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FROM THE FIELD

Preconception Care: A Technology-Based Model for Delivery in the Primary Care Setting Supported by Public Health

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Abstract

Introduction To improve reproductive, maternal, and child health, preconception health (PCH) care that is innovative and generationally relevant is essential. In response, Wellington-Dufferin-Guelph Public Health (WDGPH) developed and tested an evidence-based PCH electronic intervention delivered in a primary care setting. The purpose of this study was to: (1) identify the prevalence of PCH risks among women of reproductive age, (2) determine the impact of the PCH intervention on knowledge and behaviour, and (3) assess the implementation of the intervention.

Methods The PCH intervention was designed as a cohort study using a mixed method approach. 300 women aged 15–49 years participated across seven primary care sites. The intervention was implemented using a three-part model. Participants: (1) completed a Risk Assessment (RA) on tablet with results sent to their electronic medical record, (2) discussed results with primary care providers (PCPs), (3) received handout with results and key messages. Data were collected from participants (RA and two surveys), and PCPs (interviews).

Results The RA screened for 34 PCH risk factors. The number of risks identified per participant ranged from 4 to 24, averaging 15. The majority reported a positive experience using the RA and would recommend the intervention. PCPs reported many practice benefits. The study highlights the positive influence that PCPs have around PCH.

Discussion The PCH intervention is the first of its kind in Canada. The intervention is an evidence-based population health approach that may help to improve reproductive, maternal and child health. Further research, evaluation and promotion is needed.

Keywords Preconception care · Reproductive health · Primary care · Public health · Health information technology

Introduction

Despite Canada's status as a highly developed country with an advanced health care system, poor perinatal health outcomes continue to be a national concern. Rates of preterm births, small-for-gestational age births, congenital anomalies and infant mortality have not shown any dramatic improvements in about a 10-year period (Public Health Agency of Canada 2017a). Attention is needed to address Canada's infant mortality rate, an important indicator of child health and the well-being of society. Canada's rate is considered high, fluctuating between 4.5 and 5 deaths per 1000 live births (Statistics Canada 2012–2016). According to a UNICEF report on child well-being, Canada ranked 22 out of 29 affluent nations for infant mortality. In comparison, Iceland, Slovenia, Sweden, Luxembourg and Finland were the top performing countries with rates less than 2.5 deaths per 1000 births (UNICEF Office of Research 2013). Efforts across Canada to improve these trends are imperative.

To change the trajectory of these perinatal health outcomes across Canada, a shift is needed to focus more upstream and improve the health status of women well before pregnancy. This goal can be achieved through the promotion of preconception health. Preconception health (PCH) is the *health of all individuals during their reproductive years, regardless of gender identity, gender expression or sexual orientation. It is an approach that promotes healthy fertility and focuses on actions that individuals can take to reduce risks, promote healthy lifestyles and increase readiness for pregnancy, whether or not they plan to have children one day* (Ontario Public Health Association 2014).

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PCH is impacted by many risk factors. Identifying and managing or improving these risks throughout the reproductive years is imperative to optimizing women's health and perinatal health outcomes. One risk factor of particular concern is maternal obesity. The prevalence of obesity among women in Canada is increasing and has "more than doubled in the past 10 years" (Public Health Agency of Canada 2017b, chapter 2). Obesity lowers fertility and leads to chronic medical conditions such as hypertension and type 2 diabetes that can increase the risk of adverse maternal and child health outcomes (Poston et al. 2016). Some of these adverse outcomes include: gestational diabetes, pre-eclampsia, early pregnancy loss, congenital fetal anomalies, premature birth and stillbirth (Poston et al. 2016). Other PCH risk factors of concern that may impact fertility and maternal and child birth outcomes are related to: genetics, age, chronic medical conditions, infectious diseases, mental health, reproductive and sexual health, medications, vaccinations, nutrition, physical activity, substance use and environmental health (Ontario Public Health Association 2014).

While a comprehensive system level approach to PCH care is recommended to increase awareness of preconception health, it currently does not exist in Canada (Ontario Public Health Association 2014). Rather than preconception care, reproductive health strategies have traditionally focused on pregnancy and labour and delivery care (Ontario Public Health Association 2014). Waiting until pregnancy to assess, manage and improve one's health status may be too late to prevent exposures to risk factors. The first weeks in pregnancy are the most critical for a developing baby and often women are not aware of being pregnant this early. Furthermore, simply focusing on individuals planning a pregnancy is not enough since approximately half of all pregnancies are unplanned (Filner and Zolna 2011). Focusing on women's health throughout the reproductive years and addressing risks well before conception is necessary to improve future maternal and child birth outcomes (Frayne 2017).

To address gaps in PCH care, Wellington-Dufferin-Guelph Public Health (WDGPH) developed and tested a promising PCH intervention. This innovative technology-based PCH intervention was delivered in a primary care setting. The publicly funded healthcare system in Canada positions the primary care sector as an effective setting to reach women of reproductive age for the delivery of PCH care. In 2016, the majority (85%) of women ages 18–49 years in Canada had a regular medical doctor and the majority (79%) had contact with a medical doctor in the last 12 months (Statistics Canada 2016).

The objectives of the study were to: (1) identify the most prevalent PCH risk factors in the WDGPH area, (2) determine the impact of the PCH intervention during primary care provider (PCP) visits on PCH knowledge and behaviour among women of reproductive age, and (3) assess the implementation of the intervention.

Methods

WDGPH developed a comprehensive, evidence-based, patient-driven PCH risk assessment (RA) tool designed to assess 17 PCH content areas (Table 1) that screens for 34 PCH risk factors (Table 2). In partnership with Boston Medical Centre, the PCH intervention was adapted from *The Gabby Preconception Care System* for use in the Canadian primary care context (Jack et al. 2015). The 2008 Supplement on the Clinical Content of Preconception Care in the *American Journal of Obstetrics and Gynecology* was a key guiding document in the development process (Jack et al. 2008). The RA tool was digitized and programmed for data collection and electronic medical record (EMR) integration through a health information technology platform called *Ocean* by a Toronto-based company CognisantMD.

The PCH intervention was initiated during regular PCP visits as an add-on to participants' already scheduled appointments. Office administration staff or nurses provided tablets to participants. The intervention was implemented using a three-part model (Fig. 1) which involved: (1) participants completing the RA tool on a tablet in their PCP office waiting room or exam room, with results automatically integrating into their EMR; (2) PCPs discussing results with participants during their scheduled appointment; and (3) participants receiving a customized handout generated from the EMR and printed in the PCP office that summarizes results and provides PCH messages to take home.

Table 1 PCH content areas found in the RA tool

PCH content areas
Body mass index
Genetic/family history
Immunizations
Infectious diseases
Medical history
Medication exposures
Mental health history
Nutrition
Oral health
Physical activity
Pregnancy intention
Reproductive history
Sexual health history
Stress
Substance use
Violence/abuse

Table 2 Prevalence of PCH risk factors among participants

#	PCH risk factors	n	%
1	Canada's food guide not met	296	99
2	Consumption of unsafe foods and caffeine	294	98
3	Has been stressed in the past year	277	92
4	Had a drink of alcohol in the past year	268	89
5	Not up-to-date with immunizations	261	87
6	Family history of genetic conditions or diseases	247	82
7	Does not take folic acid supplement or multivitamin with folic acid daily	227	76
8	Family history of emotional health conditions	226	75
9	Has or ever has had an emotional health condition	194	64
10	Has had more than three alcoholic drinks at one time in the last year	183	61
11	Takes medications (prescription or over-the-counter)	179	60
12	Was exposed to second-hand tobacco smoke in the last year	156	52
13	Body mass index is not in a healthy range	152	50
14	Takes other vitamin or mineral supplements	133	44
15	Have or has had a reproductive health issue	126	42
16	Has or ever has had a medical condition	113	37
17	Has had little interest or pleasure in doing things and/or felt down, depressed or hopeless	99	33
18	Never been tested for a sexually transmitted infection	97	32
19	Has been physically, sexually, or emotionally abused as child, teen, or adult	96	32
20	Does not get enough physical activity	93	31
21	Uses natural/home remedies, herbal products weight loss or athletic products	92	31
22	Plans to travel to Africa, Asia, Caribbean, Central America, South America, Eastern Europe or the South Pacific in the next year	83	28
23	Has felt nervous, anxious, or on edge and/or has not been able to stop or control worrying	78	26
24	Has smoked and/or used tobacco in the last year	70	23
25	Avoids foods for cultural, religious, or health reasons	63	21
26	Has ever been treated for a sexually transmitted infection	61	20
27	Has not been to the dentist in the last year	61	20
28	Exposed to environmental hazards where they live, work, or play	59	20
29	Used illegal/street drugs or prescription medications that were not prescribed to them in the last year	53	18
30	Has or has had an infectious disease	37	12
31	Would like to become pregnant under age 20 or over age 35	27	9
32	Does not use birth control (but is sexually active)	27	9
33	Has been abused in the past year	18	6
34	Spouse/partner may be a blood relative	1	< 1

The PCH intervention was designed as a cohort study and used a mixed method approach. The intervention was studied across seven primary care sites in the Wellington, Dufferin, Guelph (WDG) area in Ontario, Canada in 2016.

WDGPH facilitated connections between primary care sites and the technology company to ensure registration, installation and use of the Ocean platform. WDGPH offered a one-time information session to primary care sites to review and test the intervention model and provided ongoing support throughout the study period.

Primary care sites recruited participants using a random approach. Eligibility criteria included: female, 15 to 49 years of age, not pregnant, able to become pregnant (no hysterectomy), able to read and write English, comfortable using a tablet, having an email address, and living in WDG area. Participants were offered a $10 Canadian gift card incentive.

Data were collected from participants through the RA tool and a series of evaluation tools. The RA tool data were stored in *Ocean Studies*, a research and survey module on the *Ocean* platform. One-week and two-month online follow-up surveys were emailed to participants. These surveys evaluated the RA tool and the patient handout, asked participants about their experience discussing PCH results with their PCP, and evaluated participants' knowledge and behaviour change related to the identified PCH risk factors.

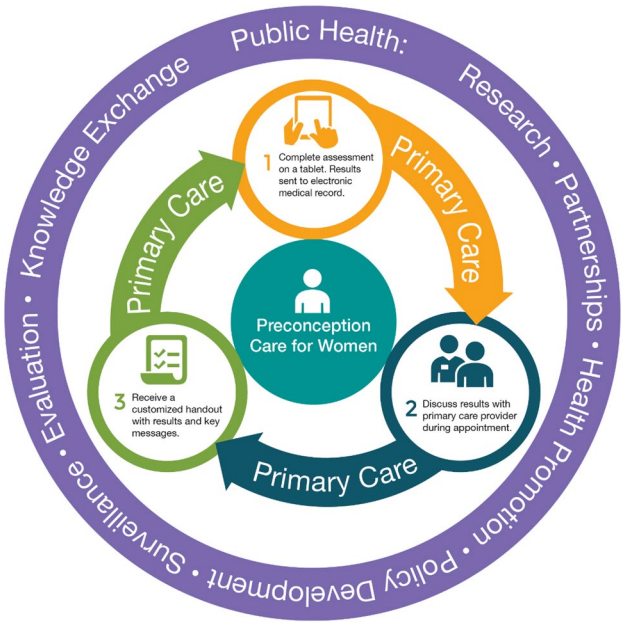

Fig. 1 An innovative and comprehensive model to deliver preconception care in the primary care setting supported by Public Health

Key informant interviews were also conducted with research sites to identify the benefits, challenges and sustainability of implementing the intervention. All participants gave their informed consent via tablet prior to their inclusion in this study. This study was approved by WDGPH's Research Ethics Committee and performed in accordance with its ethical standards.

Results

Preconception Risk Assessment

A total of 300 participants completed the RA prior to their PCP visit. Participant demographics are presented in Table 3. Chi square testing revealed no significant differences in the demographics of the respondents who completed the one-week and two-month surveys and the population that was screened. Of the 34 PCH risk factors, the number identified per participant ranged from 4 to 24 with an average of 15. The five most prevalent risk factors identified were: *Canada's Food Guide* not followed

Table 3 Participant demographics

Participant demographics		Risk assessment	1-Week survey		2-Month survey	
		Risk assessment completed	Survey 1 completed	Survey 1 not completed	Survey 2 completed	Survey 2 not completed
Number of participants		300	188	144	144	156
Age	15–29	37 (12%)	16 (9) %	21 (19%)	16 (11%)	21 (13%)
	20–34	167 (56%)	103 (55%)	64 (57%)	79 (55%)	88 (56%)
	35+	91 (30%)	64 (34%)	27 (24%)	46 (32%)	45 (29%)
	No answer	5 (2%)	5 (3%)	0	3 (2%)	2 (1%)
Education	College/university degree or diploma	178 (59%)	124 (66%)	54 (48%)	91 (63%)	87 (56%)
	Some college/university credits	46 (15%)	22 (12%)	24 (21%)	14 (10%)	32 (21%)
	High school diploma or GED	44 (15%)	30 (16%)	14 (13%)	26 (18%)	18 (12%)
	Some high school credits	31 (10%)	11 (6%)	20 (18%)	13 (9%)	18 (12%)
	Not sure	1 (0.3%)	1 (0.5%)	0	0	1 (0.6%)
Income	$19,999 or less	38 (13%)	16 (9%)	22 (20%)	12 (8%)	26 (17%)
	$20,000–$39,999	36 (12%)	21 (11%)	15 (13%)	14 (10%)	22 (14%)
	$40,000–$79,999	74 (25%)	54 (29%)	20 (18%)	42 (29%)	32 (21%)
	$80,000 or more	99 (33%)	63 (34%)	36 (32%)	49 (34%)	50 (32%)
	Not sure	52 (17%)	33 (18%)	19 (17%)	26 (18%)	26 (17%)
	No answer	1 (0.3%)	1 (0.5%)	0	1 (0.7%)	0
Geography	Urban	130 (43%)	79 (42%)	51 (46%)	59 (41%)	71 (46%)
	Rural	124 (41%)	84 (45%)	40 (37%)	69 (48%)	55 (35%)
	Other	44 (15%)	24 (13%)	20 (36%)	15 (10%)	29 (19%)
	No answer	2 (0.7%)	1 (0.5%)	1 (0.9%)	1 (0.7%)	1 (0.6%)

(99%), consumption of unsafe foods and caffeine (98%), stress in the past year (92%), consumption of alcohol in the past year (89%), and immunizations not up-to-date (87%) (Table 2). Important risks were also identified regarding family planning. The RA identified that 14% of participants reported wanting to become pregnant after age 35; and 24% of participants who had been sexually active and did not want to become pregnant were not using birth control.

One-Week Survey

Of the 300 participants who completed the RA, 188 (63%) completed the one-week survey. Overall, the majority of participants indicated that they would recommend the PCH intervention to a female friend (72%).

Risk Assessment—The majority of participants reported having a positive experience using the RA, including that the RA was clear and easy to understand (99%), they enjoyed using a tablet (97%), they felt comfortable answering the questions (89%), they enjoyed completing the RA before their PCP appointment (90%), and they felt motivated to make positive changes to their health after completing the RA (56%). Furthermore, the majority of participants estimated that it took 5–10 min to complete the RA (57%), and they felt the length of time to complete the tool was good (91%).

PCP Discussion—Of the participants who completed the one-week survey, 86 (46%) reported having a discussion with their PCP about their RA results. PCP discussions were conducted by physicians (57%), nurse practitioners (24%) and nurses (14%). The majority of participants reported that completing the RA before their appointment made it easier to have a conversation with their PCP (65%). The majority were also motivated to make positive changes to their health after having a conversation about their results with their PCP (59%). Of participants who remembered the number of health topics discussed with their PCP, the most frequently reported number was two health topics. The majority of all participants also reported that they did not have a follow-up appointment booked with their PCP to continue discussions about their RA results (93%).

Patient Handout—Of the participants who completed the one-week survey, 164 (87%) reported receiving the patient handout. Of the participants who received the patient handout, 130 (79%) reported reading the patient handout. The majority of participants who read the handout reported that they liked receiving a patient handout (82%), and they found the resource clear (98%) and helpful (85%). More than half also learned something new about their health (57%) and were motivated to make positive changes to their health (59%).

Two-Month Survey

Of the 300 participants who completed the RA, 144 (48%) completed the two-month survey. The majority of participants reported that they learned the importance of talking to their PCP about life-long health needs (72%), and how their health now affects their own future health and the health of their future children (51%). Some participants also reported learning about new health concerns that they did not know they had before (36%). The majority of participants were motivated by the study to learn more about their health or to make positive changes to their health (63%).

Key Informant (KI) Interviews

KI interviews were conducted with primary care staff (n = 7) at four of the six research sites. Most KIs reported benefits to the clinic and to patients from participating in this study, including: being introduced to the Ocean technology, connecting the tablet to the EMR system, having the results well-displayed and easy to find in the EMR, having the ability to generate a customized patient handout, gaining new and easy opportunities to learn more about patients and their risk factors, having new opportunities to provide health teaching, and increasing the profile of PCH within the clinic. KIs also provided valuable feedback about the challenges they experienced with study implementation, including: time, length of the RA and patient handout, participant recruitment, and some technological issues around internet connectivity and printing the patient handout. KIs' main suggestions for changes to the model included: shortening the RA and patient handout, offering the intervention at specific appointment types (e.g., physical examinations, sexual health, and family planning appointments), scheduling adequate time during the PCP appointment to complete the RA and address risk factors, and continuing to collaborate with primary care for future development and implementation. All KIs reported that they would consider using the intervention in the future, if their suggested changes were made to the model.

Discussion

The PCH intervention is the first patient-driven electronic risk assessment tool developed in Canada. The development represents an important step towards standardizing PCH care in the primary care setting. This research contributes to the growing momentum and interest in exploring how addressing PCH can lead to improved reproductive, maternal and child health outcomes.

This research study provided insight into the prevalence of PCH risks factors among women of reproductive age and

insight into the implementation of the intervention model. Unfortunately, the study did not allow the research team to determine the impact of the intervention on PCH knowledge and behaviour change. Specific limitations included participant attrition, high non-response rates to some questions and recall bias at the two-month survey. Inconsistent model implementation across research sites was another limitation. The intervention was designed for PCPs to discuss the RA results with participants, however only 46% of participants indicated having this interaction. Furthermore, an average of 15 PCH risks were identified per participant, yet two risks were most frequently discussed during the PCP appointment, and only 6% of participants had a follow-up appointment booked. These findings may have contributed to the number of participants who reported not being motivated to change their behaviours. Building in a mechanism that ensures consistent model implementation, prioritizes identified risks based on risk level and participant interest or concerns, and sends a reminder about booking follow-up appointments to ensure that identified risks continue to be addressed over time is important in future iterations.

While the primary care sector is a promising setting for the PCH intervention, improvements are needed. Ontario's fee-for-service model lacks a specific billing code or incentive for PCH care. This gap leads to inconsistencies in the provision of PCH care and in the selection of the appointment type that is best suited to provide PCH care. Advocacy at a system level is needed to make PCH care routine. Having a designated billing code or incentive for PCPs may help to ensure there is adequate time and compensation for PCPs to deliver PCH care.

The PCH study represents an innovative and upstream PCH model implemented in a primary care setting that is supported by Public Health. Overall, study findings highlight the positive influence that PCPs have at increasing PCH risk awareness and at motivating women to make behaviour changes. More research is still needed. Recommendations include revising the model based on participant and KI feedback, undertaking a validation study, and conducting a randomized control trial to further assess the implementation of the model and understand its impact on PCH knowledge and behaviour change. Expanding the model to community settings and other populations, such as men and youth, is also recommended.

PCH awareness gaps continue to exist at both the individual and health system levels. Until these gaps close, a model that allows for routine care in the primary care setting that is supported by public health has been shown to be a promising approach to improve reproductive, maternal and child health outcomes.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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