Physician and Patient Willingness to Pay for Electronic Cardiovascular Disease Management

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Introduction Cardiovascular disease (CVD) is an important target for electronic decision support. We examined the potential sustainability of an electronic CVD management program using a discrete choice experiment (DCE). Our objective was to estimate physician and patient willingness-to-pay (WTP) for the current and enhanced programs.

Methods Focus groups, expert input and literature searches decided the attributes to be evaluated for the physician and patient DCEs, which were carried out using a Web-based program. Hierarchical Bayes analysis estimated preference coefficients for each respondent and latent class analysis segmented each sample. Simulations were used to estimate WTP for each of the attributes individually and for an enhanced vascular management system.

Results 144 participants (70 physicians, 74 patients) completed the DCE. Overall, access speed to updated records and monthly payments for a nurse coordinator were the main determinants of physician choices. Two distinctly different segments of physicians were identified ï one very sensitive to monthly subscription fee and speed of updating the tracker with new patient data and the other very sensitive to the monthly cost of the nurse coordinator and government billing incentives. Patient choices were most significantly influenced by the yearly subscription cost.

The estimated physician WTP was slightly above the estimated threshold for sustainability while the patient WTP was below.

Conclusion Current willingness to pay for electronic cardiovascular disease management should encourage innovation to provide economies of scale in program development, delivery and maintenance to meet sustainability thresholds.

Physician and Patient Willingness to Pay for Electronic Vascular Disease Management

1. Introduction

Electronic medical records (EMRs) have been adopted by approximately 38% of physicians in Canada and 43% of physicians in the United States.[1] Many believe that use of EMRs by physicians is necessary and inevitable. Although EMRs can improve processes of care when linked with advanced computerized clinical decision support systems (CDSS) that provide patient-specific monitoring and advice for medication or chronic disease management, they have not been shown to improve clinical outcomes.[2-4] Since they are expensive, cost-effectiveness is a significant barrier to further uptake.[5]

Cardiovascular disease is the leading cause of death in most developed nations including Canada[6] and the United States,[7] has many modifiable risk factors [8] and has good evidence for a number of lifestyle and medication treatments.[9-12] These features make cardiovascular risk reduction a prime target for interventions in primary care.

COMPETE IIIwas a pragmatic randomized trial of shared electronic cardiovascular disease and risk management for 1102 older adults with diabetes, hypertension, dyslipidemia, previous myocardial infarction or stroke.[13] The trial was anchored in community primary care in Ontario, Canada where family physicians are the initial point of contact for virtually all outpatient healthcare, are commonly funded by a mix of fee-for-service and capitation, and must select and purchase their own EMRs. The objective of COMPETE III was to optimize patient-clinician interactions with the support of the COMPETE III Cardiovascular Tracker (C3CVT) to enhance the quality, safety and efficiency of care. The C3CVT is a secure web-based display of patientsô current and previous values for each of 15 cardiovascular risk factors, the relevant target value, the last time it was checked, as well as brief advice summaries for both patients and clinicians. Color highlighting (red/yellow/green) allows rapid identification of risk factors

needing attention. Targets and advice are based on the latest guidelines and best evidence from high quality trials. Each patientôs personal tracker profile was integrated with their EMR file, usable at the point of care and available to the patient via a secure Web portal. Physicians could also easily organize practice-wide views to identify which patients needed further risk factor attention, and could call upon a clinical care coordinator to provide a brief coaching session by telephone.[13] The trial showed significant improvement in processes of recommended cardiovascular care (monitoring blood pressure, lipids, diet, exercise, etc.) patient satisfaction and self-efficacy, but did not significantly improve cardiovascular events at 12 monthôs follow-up.

Scalability and sustainability are important issues for any innovative eHealth program and are rarely formally assessed. Use of the next generation of the cardiovascular tracker program in participating practices and expansion to other primary care sites and specialty clinics requires commercialization and the provision of valuable benefits that attract subscribers. The success of most products and services depends on the usersô willingness to pay (WTP) for them. WTP research is used increasingly in health economics [14-19] for modeling various attributes of programs versus the price that patients, physicians or policy makers might be willing to pay.

While observations of people choosing objects, called revealed preference (RP) data, may be the best way to identify choices actually made, that method does not provide the most effective methods for analyzing the decision making process and deconstructing choices to determine those attributes that most strongly affect the purchase decision or ways in which subjects might choose differently if the objects were modified. Decisions to choose one among several offerings are influenced by the offerings themselves but also demographic, economic, environmental and psychological dimensions of the person choosing.

Health products and services are comprised of several components or attributes that are intended to provide benefits. Those who design products and services need to understand the relative impact of each of the attributes on patientsô and physiciansô evaluations of and choices among products. Asking questions about product attributes individually by using rating scales does not get to the essence of real-life decision making that involves whole, or conjoined, products. Almost every choice among alternative health services involves trading off the benefits of one attribute for those of others.

The conditional logit (CL) method was developed to investigate how the attributes of products, as well as characteristics of decision makers affect peopleôs choices, or stated preferences (SP).[20] Methodologies based on this research and used to investigate subjectsô preferences for services and products are interchangeably called discrete choice experiments (DCE), choice-based conjoint analysis (CBC), stated preference modeling, and conjoint analysis and have been validated.[18,21-23]

DCE are designed explicitly to make respondents consider the trade-offs that must be made at each choice situation and provide enough information to quantify the trade-offs using appropriate statistical methods. It is hypothesized that people choose the product that has the highest utility, which is a non-dimensional latent measure of the fundamental preference, appeal or attractiveness of versions of a product overall and of the levels of its attributes. DCEs have been used for health products, services and treatments [15,24-27], social challenges [28], redesigning medical education [29], and others.

Our objective was to use DCE to evaluate the scalability and sustainability of the COMPETE III cardiovascular decision support program by a) determining the utilities and relative importance

of the key attributes that determine WTP, including potential heterogeneity and b) estimating the WTP by primary care physicians and patients.

2. METHODS

The research protocol was approved by 3 independent research ethics committees -- St. Josephôs Healthcare Hamilton #04-2480, Hamilton Health Sciences #05-228, and Elizabeth Bruyere Health Centre in Ottawa. Both patients and physicians signed informed consent forms prior to their involvement in the research.

Participants were physicians practicing in Ontario, Canada who used EMRs and were recruited from participation in previous COMPETE trials and from a panel for an online healthcare recruitment company (ePocrates). Patients were recruited from a cohort of those participating in the COMPETE III trial who had given consent to be contacted for future research studies.

2.1 Focus Groups

Focus groups were conducted with EMR-using physicians and with patients to inform the specific design of the DCE. Advice was sought on the usersô perceptions of the C3CVT program, which attributes and potential enhancements should be included in the choice alternatives, potential payment ranges for various levels of service, and clarity of description of EMRs, the C3CVT program and personnel.

2.2 Discrete Choice Experiment

The entire DCE study was designed to conform to the ISPOR good research practices for conjoint analysis.[30] Two internet-based DCE surveys,[31] one for physicians and the other for patients, were designed and programmed by the investigators and executed by Research Now (http://www.researchnow.com/en-GB.aspx). We used a computer-generated randomization

procedure [32] to generate the experiment - respondents received slightly different sets of full profile combinations of attribute levels in different sequences with 20 versions and an efficiency of 96% (design variance compared to variance captured by an ideal model). Respondents considered 18 choice screens, including two fixed tasks, and selected their most preferred among three randomly selected C3CVT program alternatives. Attributes and levels are displayed in Table 1 and representative choice screens are shown in Figure 1.

Table 1: Discrete Choice Experiment Attributes and Levels for Physicians and Patients

Attribute	Description	Levels
A. Physicians		
Fee/ Month	Subscription fee for program	$15, $25, $50, $75, $100
Speed of Access to Revised Information in the Vascular Tracker	If new laboratory data or prescription information is entered in the tracker, how quickly can the tracker run the decision support algorithms (e.g., update the monitoring quality indicators) and display them to physician and patient.	5 seconds, 20 seconds, 1 minute, 1 hour, overnight
Tracker Values Displayed	Longer patient history available allows for better quality trends analysis.	Most recent visit, 2 most recent sets, 12 months' worth, 5 years' worth, complete patient history
Nurse Coordinator Tasks	Coordinator who can assist with updating tracker and communicating advice and information to and from the patient, alerts physician where an issue needs to be dealt with.	No nurse coordinator, basic functions[1] only, basic functions + inputs tracker data, basic + hold information sessions with pts. and support group sessions, basic + phones pts. to remind of visits + emails pts. to remind, basic + reminds pts.
Nurse Coordinator Payment per Month[1]	Fee paid by physician to reserve coordinator for 2 days in the office.	$0, $300, $500, $750, $1000, $1200
Efficiency in Seeing Patients	# of additional patients that can be seen per day.	½ more, 1 more, 2 more, 3 more, 4 more
Billing Incentives from Government (pay for performance	If there were incentive codes that could be used to bill for on-target monitoring processes or actual patient on-target clinical variables, how large would those incentive payments have to be to make participation in the program worthwhile?	$1000/yr, $2500/yr, $5000/yr, $7500/yr, $10000/yr
B. Patients		
Fee/ Year	Subscription fee for program.	$25, $35, $50, $100, $200
Speed of New Information added to Your Vascular Tracker	If new laboratory data or prescription information is entered in the tracker, how quickly can the tracker run the decision support algorithms (e.g., update the monitoring quality indicators) and display them to physician and patient?	1 hour, Overnight, 48 hours, 1 week, 2 weeks.
Your Individual Patient Tracker Values Displayed	Longer patient history available allows for better quality trends analysis.	Most recent visit, 2 most recent sets, 12 months' worth, 5 years' worth, complete patient history.

Nurse Coordinator Tasks/ Duties[1]	The functions that the coordinator performs when assisting with updating the tracker and communicating advice and information to and from the patient.	No nurse coordinator, basic functions[1] only, basic functions + inputs your tracker data, basic + hold information sessions with you and support group sessions, basic + phones you to remind of visits + emails you to remind, basic + reminds you.
Your Access to the Nurse Coordinator	The frequency that you will be able to contact the nurse coordinator.	No access, 1 day/ month, 2 days/ month, Once/ week, 2 days/ week, 5 days/ week
Vascular Visits to Your Physician per Year	The number of visits you may make to your physician per year for vascular issues.	1 visit/ year, 2 visits/ year, 3 visits/ year, 4 visits/ year, 6 visits/ year

[1] The basic nurse coordinator functions included assisting the physician to use the tracker effectively, helping keep the tracker information up-to-date, ensuring that action is taken to address uncontrolled vascular risk factors

Figure 1. Sample Choice Screens for Physicians and Patients

Physicians

	Choose that one COMPETE III product concept below that best meets your needs If these were your only options, which would you choose? Choose by clicking one of the buttons below:		
COMPETE III Monthly Subscription Fee that is Paid by You (for use of and updating of tracker)	$15 per month	$100 per month	$25 per month
Speed of Access to Updated Patient Information in the Vascular Tracker	1 minute	20 seconds	1 hour
Individual Patient Tracker Values Display	5 years' worth of tracker values	Complete history of tracker values	Twelve month's worth of tracker values
Nurse Coordinator Tasks	Basic functions + Nurse inputs tracker data into physician's chart	Basic functions + Nurse reminds patients about their follow-up appointments, lab tests and pharmacy renewals	No nurse coordinator
Nurse Coordinator Payment	$0 ... No payment	$300 per month for 2 days per month in office	$1,000 per month for 2 days per month in office
Efficiency: Ability to See More Patients	3 patients more per day	2 patients more per day	4 patients more per day
Billing Incentives for Using COMPETE III	$7,500 annually	$1,000 annually	$5,000 annually
	○	○	○

Patients

	Choose that one COMPETE III product concept below that best meets your needs. If these were your only choices, which would you choose? Choose by clicking one of the buttons below:		
COMPETE III Yearly Subscription Fee that is Paid by Your (for use of and updating of tracker)	$50 per year	$25 per year	$100 per year
Speed of New Information Added to your Vascular Tracker view	Overnight	1 week	1 hour
Your Individual Patient Tracker Values Displays	Complete history	12 months worth	5 years worth
Nurse Coordinator Tasks/ Duties	No nurse coordinator	Basic functions + inputs your tracker data into physician's chart	Basic functions + reminds you about your follow-up appointments, lab tests and pharmacy renewals
Your Access to the Nurse Coordinator	Once a week in office and by phone or email	2 days per week in office and by phone or email	5 days per month in office and by phone or email
Number of Vascular Visits to you Physician per year	3 visits per year	6 visits per year	4 visits per year
	○	○	○

Price was presented at five levels for physicians and patients (Table 1). Our strategy was to analyze price as piecewise linear as this allowed for more detailed investigation of pricing than would a linear price function, i.e., inflections in the price curve could be investigated. [33]

Three choice alternatives were presented per choice task.[34] Since the purpose of the DCE was to identify the best design for the next generation vascular tracker, rather than to estimate shares of preference among competing alternatives, an opt-out option was not provided. This was an unlabeled design since there were no competing products in the investigated market. The study was designed and fielded using Sawtooth Softwareôs SSI Web (CBC/Web) version 5.4.8 (http://www.sawtoothsoftware.com). The DCE choice screens were preceded by a 4 or 5 page introduction, depending on the respondent group.

Hierarchical Bayes (HB) analysis was used to estimate preference coefficients, or utilities, for each attribute of the C3CVT program and for each respondent.[35-37] Segmentation analysis was used to understand the extent and nature of heterogeneity among potential users of the cardiovascular tracker program.[16,38] Latent class analysis (LCA) helped identify segments of physicians and patients.[39]

Following our focus groups, we hypothesized that 1) lower prices would be more desired than higher prices, 2) faster speed of access to updated patient information would be preferred to slower speeds, 3) tracking more patient visits would be more desirable than fewer visits, 4) physicians would prefer greater efficiencies in seeing more patients up to a limit, 5) physicians would prefer higher government billing incentives over lower incentives, 6) patients would prefer greater access to a nurse coordinator up to a limit, 7) patients would prefer more cardiovascular visits to their physicians up to 3 to 4 visits per year, and 8) those participants who

had been part of the COMPETE III trial or who used computers more often would have stronger intentions to subscribe to an upgraded electronic cardiovascular decision support system.

The WTP calculations in this study were performed by using randomized first choice (RFC) simulations and sensitivity analyses to estimate respondent preferences for purchasing different configurations of the C3CVT program.[40-42] RFC overall preference for a proposed profile of the cardiovascular tracker program was the sum of the utilities over all attributes, including a random factor added for each attribute, plus an overall random component. This procedure is felt to more realistically represent real-life decision-making where people donât always follow fully deterministic decision sequences.

Sensitivity analyses using simulations were run for scenarios comprised of two tracker program profiles each where both were set to the lowest price, either $15/month for physicians or $25/year for patients, and all other attribute levels were identical except for that one attribute for which incremental WTP was being estimated. For example, one physician simulation profile compared overnight updating of patient information to a 1-hour updating. Sensitivity analysis of the scenario determined how much the monthly cost of the cardiovascular tracker program with the more preferred 1-hour updating could be increased before respondents would be indifferent between it and a tracker with overnight updating. WTP was judged to be the incremental price at the indifference point. Segmentation was conducted using Latent GOLD Choice 4.5 developed by Statistical Innovations (http://www.statisticalinnovations.com).[39]

3. RESULTS

3.1 Focus Groups

Three professionally facilitated focus groups were completed with a total of 29 physicians and 21 patients to help identify key attributes of the COMPETE III cardiovascular decision support program. The focus groups along with input from experts and the literature identified 7 key attributes for physicians (monthly fee, speed of access, duration of past history tracker values displayed, nurse coordinator tasks, payment for the nurse coordinator, workflow efficiency, billing incentives) and 6 for patients (monthly fee, speed of access, duration of tracker values displayed, nurse coordinator tasks, access to the nurse coordinator and number of vascular visits to your physician per year) for testing in the DCE (Table 1).

3.2 Discrete Choice Experiment

A total of 144 subjects completed the DCE -- 70 EMR-using community-based primary care physicians, 20 of whom had participated in the COMPETE III randomized trial, and 74 patients, all of whom had participated in COMPETE III. The physician group was 76.5% male with a mean age of 46.5 years, compared to the patient group with 50.4% males and a mean age of 68.9 years. Baseline demographic characteristics are shown in Table 2. The selections of choice alternatives within the two fixed tasks were not significantly different, indicating good reliability within the DCE.

Table 2. Baseline Characteristics of Participants

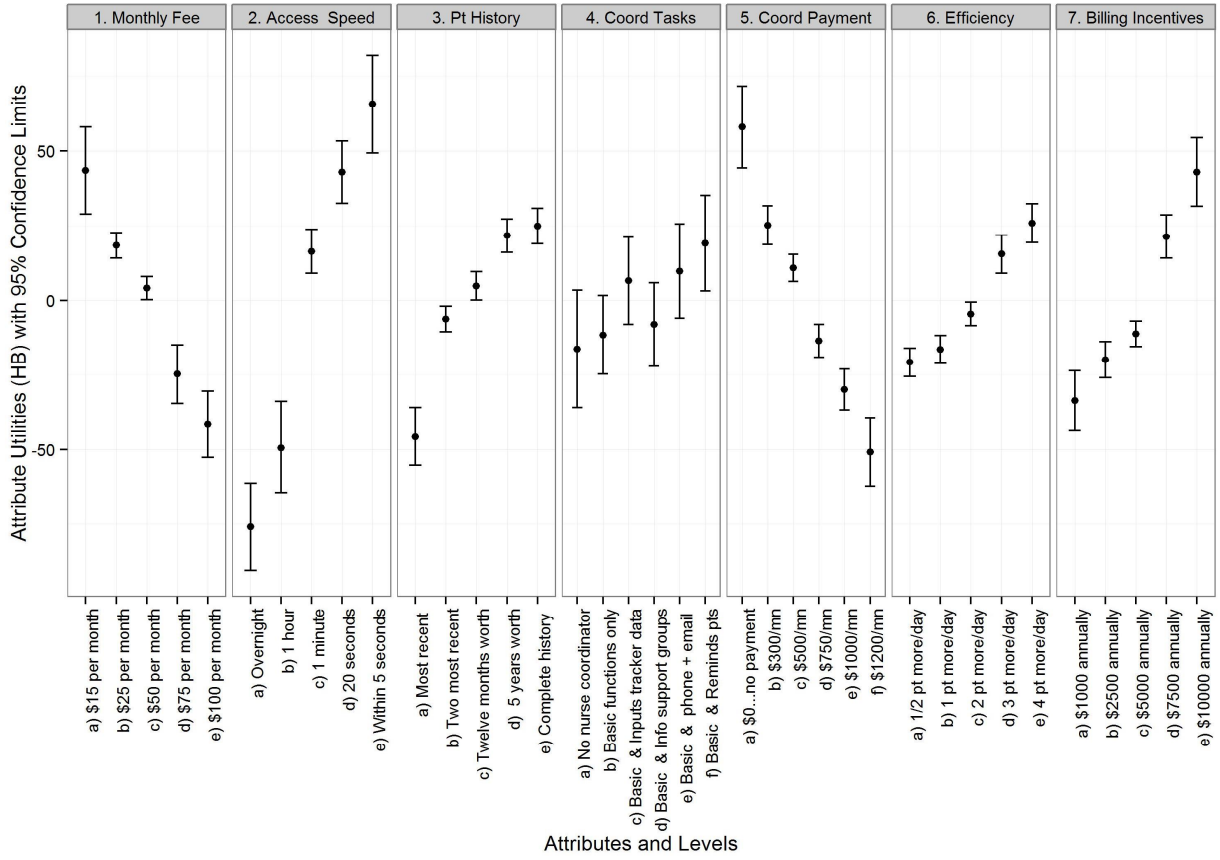
Characteristic	Physicians (n = 70)	Patients (n = 74)
Sex (% male)	76.5	50.4
Age, yr (mean (SD))	46.5 (9.4)	68.9 (7.5)
Use computers at least daily (%)	92.5	83.8
Use Internet at least daily (%)	NA*	70.3
# non-physician office staff personnel (mean (SD))	9.11 (11.9)	NA
# nurses in practice (mean (SD))	1.93 (2.3)	NA
# computers in office (mean (SD))	12.16 (17.0)	NA

*NA= not asked

Physician utilities for speed of access to updated patient information in the cardiovascular tracker spanned the greatest range, from -76 for overnight to 66 for within 5 seconds (Figure 2); this attribute had the greatest impact on respondentôs preferences. The relative importance of attributes in influencing choices in DCEs is proportional to the range of the utilities for each attribute. The utilities had an average difference of 100 between best and worst levels of attributes.[42,43]

Internal reliability was tested by comparing our findings with our *a priori* hypotheses. Physician utilities for monthly subscription fee and nurse coordinator monthly payment declined from the lowest dollar amount to the highest, as hypothesized. Utilities for access speed, duration of patient past tracker history, patient flow efficiency and government billing incentives, all increased from the lowest values to the highest - again confirming our hypotheses.

Figure 2. Physician Utilities for Attributes and 95% Confidence Limits

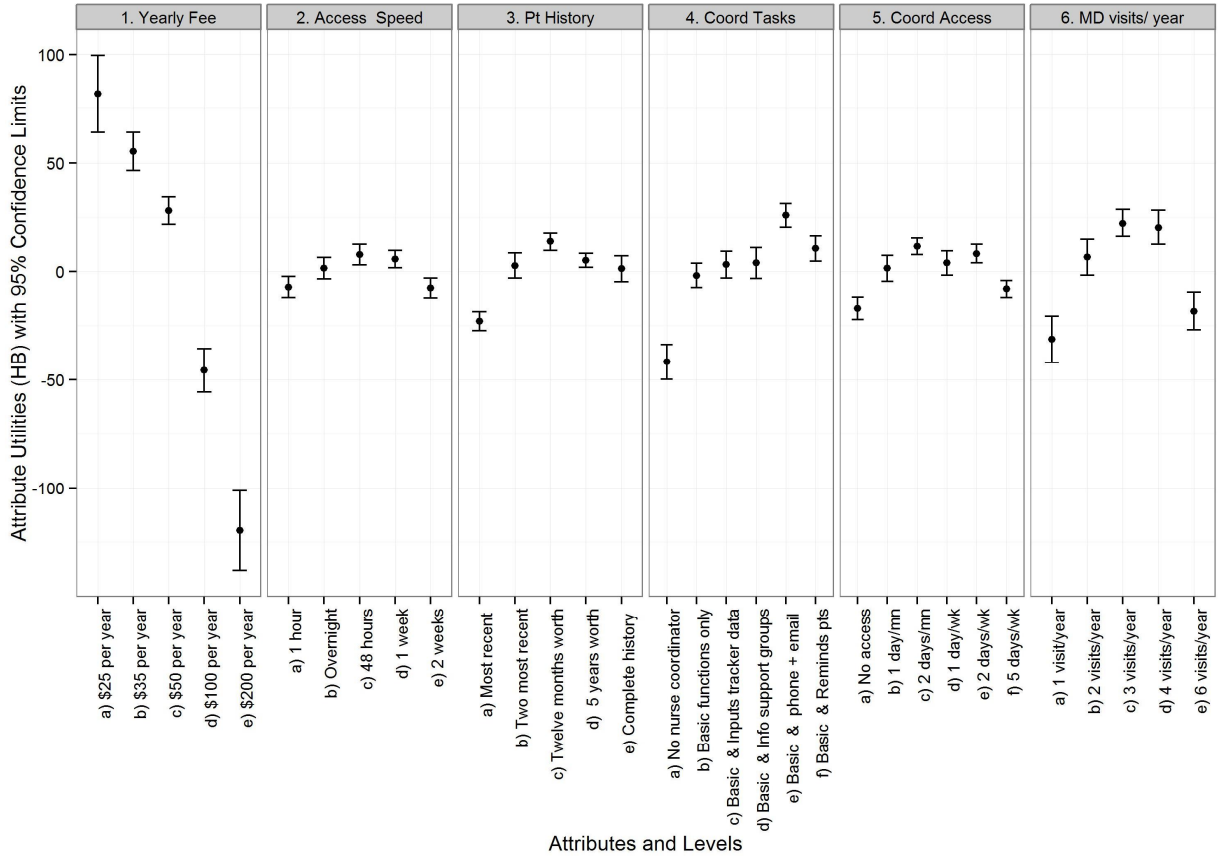


The 95% confidence limits in Figure 2 indicate that utility coefficients were statistically significant for all attributes other than nurse coordinator tasks where only the most preferred task of providing the basic functions and reminding patients of their appointments was statistically significant.

Our hypothesis that physicians who had participated in the COMPETE III trial would more likely intend to subscribe to the next generation of COMPETE was refuted (t-value=1.080). Since only 5 of the 70 physicians did not use computers daily, our hypothesis regarding the relationship between computer usage and intention to subscribe to a reconfigured and refined vascular tracker system could not be tested adequately.

Patient choices were influenced predominantly by the yearly subscription fee (Figure 3), as shown by those utilities spanning the broadest range among the attributes, from 82 for $25 per year fee to -120 for $200 yearly subscription fee. Ignoring price, the optimal configuration of the cardiovascular tracker program for patients provided 48-hour turnaround of new information, 12 monthsô worth of patient tracker historical information, the nurse coordinator providing basic functions plus staffing the phone and sending email notices, two days per month access to the nurse coordinator, and three or four cardiovascular risk management visits per year to their physicians. Patient utilities for speed of access to their new information peaked at 48 hours and faster responses had lower utilities. This pattern held for the amount of information displayed, with 12 monthsôworth having the highest utility and more information declining in appeal.

Figure 3. Patient Utilities for Attributes and 95% Confidence Limits



3.3 Physician and Patient Segments

Two significantly different physician segments, each with 35 members, were identified by LCA. Physician Segment 1 was much more influenced by the nurse coordinator monthly cost and the annual billing incentives while Segment 2 was highly sensitive to the access speed to updated patient tracker data and to the monthly fee for the vascular tracker program (Figure 4). Segment 1 physicians had a very steep utility curve for nurse coordinator monthly payments with their utility for a $300/month payment being significantly lower than their utility for no payment. In contrast, those in Segment 2 had a much flatter curve with a very small difference between their

utilities for $0/month and $300/month. The relative impacts of the attributes on physician segment preferences are shown in Table 3a.

The two segments had very similar utilities for the amount of patient history included in the tracker and the efficiency of seeing more patients per day. While Segment 1 most highly valued the nurse coordinators performing the basic tasks plus inputting the tracker data, Segment 2 most valued the basic tasks plus reminding patients of their appointments.

Segment 2 was significantly more likely to include male physicians (91% versus 63%) compared to Segment 1 ($p<0.01$). There were no statistically significant differences between the physician segments in age, participation in the COMPETE III study, or number of staff employed.

Figure 4: Physician Segments: Attribute Utilities

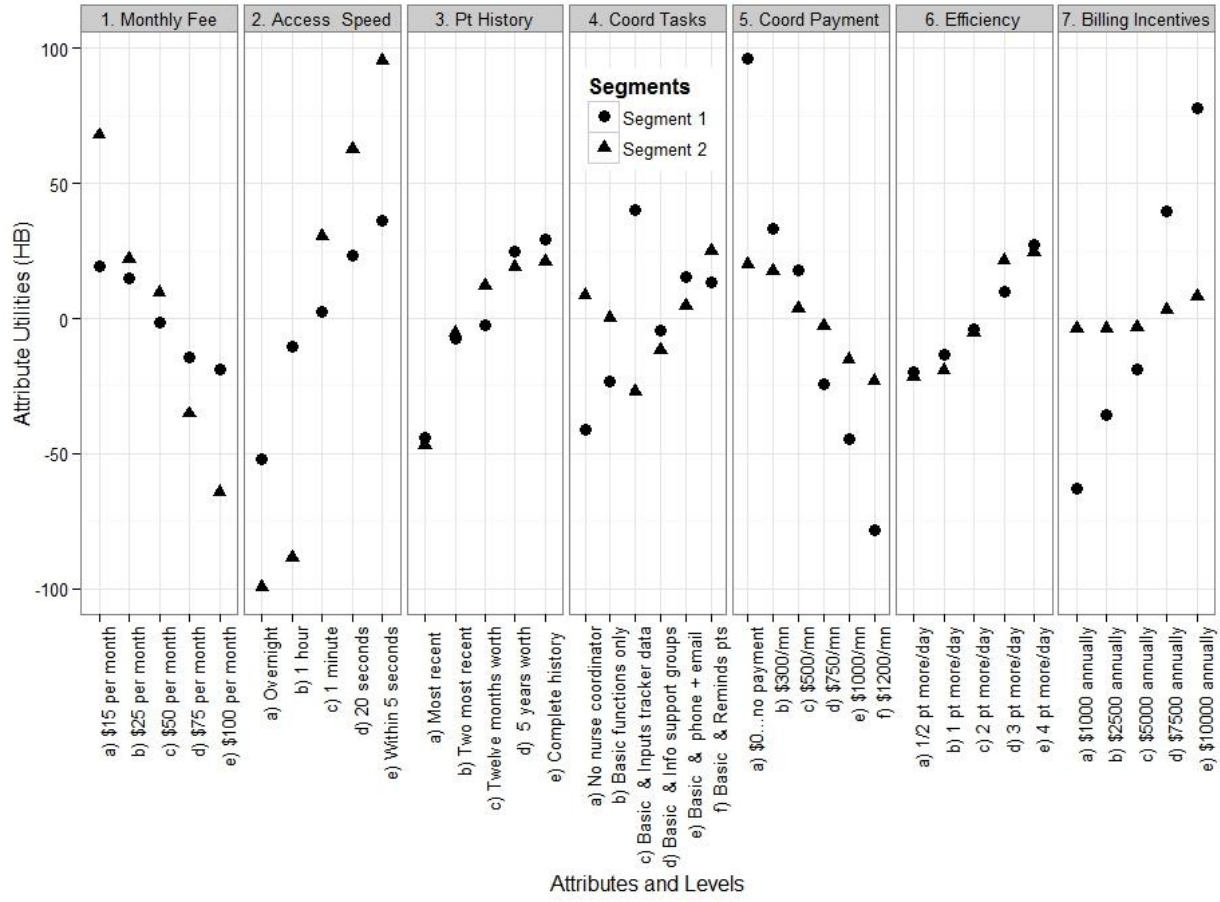


Figure 5 Patient Segments: Attribute Utilities

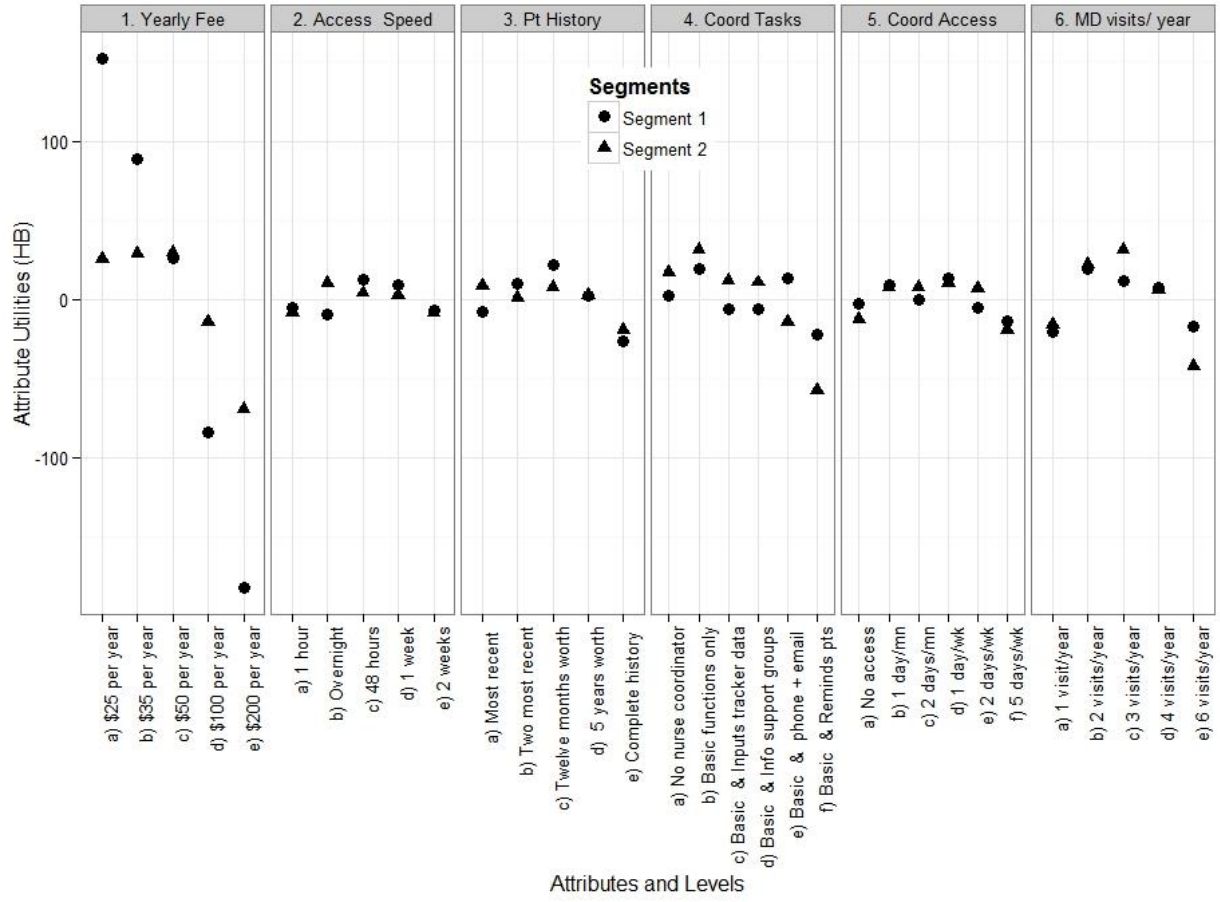


Table 3: Importance Ranking of Attributes for Physician and Patient Segments

	Segment 1	**Segment 2**
Physician Study Attributes (3a)	**Ranked Attribute Importance**	
Nurse Coordinator Payment	**1 (most)**	4
Billing Incentives for Using COMPETE III	2	*7*
Individual Patient Tracker Values Display	3	3
Speed of Access to Updated Patient Information	4	**1**
Ability to See More Patients per Day	5	5
Nurse Coordinator Tasks	6	6
Monthly Subscription Fee	*7 (least)*	2
Patient Study Attributes (3b)	**Ranked Attribute Importance**	
Yearly Subscription Fee Paid by You	3	2
Speed of New Information added to your Vascular Tracker View	*6 (least)*	*6*
Individual Patient Tracker Values Display	4	**1**
Nurse Coordinator Tasks/ Duties	**1 (most)**	3
Your Access to the Nurse Coordinator	5	5
Number of Vascular visits to your Physician per year	2	4

Two patient segments were identified, Segment 1 with 41 members and Segment 2 with 33. Segment 1 was highly sensitive to the yearly subscription price while Segment 2 showed little sensitivity from $25/year to $50/year with quite a substantial fall-off for higher fees. (Figure 5) Segment 2 had slightly greater sensitivity to the other five attributes than did Segment 1. The shapes of the utility curves were similar and relatively flat for the other 5 attributes, but there were a number of small differences between the utility coefficients for the two segments. For example, those in Segment 1 most preferred two MD visits per year while those in Segment 2 found three visits most appealing. The relative importance of attributes on preferences is shown in Table 3b. There were no significant differences between the two patient segments in sex, age, personal computer usage or internet usage. However, those in Segment 2 were significantly more likely (66.7%) to subscribe to a revised cardiovascular tracker program than were those in Segment 1 (24.4%), supported by Segment 2ôs relative lack of sensitivity to yearly prices.

3.4 Willingness to Pay (WTP)

The incremental WTP findings for each attribute in the physician study are presented in Table 4. For example, the price of a cardiovascular tracker program offering one-minute updating of patient information rather than one hour updating could be increased from a base of $15 to $67 per month before the probability of choosing the two products would be equal, yielding an incremental WTP of $52 monthly. Incremental WTP for updating in 5 seconds versus 20 seconds was $18 monthly. WTP for duties of the nurse coordinators was relatively high for three of the 5 levels, with an incremental WTP of $217 monthly for having the nurses execute the basic functions plus remind patients of appointments versus having no nurse coordinators. The incremental WTP for improved patient efficiency was only $9 monthly for seeing 4 more patients rather than 3 more patients per day.

Table 4. Incremental Willingness to Pay by Physicians & Patients for each Attribute

Physicians

Access Speed	WTP
1 hour v. Overnight	$32
1 minute v. 1 hour	$52
20 seconds v. 1 minute	$25
5 seconds v. 20 seconds	$18

Efficiency	WTP
1 more Pt/day v. 1/2 more	$4
2 more Pt/day v. 1 more	$7
3 more Pt/day v. 2 more	$9
4 more Pt/day v. 3 more	$9

Individual Patient Tracker Values Display	WTP
2 most recent v. Most recent only	$48
12 months v. 2 most recent	$6
5 years v. 12 months	$10
Complete history v. 5 years	$3

Billing Incentives	WTP
$2500 v. $1000	$9
$5000 v. $2500	$6
$7500 v. $5000	$35
$10000 v. $7500	$23

Nurse Coordinator Tasks*	WTP
Basic v. None	$34
Basic & Input Data v. None	$188
Basic & Info Sessions v. None	$33
Basic, phone, email v. None	$143
Basic & Reminders v. None	$217

*Since a categorical non-monotonic relationship, comparisons were made to a base of no nurse coordinator. Incremental WTP is based on the monthly fee for the nurse coordinator, not on monthly subscription fee.

The 'base' platform was comprised of a monthly subscription cost of $15, overnight revision of tracker information, 12 months of patient data displayed, basic nurse coordinator functions plus inputting tracker data, nurse coordinator fee of $300/ month, an efficiency level of 3 additional patients per day and a government billing incentive of $7,500 per year.

Patients

Access Speed	WTP
1 week v. 2 weeks	$6
48 hours v. 1 week	$2
Overnight v. 48 hours	-$5
1 hour v. Overnight	-$3

Efficiency	WTP
1 day/month v. No access	$7
2days/month v. 1 day/month	$4
Once/week v. 2days/month	-$5
2 days/week v. Once/week	$16
5 days/week v. 2 days/week	-$20

Individual Patient Tracker Values Display	WTP
2 most recent v. Most recent only	$9
12 months v. 2 most recent	$5
5 years v. 12 months	-$5
Complete history v. 5 years	-$15

Visits/year	WTP
2 visits v. 1	$20
3 visits v. 2	$7
4 visits v. 3	$2
6 visits v. 4	-$21

Nurse Coordinator Tasks*	WTP
Basic v. None	$17
Basic & Input Data v. None	$22
Basic & Info Sessions v. None	$18
Basic, phone, email v. None	$35
Basic & Reminders v. None	$21

* Since a categorical non-monotonic relationship exists, comparisons were made to a base of no nurse coordinator. Incremental WTP is based on the yearly subscription fee.

The 'base' platform was comprised of a yearly subscription cost of $25, overnight revision of tracker information, the two most recent sets of patient data displayed, basic nurse coordinator functions plus inputting tracker data, access to the nurse coordinator two days per month, and the ability to have four visits per year to the physician.

The COMPETE development team specified the likely configuration of a next generation cardiovascular tracker program for physicians to a) provide 1 minute updating of patient information, b) display 12 monthsô worth of patient tracker data, c) include a nurse coordinator providing the basic functions (as outlined in Table 1) plus updating tracker data and costing $750 per month, d) increasing efficiency to see two more patients per day, while e) yielding billing incentives of $5,000 per year. Physicians were willing to pay an additional $60 monthly for such a cardiovascular tracker program.

The patient incremental WTP for access to updated tracker values within 48 hours rather than one week was $2 yearly (Table 4) and the incremental WTP for overnight versus 48 hours was -$5 per year, compared to a base level of $25 per year. Patients' incremental WTP for access to their historical data peaked at 12 months of data, at three physician visits yearly, and at two days per month access to the nurse coordinator services. Incremental WTP was negative for several tracker configurations. Patient utilities declined past tracker updating within 48 hours, and were flat beyond 12 monthsô worth of their tracker data history. Overall incremental WTP for an enhanced tracker program was $39 yearly.

Developers estimated that approximately $50 per month for physicians and $50 yearly for patients, would be required to sustain the cardiovascular tracker program.

4. DISCUSSION

This study is one of the first to use DCE to estimate willingness to pay by physicians and patients for chronic disease management anchored in EMRs with computerized decision support. Our findings indicate that physicians are willing to pay for currently unavailable levels of electronic and healthcare professional-based support for cardiovascular risk reduction, if costs are modest, access is quick, a reasonable amount of historical patient data is available and their participation is supported through payment incentives. It appears that physicians are willing to pay the additional amount needed to sustain the development of the next generation of the cardiovascular tracker program. However, patientsô WTP fell short of the threshold thought to be sustainable by the COMPETE development team at the time of the study. In todayôs environment of cloud computing and other technological advances, sustainability might be more achievable.

A sustainable cardiovascular decision management program might have to pursue the two physician segments separately. For Segment 1 physicians, higher reimbursement incentives to compensate for monthly fees for the nurse coordinator and, especially, the monthly subscription fee might make the revised cardiovascular tracker program financially viable but are beyond the control of the developers. However, for Segment 2, an increase in monthly fee from $50 monthly to $75 monthly might be a significant disincentive, making it imperative for developers to hold costs while enhancing speed and function of the system. Similarly for patients, the yearly fee was the dominant determinant of interest in an enhanced tracker program and would likely not provide adequate demand at necessary sustainable prices for full pricing to patients ï but some blended pricing between physicians and patients might sustain the next generation tracker program.

4.1 Limitations

There are several limitations to our analysis. Although all participants were introduced to the cardiovascular tracker program both current and possible, those who had not participated in COMPETE III might not have had as complete understanding of the programôs functionality as did those who were in the trial. While our incremental WTP estimations assist with understanding physician and patient fee tolerance and attribute preferences, they do not determine business feasibility in terms of program development costs and full sustainability. It is difficult to know how representative our relatively small sample is of the larger physician and patient populations in Canada or internationally, where paying out-of-pocket for health services might be more (or less) common. When the revised cardiovascular tracker program is designed and made available, revealed preference data of actual subscriptions will allow for external validity testing. [22,44-46].

5. Conclusion

Our results suggest that a segment of physicians are willing to pay monthly fees that could sustain a revised electronic cardiovascular disease management program including a nurse coordinator. Patients are not generally willing to pay for a sustainable configuration of the program, but innovation around patient group support or utilization of informed peers, might move price into the sustainability range.

Authors' contributions

AH is Principal Investigator for COMPETE III. AH, KD and KK conceptualized the study, developed the questionnaire and wrote the manuscript. KD, AH and KK designed the discrete choice experiment. KD programmed the DCE , analyzed the data and conducted the segmentation. RK, KD, KK and AH designed the qualitative research and RK conducted the focus grous and summarized the findings. ST coordinated investigators and participants, and assisted with manuscript preparation.

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Statements on conflicts of interest

The authors have no conflicts of interest to report.

Summary points

What was already known on this topic:

- Electronic medical records (EMRs) and computerized decision support systems (CDSS) are used extensively in healthcare despite lack of convincing evidence that they improve patient outcomes or cost-effectiveness of care.
- Next generation EMRs and CDSS may benefit from a closer examination of preferences of physicians and patients for their attributes, and willingness to pay for future products.

What this study added to our knowledge:

- The positive WTP estimates lead us to believe that a cardiovascular disease management program such as COMPETE III Cardiovascular Tracker Program appears to add value to EMR-using physicians and their patients.
- Patients were generally not WTP a yearly fee considered adequate to keep their Web-based personal tracker access, additional physician visits, and nurse coordinator access, sustainable.

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