be adopted to measure WT for consultation with physicians from other medical specialties, as well as primary care; it can be used in public and private health systems. Its core competencies are derived from its ease of using existing administrative data, allowing ongoing monitoring at relatively low costs. Once the physician scenario and number of first available appointments are set, it can serve for ongoing monitoring of WT at the local, regional and national levels. The complexity of comparing waiting times between countries was demonstrated by Viberg et al., [8] showing the considerable barriers caused by different measurement systems. The authors called for ä more coherent approach to waiting time measurement.̈ The methodology described here has succeeded in overcoming system differences between HMOs to create a national measure, and may in the future lead the way for standardization and comparison across nations.

The algorithm presented in this study bears several limitations: 1) The assumption that the number of HMO enrollees seeking an available appointment is identical throughout all days of a given month. This number, representing the actual average daily demand, might change between weekdays and weekends, or be higher on the first workday of the week, for instance. This limitation can be resolved by calculating the average daily demand by type of day (weekday, weekend, vacation), whenever this information on volume by type of day is available, and accounting for the weekly cycle and the effect of holidays;

2) In a steady state, demand equals supply, i.e. the number of HMO enrollees looking for an appointment equals the number of actual visits to a specialist practice in a given period of time. However, in the real world, there are two exceptions that should be considered in estimating WT. Some patients visit the physician without scheduling an appointment (ẅalk-ins̈). WT for these patients is 0 days, because the physician accepted them on the same day. Under the steady state assumption, we included these visits in calculation of the demand, resulting in over-estimation of WT. On the other hand, 19 % of Israeli patients who needed a consultation with a specialist, did not book an appointment because of long WT. [27] Thus, the real demand may be higher than the actual number of visits. This leads to under-estimation of WT. These too opposing trends presumably balance each other out;

3) Extraction of data took place once a day, not allowing for cancelations and rescheduling of appointments after extraction time to be included in the calculation.

The algorithm relies on data provided by the HMOs, therefore comprehensive audit is necessary to ensure data quality and to avoid data manipulation.

The ideal measurement of actual WT may be obtained by developing a computerized process that continuously collects the following parameters: The time when a patient enters the system, a list of available appointments for the relevant physicians at this moment and the actual appointment that the patient chooses. These measures will be incorporated into the next stage of the national measurement.

5. Conclusions

The novelty of this methodology lies in the utilization of existing computerized scheduling systems to create a national measurement of offered WT for community care in the public health system, and the integration of different scenarios for appointment scheduling, which allows analysis of the tradeoff between continuity of care and waiting time. A prospective community-based approach was used, in contrast to the more often used retrospective, hospital-based assessment of waiting time. The designed method was further able to overcome differences in IT systems between health providers, thus providing a tool for the comprehensive national assessment of waiting times for specialist care, and supplying essential information to policy makers and the public. This is a vast improvement on previously available survey data and anecdotal media reporting of WT, which was the case in Israel. This relatively low-cost method allows ongoing monitoring and periodic public reporting of data. It is already being utilized by the MOH as a tool for continuous monitoring and dialogue with the HMOs and is reported to the public on a quarterly basis.

This tool can inform better allocation of resources, both by HMO managers and by the regulator. Future comparative reporting of WT by health provider will provide transparency and allow patients to make informed choices. Accurate assessment of WT by geographic regions can identify differences in care access, promote further research into the sources of these differences and help target interventions. These might reduce WT and improve equity and ultimately strengthen the public healthcare system.

CRediT authorship contribution statement

Rachel Wilf - Miron: Conceptualization, Project administration, Supervision, Writing - original draft, Writing - review & editing. **Ilya Novikov:** Formal analysis, Methodology, Software, Writing - original draft, Writing - review & editing. **Arnona Ziv:** Data curation, Formal analysis, Methodology, Software, Writing - original draft, Writing - review & editing. **Avishai Mandelbaum:** Formal analysis, Methodology, Writing - review & editing. **Yaacov Ritov:** Formal analysis, Methodology, Writing - review & editing. **Osnat Luxenburg:** Conceptualization, Resources, Supervision, Writing - review & editing.

Please cite this article in press as: Wilf - Miron R, et al. A novel methodology to measure waiting times for community-based specialist care in a public healthcare system. Health Policy (2020), https://doi.org/10.1016/j.healthpol.2020.06.006

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.healthpol.2020.06.006.

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Please cite this article in press as: Wilf - Miron R, et al. A novel methodology to measure waiting times for community-based specialist care in a public healthcare system. Health Policy (2020), https://doi.org/10.1016/j.healthpol.2020.06.006