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REVIEW

A scoping review to explore the suitability of interactive voice response to conduct automated performance measurement of the patient's experience in primary care

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Introduction: Practice-based performance measurement is fundamental for improvement and accountability in primary care. Traditional performance measurement of the patient's experience is often too costly and cumbersome for most practices. **Objective/Methods:** This scoping review explores the literature on the use of interactive voice response (IVR) telephone surveys to identify lessons for its use for collecting data on patient-reported outcome measures at the primary care practice level. **Results:** The literature suggests IVR could potentially increase the capacity to reach more representative patient samples and those traditionally most difficult to engage. There is potential for long-term cost effectiveness and significant decrease of the burden on practices involved in collecting patient survey data. Challenges such as low response rates, mode effects, high initial set-up costs and maintenance fees, are also reported and require careful attention. **Conclusion:** This review suggests IVR may be a feasible alternative to traditional patient data collection methods, which should be further explored.

Key words: clinical competence; family practice; interactive voice response; patient satisfaction; primary health care; quality assurance, health care; quality indicators, health care; review; scoping review; speech recognition software

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Introduction

There are growing demands for accountability and a recognized need for constant quality improvement (QI) in primary care practices (Government of Ontario, 2012). Performance measurement is often used to identify and address strengths and weaknesses through data collection and the provision of feedback (Simpson and Birdshell, 2006; WHO, 2008). However traditional methods of data collection, particularly those measuring patient-reported outcomes, can be laborious and costly and many primary care practices lack the time and resources to implement

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them (Stroebel *et al.*, 2005; Parker *et al.*, 2007; Ivers *et al.*, 2012; Creswell, 2013). Thus for tools to be applicable to primary care settings they must cater to practice capabilities and concerns and also be efficient, minimally disruptive, and cost effective (Stroebel *et al.*, 2005; Parker *et al.*, 2007; Government of Ontario, 2012; Ivers *et al.*, 2012). In looking for such methods, we conducted a scoping review of the literature on automated performance measurement (APM) through the use of interactive voice response technology (IVR), in order to assess lessons for its potential use in primary care health services research. For this review APM is defined, using elements from two sources, as: the use of telephones to administer computer-driven surveys, utilizing computerized or pre-recorded voices and touch tone response or speech recognition, to gather performance data (Abu-Hasaballah *et al.*, 2007; Shaw and Verma, 2007). We specifically sought to identify the benefits and challenges in using an IVR approach (that includes any type of IVR system using a telephone only) to APM to determine feasibility for primary care practices' quality improvement efforts and practice-based research studies.

Methods

In order to broadly explore this technology, we adopted a scoping review method outlined by Arksey and O'Malley (2005) and Levac *et al.* (2010). Our goal was to identify relevant lessons from published literature on the potential of an emerging technology, automated interactive voice response surveys, for primary care health services research and practice-based quality improvement. We sought all relevant literature regardless of study design, to record the approach used, and main findings, both broad and specific. We searched the MEDLINE database from the year 2000 to 2013 using keywords related to interactive voice response, performance measurement, and primary care. A list of the search terms and combined searches may be found in Appendix. International articles reporting the use of IVR for any reason in any health care practice setting were included if they were research studies or literature reviews. Articles were excluded if they were not published in English, contained a non-health care-related research question, the abstract was not available through Medline, or their interactive voice response systems were not conducted through the telephone.

M.F. ran the search and screened the titles and abstracts for meeting the inclusion criteria. Included articles at this stage underwent full text review by M.F. Their references were also reviewed for relevant sources. Articles were assessed for relevance to use of IVR for health care performance measurement such as applicable methods or population, as only a limited number addressed performance measurement specifically. Articles discussing interactive voice response survey technology in other health care contexts outside of primary care were also included to broaden the search. Included articles underwent in depth review and data extraction, the rest were excluded following initial review because they were not relevant to IVR and automated performance measurement.

Studies using IVR for a broad range of functions such as health intervention, follow-up calls, disease management, health education, and health databases were analysed alongside performance measurement articles due to a lack of data specifically on performance measurement. We extracted data from included studies on study goals, population/context, method of IVR implementation, type of IVR administration (call in/call out), survey questions, response rates, number of follow-up calls required, data quality, cost information, and factors reported as facilitating or hindering integration into a clinical practice. Descriptive data from each article was analysed by M.F., S.J., and W.H. to identify lessons for the use of interactive voice response technology for performance measurement in primary care. We identified common findings across studies, and paid attention to disconfirming results and areas requiring further investigation. To promote the rigour of the study, our analysis team was multidisciplinary including two clinician primary care health services researchers and one non clinician health systems researcher. Further we presented our early analysis findings to several health services researchers and an information technology expert in the field of IVR incorporating feedback into our ongoing assessment of relevance to primary care. We synthesized the main findings relevant for primary care, based on recurrence between studies and/or the impact or potential impact for performance measurement. These are presented under categories in the result section.

Results

The initial search retrieved 1987 articles, 123 of which were selected for full text review. 10 additional sources were added after searching the references of included articles. In all, 33 articles were included for in depth review and data extraction. A summarized figure of the search results is shown in Figure 1.

A total of 33 articles were included in our search and addressed interactive voice response technology use in health care but very few specifically addressed primary care and performance measurement. Five studies utilized IVR for collection of patient satisfaction data while 14 studies used IVR alongside patient services such as monitoring and education. Multiple study types were reviewed, including 14 randomized controlled studies, other experimental designs, observational studies, and systematic reviews. Five studies were literature reviews of IVR or related technologies. The studies used diverse methods,

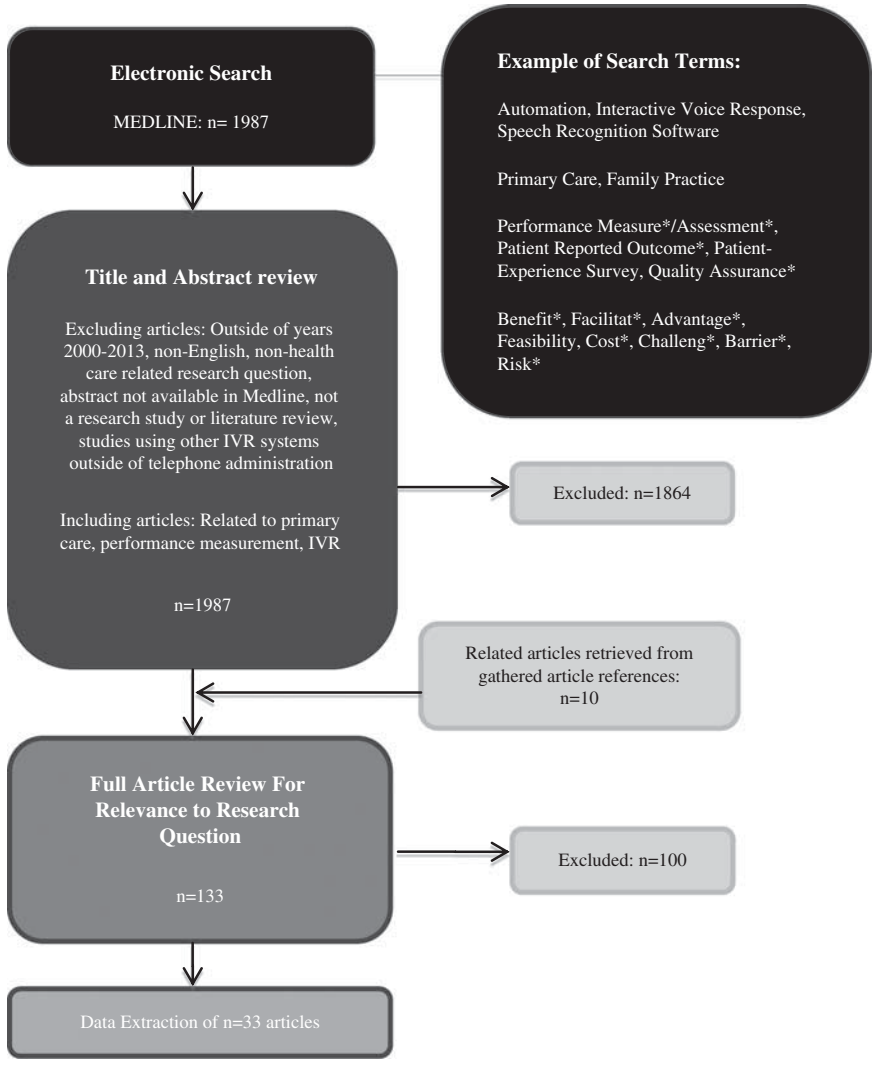

Figure 1 Scoping review

sample populations, implementations of IVR, and outcomes measures. In all, 27 studies had sample populations ranging from 36 to 58 440, with a total of 117 692 participants across all studies reviewed. An additional study included three practices as their sample population and the remainder of studies were literature reviews. All studies were set in the United States except for one that was conducted in Canada by Reid *et al.* (2007).

This section presents the results most pertinent to the topic of interactive voice response for automated performance measurement. The following tables present brief summaries of each source grouped by study focus. Table 1 summarizes the methods and relevant findings of studies specifically evaluating IVR survey methods. Table 2 summarizes the findings of studies which combined IVR surveys with another intervention. The articles detailing technological specifications or implementation issues are summarized in Table 3. The studies investigating mode effect are described in Table 4, and Table 5 presents the literature reviews on this topic. Highly relevant or commonly reported aspects of IVR surveys are presented below.

IVR features

Several sources discussed the multiple features that interactive voice response technology provides. IVR can reach multiple simultaneous participants, across a wide geographic spread, in multiple languages and accents, and most people own and know how to use a phone (Stuart *et al.*, 2003; Brodey *et al.*, 2005; Abu-Hasaballah *et al.*, 2007; Estabrooks *et al.*, 2009; Oake *et al.*, 2009; Dalal e*t al.*, 2010; Lundy and Coons, 2012; Skolarus *et al.*, 2012). IVR may use computerized voice or pre-recorded messages, can ask multiple choice and open-ended questions, and can randomize participants to receive different messages or survey questions (Abu-Hasaballah *et al.*, 2007; Welker, 2007; Willig *et al.*, 2013). IVR allows skipping and branching of irrelevant questions to save participant time and can call-out to patients during specific time intervals or allow patients to call-in at their own convenience (Lee *et al.*, 2003; Abu-Hasaballah *et al.*, 2007; Shaw and Verma, 2007; Naylor *et al.*, 2008; Shea *et al.*, 2008). Finally IVR technology can be integrated with databases and enter information directly into tables and graphs (Aharonovich *et al.*, 2012).

Data quality

IVR produced data quality comparable to other modes in multiple studies (Weiler *et al.*, 2004; Shea *et al.*, 2008; Dalal *et al.*, 2010; Skolarus *et al.*, 2012; Houser *et al.*, 2013). Mode effects due to the telephone delivery method and automated nature of IVR were experienced in some studies, as respondents were found more likely to choose the extreme categories (Rodriguez *et al.*, 2006; Dillman *et al.*, 2009). Some participants became frustrated by the survey pace causing them to 'satisfice', selecting the first available answer to move on to the next question, which biased results (Rodriguez *et al.*, 2006). In contrast, recency effects may result when the participant remembers the last answer choice read out, due to it being heard most recently, and is more prone to pick it as a result (Dillman *et al.*, 2009).

IVR was used effectively to reach diverse populations and hard to reach patient samples such as the visually impaired, illiterate, lower education, and non-English speaking patients. However, studies noted that those with hearing impairment may have difficulty participating in a phone survey and some populations may not trust reporting information to a machine (Stuart *et al.*, 2003; Brodey *et al.*, 2005; Goldman *et al.*, 2008; Naylor *et al.*, 2008; Dalal *et al.*, 2010; Rose *et al.*, 2010a; 2010b; Graham *et al.*, 2012; Skolarus *et al.*, 2012).

Sources suggested that to achieve good data quality installers need to carefully consider variables of speech recognition such as sensitivity of speech, risks of words being misrecognized, poor audio quality such as echoes, poor telephone service, and that phones encourage the use of shorter rating scales and simplified wording (Welker, 2007; Dillman *et al.*, 2009; Skolarus *et al.*, 2012; Willig *et al.*, 2013).

Costs

Multiple sources cited IVR technology as a feasible tool for practices and though there is a substantial initial expense, it is balanced against low incremental costs and long term savings (Janda *et al.*, 2001; Abu-Hasaballah *et al.*, 2007; Piette *et al.*, 2008; Oake *et al.*, 2009; Rose *et al.*, 2010a; Houser *et al.*, 2013; Willig *et al.*, 2013). Initial expenses included paying for: the system, programming, script creation, technical support

Table 1 IVR methods and findings from included studies relevant to potential use for primary care patient-reported outcome measures

Author	Year	Study goals	Population and sample size	Setting	Design	Call in or call out	IVR response rate	Number of follow up contacts	Data quality	Cost/Ease of integration
Dillman *et al.*	2009	Investigated mixed mode designs including mail, telephone, IVR, and the internet. Studied improving response by changing to another mode	Individuals with a known long distance provider $n = 8999$	Households	Satisfaction survey Randomized controlled trial	Call out, live interviewer asked one question then changed to IVR	28%	Follow-up with a live call	IVR chose extreme positive category more often than mail and web Recency/ primacy affects	$2 cash incentive with the mail request
Isenburg *et al.*	2001	Feasibility of digital patient outcome data collection using web and IVR	Practitioners and patients $n = 77$ practitioners $n = 998$ patients	Medical and surgical practices	Patient outcome survey	Patients visiting clinic were given instructions to call into the system	3 trials: 27.7%, 12.8%, 34.8%			20 min prepaid phone card incentive to full completion of the IVR
Rodriguez *et al.*	2006	Tested and compared Mail, Web and IVR approaches for evaluating patient experience	Adult patients from a panel of 62 primary care physicians $n = 9126$	Primary care	Randomized controlled trial, modified ambulatory care experiences survey	Participants received the invitation by mail and were told to call in	34.70%	Second invitation letter sent at one week, a third at three weeks	IVR mode effect, systematically lower results compared with other modes Risk of satisficing	Mail was less expensive than web and IVR Mail-$5.19 per unique response versus IVR $9.04 for pure, $8.04 for mixed mode samples Used crossover mailing to boost response rates
Shea *et al.*	2008	Compared IVR, illustrated, and print versions of a survey	Patients 18 or older Medicaid or Medicare health plan, English or Spanish $n = 6815$	Primary care	Patient satisfaction survey Randomized controlled trial	Participants received instrument by mail and were instructed to call in	18.10%	Two contacts by mail followed by six calls from a live interviewer	Data quality was better for IVR because it controlled the question options	$10 incentive for participation
Tourangeau, Couper and Steiger	2003	Investigated how social interface influenced response, compared six versions of IVR	Population selected via random digit dialling $n = 25\,000$	Households	Compared six versions of an IVR Interview survey	Call out by live interviewer then switched to IVR	26.20%	40.9% answered the phone 64% of these completed the questions		Many participants hung up during the switch between live and IVR or immediately after entering the system

IVR = interactive voice response.

Table 2 IVR methods and relevant findings from included studies which paired IVR with another intervention

Author	Year	Study goals	Population and sample size	Setting	Design	Call in or call out	IVR response rate	Number of follow up contacts	Data quality	Cost/ease of integration
Aharonovich *et al.*	2012	Used IVR for intervention to reduce non-injection drug use in HIV primary care patients	Inclusion: HIV positive, English/ Spanish, 18 and older, largely included disadvantaged backgrounds, unstable housing, minorities *n* = 40	Primary care	IVR for automated health calls Randomized controlled trial	Patients given a watch with an alarm set as a reminder to call into the system	85% retention at 30 days, 79% at 60 days	Patients completed 4 min daily health calls into the system	Data entered directly into graphs	Reduced staff hours Some felt calling in was annoying and difficult to remember
Bender *et al.*	2010	Tested IVR to improve adherence to medication in adults with asthma	Patients aged 18–65 who had a physician diagnosis of asthma and prescription for a daily inhaled corticosteroid *n* = 50	Recruited through newspaper advertising and cooperation with community allergy practice	Automated health calls providing information and reminders Randomized controlled trial	Call out, toll free number left on answering machine	100%	Needed to complete two calls over one month All participants listened to health information provided No indication of how many calls were required to reach them		Increased adherence to medication guidelines
Estabrooks *et al.*	2009	Evaluated effectiveness of three interventions to assist parents of overweight children	Parents and children (8–12) days *n* = 220	Care setting	Randomized controlled trial	Patients could call in, system would also call out at specific times	80% at six months 74% at 12 months	10 automated counseling sessions over one year		Completion of 6/10 IVR calls had greatest decrease in BMI compared with other method
Graham *et al.*	2012	Investigated use of a monitoring system in primary care to reduce emergency room visits and readmissions among case-managed patients	Patients recently discharged from the hospital *n* = 3772	Primary care	IVR surveys for a 30-day post hospital transition period Post parallel quasi-experimental design	IVR Call out	96%	One IVR call per week over a month IVR was programmed to automatically retry calls if it was unsuccessful		IVR calls cost $25 per patient, did not replace all traditional contact but helped extend reach for the intervention and lowered case manager burden Calls took 2–3 min to complete versus 30-min traditional calls from clerical staff 44% less likely to readmit if they were case managed and participated in IVR
Greaney *et al.*	2012	Tested IVR and text to improve health behaviors alongside an intervention	Adult patients with scheduled visit appointments *n* = 598	Primary care	Using electronic reminders for cancer prevention Randomized controlled trial	IVR Call out reminders				About 2/3 preferred IVR to SMS reminders

Table 2 ***Continued***

Author	Year	Study goals	Population and sample size	Setting	Design	Call in or call out	IVR response rate	Number of follow up contacts	Data quality	Cost/ease of integration
Houser *et al.*	2013	IVR calls for follow-up	Primary care/acute patients *n* = 539 (patients called and not called completed satisfaction survey)	Ambulatory care	Two cohorts, one receiving human calls, one receiving IVR Meta-analysis	IVR call out	89%		No differences between live staff and IVR	Patients overall thought follow-up was a good idea, positive toward both live interviewer or IVR with no significant difference
Kemp *et al.*	2012	IVR to outreach and improve colorectal screening	Patients at risk or presenting with colorectal cancer *n* = 58 440	Outreach intervention	Quasi experimental design, provided education on colorectal screening	IVR call out	17%	3000 IVR calls were sent out per week form April to mid-September 2008		Sent IVR call then mailed a screening kit This group had almost four times higher screening rate compared with usual care, reached those not visiting the practice
Naylor *et al.*	2008	Used therapeutic IVR to decrease chronic pain and improve coping	Subjects with chronic musculoskeletal pain *n* = 114	Care setting	Therapeutic IVR Randomized controlled trial	Patients had to call in and complete a daily monitoring questionnaire Patients were also able to access additional health information	100%	Intervention provided over four months		Significant improvement in scores in the IVR group versus no improvement in control patients using the tool continued to improve, did not relapse and kept improving four months after the tool was implemented Suggest it is a cost effective addition to any health care program
Reid *et al.*	2007	IVR response follow-up for smokers recently hospitalized with Coronary Heart Disease	Smokers over the age of 18 *n* = 99	Hospital	Asked smoking-related questions, provided educational material and notified a nurse-specialist if patients indicated relapse risk Randomized controlled trial	IVR call out	70% at three days, 72% at 14 days, 68% at 30 days	About two calls per participant 18 received all calls, 21 received two, nine received one, two received none		1.6 odds of quitting in IVR group versus usual care, 32% cessation increase at one year

Table 2 *Continued*

Author	Year	Study goals	Population and sample size	Setting	Design	Call in or call out	IVR response rate	Number of follow up contacts	Data quality	Cost/ease of integration
Rose *et al.* (A)	2010	Developed a brief interviewing intervention using IVR to deliver alcohol screening and brief intervention in primary care	Patients presenting for an office visit *n* = 188	Primary care	IVR for screening and support Comparative study	Patients asked to call in to receive the IVR brief interviewing intervention	56%	1/3 of calls were made outside of regular clinic hours		IVR was programmed and setup by an initial vender, followed by monthly fees IVR is feasible in a busy PC setting and acceptable to patients One IVR system can support a number of practices
Rose *et al.* (B)	2010	Automated screening for at risk drinking using IVR in a primary care office	Patients presenting for an office visit *n* = 101	Primary care	IVR for screening and support Comparative Study	Conducted using a dedicated phone in the waiting room	96%			Positive feedback from patients and providers lowers the need for staff and did not interfere with patient-provider interaction
Shaw and Verma	2007	Tested the equivalency of IVR to other modes for home assessment of back pain and function	Working adults, Age range 18–80 *n* = 547	Occupational health clinic	Questions aimed to track improvements for back function Prospective cohort study	Participants were mailed the number and instructed to call in	35.60%	Live telephone call five days after non-response to IVR The majority of patients called in at day time (8am to 5pm) (60%) 34%–5pm to 10pm, 1%(6–8) early morning hours	No differences in data between IVR and live interviewing	IVR reduced staffing requirements but due to low response it was necessary for live interviewers to be used to contact participants later Cost savings of ~100$ per IVR call in reduced hours of live interviewers $25 incentive for participation
Skolarus *et al.*	2012	Tested the feasibility of IVR to monitor prostate cancer survivors through survey assessment	Prostate cancer patients, median age 63, range 41–77 *n* = 40	University-based cancer center clinic	Completed written version in office, then IVR two days after Comparative study	Live interviewer called out to patients and then switched to IVR	87.50%	Multiple calls attempted over three days at 11:30am, 1:30pm, 5:30pm, and 7:30pm 53% answered initial call, 30% completed it Over half of all calls were answered after two attempts	Data quality similar to other modes, more likely to provide embarrassing information	Provided more systematic reporting and symptom assessment, without staff increase
Stuart *et al.*	2003	Evaluated three different strategies including IVR to increase patient compliance with antidepressant medication	Patients newly prescribed antidepressant medications *n* = 647	Primary care	Randomized controlled trial, IVR for education and support	Patients were educated by nursing staff and instructed to call into the system	50%	25 calls over three months		Costs associated with writing the script, system development, programming, support personnel Used live telephone operators for recruitment Patients would rather receive calls

IVR = interactive voice response.

Table 3 Studies detailing IVR technological specifications and/or implementation issues

Author	Year	Study goals	Population	Setting	Design	Cost/ease of integration/ implementation issues
Ariza *et al.*	2004	Evaluated computer capabilities in a primary care practice-based research network	Members of Pediatric practice research group *n* = 96 offices and 194 pediatricians	Practice settings	Questionnaire to assess electronic systems in practice	Privacy concerns Insufficient training with technology
Goldman *et al.*	2008	Qualitative study explored the best ways to develop IVR tool for diabetes management	Patients with diabetes *n* = 36	Primary care	In-depth telephone interviews with qualitative analysis	Positive attitudes toward IVR Felt it would be beneficial for multiple functions but would prefer a live physician
Janda *et al.*	2001	Used IVR test & survey program to facilitate setup and data collection of IVR	IVR for researchers in a variety of contexts *n* = 100		Describes IVR test and survey	EASE 2800$ Artisoft 1400 $-both require programming knowledge Cost based on number of phone lines, four line capability New package not requiring programming knowledge: 4 lines- $3300 must be integrated with a database that stores voice prompts Could outsource to a company 40$ per respondent and testing fees
Willig *et al.*	2013	IVR feedback for follow-up and feedback in primary care	Patients presenting for an office visit *n* = 3 primary care clinics	Primary care	Data entered into EMR while in practice and an IVR follow-up happened one week after the acute care visit	IVR is feasible Variability in technology at each site Important to understand the specifics of technology at each site

IVR = interactive voice response; EMR = electronic medical record.

Table 4 Studies investigating mode effects

Author	Year	Study goals	Population	Setting	Design	Call in or call out	IVR response rate	Number of follow-up contact	Data quality	Cost/ease of integration
Brodey *et al.*	2005	Reliability and acceptability of IVR versus paper among Spanish and English seeking mental health services recipients	Low income population Spanish and English *n* = 107	Mental health services	Patient satisfaction survey Randomized controlled trial	Surveys completed in practice	98%	Surveyed three times, one week apart	IVR is reliable	$5.00 incentive for the first survey $15 for second and third
Dalal *et al.*	2010	IVR versus other modes for lung function questionnaire	Smoking patients aged 40 or older *n* = 149	Primary care	Multicenter, prospective, noninterventional data-collection study Randomized controlled trial	Two study visits, completed paper then alternative mode that included IVR			No significant differences between paper and alternate modes	
Lundy and Coons	2012	Assess test-retest ability of IVR patient-reported outcome survey	Cancer survivors *n* = 127	Cancer clinic	Two administrations of the survey spaced two days apart	Mailed instructions and had to call in	77.9% completed both surveys	Recruiters called prior to promote completion of questionnaire if there was a delay	Substantial evidence that IVR scores are reliable on repeat administration	20$ gift card
Sikorskii *et al.*	2009	IVR versus live telephone Investigating mode effects	Cancer patients *n* = 386	Cancer clinic	Randomized controlled trial, Patient symptom reporting	Call out	85%	Six contacts over eight weeks	Higher reporting of symptom severity using IVR	
Weiler *et al.*	2004	Compare data collection of IVR versus paper	Adults with allergic rhinitis *n* = 87	Single-center, three-way cross over study	Patient reported outcome data Participants completed paper version, diary card for one week, IVR for one week, or both concurrently for one week Randomized controlled trial	Call in	63% of data collected within specified times, 87.6 collected within one half-day	Data collected twice a day (morning and evening) for three weeks	Paper based versus IVR data was indistinguishable	75$ incentive for participation in the study 85% preferred paper, 4% preferred IVR, 11% no preference

IVR = interactive voice response.

Table 5 Literature reviews on IVR

Author	Year	Study goals
Abu-Hasaballah *et al.*	2007	Reviewed lessons/challenges of IVR
Lee *et al.*	2003	Reviewed IVR in Health services
Oake *et al.*	2009	Described studies using IVR with clinical interventions
Piette *et al.*	2008	Reviewed health information technology to support diabetes management
Welker	2007	Reviewed implementation of electronic data capture systems

IVR = interactive voice response.

staff, and hardware for data storage (Stuart *et al.*, 2003; Ariza *et al.*, 2004; Abu-Hasaballah *et al.*, 2007). Janda *et al*. (2001) listed two programs that required programming knowledge to use, EASE (2800$) and Artisoft (1400$). Another package by VOS ($3300) did not require programming knowledge. Furthermore an outsourced company could be used for 40$ per respondent (Janda *et al.*, 2001); Graham *et al.* (2012) reported that IVR calls were 25$ per patient. Shaw and Verma (2007) found cost savings of 100$ per IVR call compared with a live interviewer. However, Rodriguez *et al.* (2006) reported that a mailed survey was cheaper than IVR in their study and IVR costs increased when low response rates required crossover mailing. Lower response rates in some studies created a need to supplement IVR with other formats to improve response rates, which can incur additional expenses (Stuart *et al.*, 2003; Rodriguez *et al.*, 2006; Shaw and Verma, 2007; Dillman *et al.*, 2009).

Some studies used the technology for service delivery or clinical care including for monitoring health outcomes, reminders, interventions and disease management (Reid *et al.*, 2007; Goldman *et al.*, 2008; Naylor *et al.*, 2008; Sikorskii *et al.*, 2009; Bender *et al.*, 2010; Kempe *et al.*, 2012; Greaney *et al.*, 2012; Houser *et al.*, 2013). The cost was part of health care delivery, often eliminating the need for a member of the health care team to carry out the task.

Response rate

Low response rates (around 30%) were observed when studies focused solely on survey administration (Isenberg *et al.*, 2001; Tourangeau *et al.*, 2003; Rodriguez *et al.*, 2006; Shea *et al.*, 2008; Dillman *et al.*, 2009). Aside from two sources, much higher response rates were usually observed and sustained over longer periods when IVR questions were paired with interventions (Table 2). For example, a 79% response rate was observed in an intervention to reduce non-injection drug use (Aharonovich *et al.*, 2012) and there was a 74% response rate at 12 months in an IVR study that aided in a weight loss intervention (Estabrooks *et al.*, 2009).

Many studies sought survey recruitment and patient consent using a different format such as mail, a live phone call, or were recruited during a visit to the practice and expected to call into the system (Stuart *et al.*, 2003; Shea *et al.*, 2008; Aharonovich *et al.*, 2012). Patient thoughts on such approaches throughout the process indicated annoyance with having to call into the IVR system and noted that they would rather receive calls (Stuart *et al.*, 2003; Rodriguez *et al.*, 2006; Aharonovich *et al.*, 2012); it is possible to combine both call in and call out methods to further accessibility (Estabrooks *et al.*, 2009).

Several studies reported strategies to improve response rates including: brief calls, call-in lines for additional time, pre-recorded voices, money incentives, calling cards, draw prizes, medical information, instructions, reminders, useful feedback, physician endorsements, indicators of practice improvement, and use of caller ID and statements to distinguish from telemarketing calls (Isenberg *et al.*, 2001; Lee *et al.*, 2003; Brodey *et al.*, 2005; Abu-Hasaballah *et al.*, 2007; Shaw and Verma, 2007; Welker, 2007; Goldman *et al.*, 2008; Aharonovich *et al.*, 2012; Skolarus, 2012; Willig *et al.*, 2013).

Ease of integration of IVR with clinical practice

Once installed, IVR caused little disruption to normal practice functioning in several circumstances (Stuart *et al.*, 2003; Bender *et al.*, 2010;

Rose *et al.*, 2010b; Willig *et al.*, 2013). Studies also noted that the integration of IVR into a database allowed for timely, accurate information, and decreased staff hours (Lee *et al.*, 2003; Shaw and Verma, 2007; Goldman *et al.*, 2008; Naylor *et al.*, 2008; Rose *et al.*, 2010a; Graham *et al.*, 2012; Skolarus *et al.*, 2012; Aharonovich *et al.*, 2012).

Discussion

The review of studies reporting on interactive voice response technology found some important considerations for practices and research teams considering IVR as a tool to better understand the patient experience in primary care. Several features of IVR survey capacity are particularly noteworthy as they might address limitations in our current approaches to collecting data on patient-reported outcome measures. The capacity to reach diverse populations through IVR technology addresses a significant limitation of the common practice-based waiting-room administration of surveys which reach only those who attend the practice, potentially creating biased samples (Green *et al.*, 2012). IVR surveys offer the flexibility to programme for a random sample from a defined roster of patients, perhaps the entire list, or a sub-set of highest interest for the study, and use different languages. As the telephone is almost universal, IVR surveys could facilitate access to a more representative sample of the group being studied. This is especially important for those patients who are traditionally more difficult to reach with paper-based waiting room surveys or even online surveys such as the visually impaired, illiterate, lower education, and non-English speaking patients (Stuart *et al.*, 2003; Brodey *et al.*, 2005; Abu-Hasaballah *et al.*, 2007; Estabrooks *et al.*, 2009; Oake *et al.*, 2009; Dalal e*t al.*, 2010; Lundy and Coons, 2012; Skolarus *et al.*, 2012).

A major barrier to practices participating in research or collecting data on patient reported outcomes of care is the perceived lack of time and concern of added burden on already stretched practices (Fitzpatrick, 2009; Johnston *et al.*, 2010). Once installed IVR could have a limited burden, if any at all, on a practice and if integrated with an electronic medical record (EMR) efficiently create outreach to patients without involving practice staff (Stuart *et al.*, 2003; Shaw and Verma, 2007; Bender *et al.*, 2010; Rose *et al.*, 2010b; Aharonovich *et al.*, 2012; Willig *et al.*, 2013). It could be programmed to generate and provide data at meaningful intervals to match study or practice needs.

The range in response rates and the relatively high upfront costs of investing in IVR technology require attention to maximize response rates. A significant feature of IVR for primary care is the ability to have the technology multi-task (Isenberg *et al.*, 2001; Janda *et al.*, 2001; Tourangeau *et al.*, 2003; Rodriguez *et al.*, 2006; Abu-Hasaballah *et al.*, 2007; Shea *et al.*, 2008; Dillman *et al.*, 2009; Estabrooks *et al.*, 2009; Aharonovich *et al.*, 2012). The capacity to customise IVR and integrate it with EMR (Lee *et al.*, 2003; Shaw and Verma, 2007; Goldman *et al.*, 2008; Naylor *et al.*, 2008; Rose *et al.*, 2010a; Graham *et al.*, 2012; Skolarus *et al.*, 2012; Aharonovich *et al.*, 2012; Willig *et al.*, 2013) opens possibilities for combining patient services such as appointment reminders or information on clinical services with patient survey questions. Services such as appointment reminders are often welcome by patients and might help overcome reluctance to complete general survey questions (Dillman *et al.*, 2009). Additionally, several practices could share one IVR system, which would help diminish the burden of cost on an individual practice (Rose *et al.*, 2010a).

Several studies suggested patients prefer a simpler process of a direct call-out to them rather than a call-in option (Stuart *et al.*, 2003; Rodriguez *et al.*, 2006; Aharonovich *et al.*, 2012). However, using a simple call-out survey will raise challenges in securing patient consent when IVR is used for research purposes and there have been variable approaches by institutional ethics review boards on whether prior consent is required (Nelson *et al.*, 2002). The potential harm to patients from the responses they might give would need to be very low to make a short consent process possible via automated recorded message ethically acceptable. Securing patient informed consent beforehand, such as during a practice visit, or through a mail-out to potential participants requesting permission to contact them by phone could significantly decrease participation rates or limit the sample to those who attend a practice (Nelson *et al.*, 2002; Angus *et al.*, 2003; Krousel-Wood *et al.*, 2006). However the use of IVR for practice-based quality improvement patient surveys might not require the

same degree of information as patient informed consent for research purposes.

An automated IVR phone survey is a different mode from the ones used for many previously validated surveys (Weiler *et al.*, 2004; Sikorskii *et al.*, 2009; Dalal *et al.*, 2010). The potential for mode effects such as satisficing and recency require attention such as changing the order of questions asked (Rodriguez *et al.*, 2006; Dillman *et al.*, 2009). Survey instruments used in other modes would have to be validated for IVR (Abu-Hasaballah *et al.*, 2007). Designing surveys which take advantage of the strengths of IVR would maximise the value of this approach. Shorter surveys spread over a larger population, customized by patient input on language, would be best suited for IVR (Weiler *et al.*, 2004; Abu-Hasaballah *et al.*, 2007; Goldman *et al.*, 2008; Naylor *et al.*, 2008; Shea *et al.*, 2008; Dalal *et al.*, 2010; Rose *et al.*, 2010b; Greaney *et al.*, 2012; Willig *et al.*, 2013). Survey questions benefitting from specific follow up timing would also be suited for IVR (Houser *et al.*, 2013; Willig *et al.*, 2013).

The various studies highlight diverse strategies to improve response rates, which could be a potential weakness of IVR used for research or quality improvement purposes. Using the strengths of flexibility to optimise timing for patients and the capacity to integrate the IVR survey with patient services are attractive ways to enhance the functionality of IVR and possibly increase response rates (Reid *et al.*, 2007; Goldman *et al.*, 2008; Naylor *et al.*, 2008; Sikorskii *et al.*, 2009; Bender *et al.*, 2010; Kempe *et al.*, 2012; Greaney *et al.*, 2012; Houser *et al.*, 2013). Further exploration of response rates and reach capacity with IVR surveys linked to patient services would significantly advance the understanding of this technology to improve primary health care data collection capacity.

Conclusion

As primary care reform continues, the need for understanding the patient experience and improving data collection capacity on patient-reported outcome measures, especially from traditionally difficult to reach populations, is essential. This review of interactive voice response technology, for potential use in automated performance measurement of the patient experience in primary care practices, suggests it may be a feasible alternative to traditional patient data collection methods, which should be further explored. The lessons from the use of IVR in many other health care sectors can guide implementation efforts within the primary care sector to maximise the potential of this approach.

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Authors' Contributions

This scoping review was conducted by Michael Falconi under the guidance of Dr. William Hogg and Dr. Sharon Johnston. Michael Falconi wrote the first draft and Dr. William Hogg and Dr. Sharon Johnston contributed to the writing and critically reviewed the manuscript. All authors approve the final manuscript.

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Conflicts of Interest

None.

Ethical Standards

No ethical clearance was required for this scoping review.

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Appendix A: Scoping searches

#	Searches	Results
1	Automation.mp.	22 755
2	Interactive voice response.mp.	468
3	Automated IVR.mp.	4
4	IVR technology.mp.	55
5	Speech recognition software.mp.	527
6	Voice recognition software.mp.	28
7	Internet survey.mp.	659
8	Computerized survey.mp.	90
9	Electronic data capture.mp.	153
10	Primary health care.mp.	64 311
11	Primary healthcare.mp.	2357
12	Primary care.mp.	74 020
13	Family practice.mp.	64 661
14	Patient-experience survey.mp.	31
15	Patient reported experience*.mp.	50
16	Patient satisfaction survey.mp.	399
17	Patient reported satisfaction.mp.	60
18	Patient reported outcome*.mp.	3560
19	Performance Measure$.mp.	6833
20	Performance assessment*.mp.	1538
21	Organizational performance assessment$.mp.	2
22	Outcomes management system*.mp.	25
23	Performance report*.mp.	414
24	Performance information.mp.	211
25	Performance indicat*.mp.	2415
26	Process measure*.mp.	1379
27	Outcome measure*.mp.	151 006
28	Quality assurance*.mp.	59 817
29	Quality control*.mp.	61 937
30	Benefit*.mp.	469 116
31	Facilitat*.mp.	330 899
32	Positive*.mp.	12 53 827
33	Advantage*.mp.	283 282
34	Merit*.mp.	28 919
35	Profit*.mp.	17 470
36	Practical*.mp.	171 774
37	Feasibility.mp.	117 073
38	Improve*.mp.	1 357 286
39	Prospect*.mp.	604 867
40	Promot*.mp.	700 054
41	Support*.mp.	8 038 586
42	Encouragment.mp.	5
43	Cost*.mp.	447 604
44	Challeng*.mp.	428 788
45	Risk*.mp.	1 659 220
46	Barrier*.mp.	179 656
47	Disadvantage*.mp.	50 287
48	Negativ*.mp.	848 842
49	Harm*.mp.	103 156
50	Obstacles.mp.	17 626
51	Hurdle*.mp.	5947
52	Obstruct*.mp.	259 125
53	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9	24 589
54	10 or 11 or 12 or 13	161 038
55	14 or 15 or 16 or 17 or 18	4076
56	19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29	276 011
57	30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42	10 204 248

Appendix A: ***Continued***

#	Searches	Results
58	43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52	3 575 853
59	53 and 54 and 55 and 56 and 57 and 58	0
60	53 and 54 and 55 and 56	0
61	53 and 55 and 56	13
62	53 and 55	32
63	53 and 54 and 56	24
64	53 and 54	233
65	53 and 56	1221
66	53 and 56 and 57	827
67	53 and 56 and 58	388
68	limit 61 to (english language and yr = '2000–Current')	13
69	limit 62 to (english language and yr = '2000–Current')	32
70	limit 63 to (english language and yr = '2000–Current')	16
71	limit 64 to (english language and yr = '2000–Current')	167
72	limit 65 to (english language and yr = '2000–Current')	846
73	limit 66 to (english language and yr = '2000–Current')	647
74	limit 67 to (english language and yr = '2000–Current')	279