



## Original Article

# Designing a Multidisciplinary Cardio-obstetrics Curriculum for General Cardiology and Obstetrics Residents: A National Survey of Educational Needs

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### ABSTRACT

**Background:** The increasing and potentially preventable cardiac events in pregnant patients have led to calls to enhance multidisciplinary cardio-obstetrics education. To design a multidisciplinary cardio-obstetrics curriculum for general cardiology and obstetrics and gynecology (OBGYN) residents, we need to define educational needs from the perspectives of both cardiology and OBGYN residents. Our study characterizes the educational needs of Canadian cardiology and OBGYN residents.

**Methods:** Canadian cardiology and OBGYN residents were surveyed on clinical exposures, perceived needs for topics, unperceived needs for topics (multiple-choice questions) and preferences for educational

### RÉSUMÉ

**Contexte :** L'augmentation du nombre d'événements cardiaques potentiellement évitables chez les patientes enceintes a conduit à des appels pour renforcer la formation multidisciplinaire en cardio-obstétrique. Afin de concevoir un programme d'études multidisciplinaires en cardio-obstétrique pour les résidents en cardiologie générale et en obstétrique et gynécologie (OBGYN), nous devons définir les besoins éducatifs du point de vue des résidents en cardiologie et en OBGYN. Notre étude caractérise les besoins éducatifs des résidents canadiens en cardiologie et en OBGYN.

**Méthodes :** Les résidents canadiens en cardiologie et en OBGYN ont été interrogés sur leurs expositions cliniques, les besoins perçus et non

### Lay Summary

*Heart-related complications of pregnancy are increasing. Approximately one-half of these complications are preventable with increased provider knowledge. We surveyed Canadian cardiology and obstetrics and gynecology residents on their perceived knowledge gaps relating to cardiac complications of pregnancy. Residents in both specialties identified broad knowledge gaps and limited exposure to pregnant patients with heart issues. This study highlights the value of a supplementary curriculum on diagnosis and treatment of heart-related complications of pregnancy.*

The increasing cardiovascular morbidity and mortality in pregnant patients have prompted calls for enhanced multidisciplinary cardio-obstetrics training.<sup>1-3</sup> Care of pregnant patients is commonly delivered in multidisciplinary teams of

cardiologists, obstetricians, maternal-fetal medicine specialists, obstetric internists, and specialized nurses, in addition to other health professionals depending on the care needs of the patient. This team context requires a shared understanding of principles of caring for pregnant patients with heart disease and skills for effective collaboration in multidisciplinary teams, as well as specialty specific content expertise. A recent American survey of cardiologists and cardiology trainees provides some insights about cardio-obstetrics education.<sup>4</sup> This survey identified that current clinical exposure of American cardiology trainees to pregnant patients with heart disease is limited. Consequently, broad educational needs were identified, including medication safety and management of cardiac disorders.<sup>4</sup> Although this study was the first to assess educational needs in cardio-obstetrics, it focused on a single discipline. To inform the design of a multidisciplinary cardio-obstetrics curriculum, we must understand the educational needs from the perspectives of cardiology and obstetrics and gynecology (OBGYN) health care providers.

The current study focused on the educational needs of cardio-obstetrics topics relevant to general cardiology and OBGYN residents. The findings, along with perspectives from

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formats. High priorities were defined as  $\geq 50\%$  of responses indicating a perceived need or  $\geq 50\%$  indicating an unperceived need.

**Results:** A total of 154 residents participated (cardiology  $n = 44$ , OBGYN  $n = 110$ ). Residents reported insufficient clinical exposure to nearly all cardiac disorders, with 33% of exposures occurring in multidisciplinary contexts. All topics aside from gestational hypertension were rated as high priority on perceived needs by both specialties. High-priority unperceived needs were congenital heart disease (both specialties), pre-existing acquired heart disease (both specialties), medication safety (OBGYN), peripartum management (OBGYN), and pregnancy-related heart disease (OBGYN). Cardiology and OBGYN residents shared preferences for in-person simulation, virtual simulation, and online modules.

**Conclusions:** Residents in both specialties reported low clinical exposure to most cardiac disorders during pregnancy, identified high-priority perceived needs in multiple topics, and shared 2 high-priority unperceived needs. OBGYN residents identified 3 additional high-priority unperceived needs. These data can inform design of multidisciplinary cardio-obstetrics curricula for general cardiology and OBGYN residents.

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faculty, can inform design of a multidisciplinary cardio-obstetrics curriculum consisting of both shared and specialty-specific curricular activities.

## Materials and Methods

We conducted a national, online, cross-sectional end-user centered educational needs assessment employing an online survey (Qualtrics, Provo, UT). We invited all Canadian cardiology and OBGYN training program directors to distribute the survey to residents in their training programs, encompassing all 31 cardiology ( $n = 15$ ) and OBGYN ( $n = 16$ ) residency programs in Canada. Surveys were anonymous and completed between April 2022 and June 2023. Participants received \$50 gift cards as compensation for their time.

### Survey design

The aim of the survey was to define the learner perspective of the current exposures to cardio-obstetrics and the educational needs of general cardiology and OBGYN residents. The findings could be used to inform a core curriculum for general cardiology and OBGYN residents. From the outset, we recognized that there might be some topics suitable for shared curricular activities and other topics best delivered by specialty-specific instruction. The educational needs of other health professionals (maternal-fetal medicine fellows, obstetric medicine fellows, nurses, midwives, and others) and the faculty perspectives on the educational needs are beyond the scope of this survey.

The survey consisted of 5 sections: demographics and current clinical exposures, perceived needs, unperceived needs, prompted needs, and preferences for educational formats.

perçus en matière de thématique à aborder (questions à choix multiples) et leurs préférences en matière de formats éducatifs. Les priorités élevées ont été définies comme représentant  $\geq 50\%$  des réponses indiquant un besoin perçu ou  $\geq 50\%$  indiquant un besoin non perçu.

**Résultats :** Cent cinquante-quatre résidents ont participé (cardiologie  $n = 44$ , OBGYN  $n = 110$ ). Les résidents ont signalé une exposition clinique insuffisante pour presque tous les troubles cardiaques, 33 % des expositions se produisant dans des contextes multidisciplinaires. Toutes les thématiques, à l'exception de l'hypertension gestationnelle, ont été jugées hautement prioritaires en ce qui concerne les besoins perçus par les deux spécialités. Les besoins non perçus comme hautement prioritaires comprenaient les cardiopathies congénitales (les deux spécialités), les cardiopathies acquises préexistantes (les deux spécialités), la sécurité des médicaments (OBGYN), la gestion du périmpartum (OBGYN) et les cardiopathies liées à la grossesse (OBGYN). Les résidents en cardiologie et en OBGYN partageaient des préférences pour les simulations en personne, les simulations virtuelles et les modules de formation en ligne.

**Conclusions :** Les résidents des deux spécialités ont rapporté une faible exposition clinique à la plupart des troubles cardiaques pendant la grossesse, ont identifié des besoins perçus comme hautement prioritaires dans plusieurs domaines, et ont partagé 2 besoins non perçus comme hautement prioritaires. Les résidents en OBGYN ont identifié 3 autres besoins non perçus comme hautement prioritaires. Ces données peuvent éclairer la conception de programmes d'études multidisciplinaires en cardio-obstétrique pour les résidents en cardiologie générale et en OBGYN.

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The survey ([Supplemental Appendix S1](#)) was developed by cardio-obstetrics experts (S.C.S., G.E., S.B.), with the design informed by a published end-user-centred framework for conducting online educational needs assessments.<sup>5</sup> The end-user perspective is paramount to identifying educational needs because expert-developed curricula may lack or under-emphasize content that is foundational for individuals with less content expertise.<sup>6</sup> Accordingly, best practices for developing educational resources recommend a needs assessment be conducted before the curriculum is developed.<sup>6</sup> The end-user-centred framework we used incorporates both subjective and objective processes for identifying educational needs.<sup>5</sup> Perceived needs and prompted needs represent subjective perspectives from the respondents, and unperceived needs represent an objective perspective.<sup>5</sup> This published framework for identifying educational needs from the user perspective has been used in hematology<sup>5</sup> and emergency medicine<sup>7</sup> domains. Faculty perspectives are also valuable in defining educational needs<sup>6</sup> and could complement the data identified in this study.

**Content of exposures and cardio-obstetrics topics.** Given the lack of robust, validated tools for assessing cardio-obstetrics educational needs, selection of common cardiac disorders during pregnancy and cardio-obstetrics topics were informed by the Competencies for Cardiology<sup>8</sup> and Obstetrics and Gynecology<sup>9</sup> as outlined by the Royal College of Physicians and Surgeons of Canada, input from cardio-obstetrics experts (cardiology: S.C.S., S.B.; maternal-fetal medicine: G.E.), topics elaborated in recent publications on cardio-obstetrics education<sup>4,10</sup> and frequency of the disorder reported in large cohorts of pregnancies in patients with heart disease (Cardiac Disease

in **Pregnancy II [CARPREG II]**<sup>11</sup> and **Registry of Pregnancy and Cardiac Disease [ROPAC]**<sup>12</sup>). We aimed to include disorders and topics applicable to general cardiology and general OBGYN residents, prioritizing disorders and topics in which management requires content knowledge from both cardiology and OBGYN providers. We recognized that some cardio-obstetrics topics are applicable to both specialties, and other topics require specialty-specific knowledge. There was consensus between 2 cardiologist experts (S.C.S., S.B.) and 1 maternal-fetal medicine expert (G.E.) on the included common cardiac disorders and cardio-obstetrics topics. We surveyed regarding exposures to 9 common cardiac disorders of pregnancy: peripartum cardiomyopathy (PPCM), spontaneous coronary artery dissection (SCAD), pre-existing systolic dysfunction, pre-existing arrhythmias, pulmonary hypertension, pre-existing acquired heart disease, congenital heart disease, maternal cardiac arrest, acute heart failure, acute arrhythmias, and hypertensive disorders. We surveyed about educational needs relating to 12 cardio-obstetrics topics: medication safety, safety of investigations, pre-existing congenital heart disease, pre-existing acquired heart disease, arrhythmias, hypertensive disorders, maternal cardiovascular risk, obstetric and fetal risks, antepartum management, peripartum management, cardiac arrest and pregnancy related heart disease (encompassing questions on PPCM and SCAD). Because of the scope of the survey and the intended focus on general cardiology and OBGYN residents, some more rare conditions (eg, rarer arrhythmias such as congenital long QT syndrome) and adverse pregnancy outcomes were not included.

**Current exposures.** We surveyed residents on current exposures to common cardiac disorders in pregnancy and whether these exposures occurred in a multidisciplinary context.

**Educational needs.** We captured data on perceived needs, unperceived needs, and prompted needs on the 12 cardio-obstetrics topics.

Perceived needs are needs that individuals are able to identify—either as self-assessed gaps or interests.<sup>13</sup> In the perceived needs section, we asked residents to indicate if they perceived they needed to learn more about 12 cardio-obstetrics topics.

Unperceived needs were knowledge gaps identified using multiple-choice questions. Residents answered 15 multiple-choice questions on the 12 cardio-obstetrics topics. Some questions tested multiple topics ([Supplemental Appendix S1](#)). To ensure the questions were appropriate for both specialties and encompassed the 12 cardio-obstetrics topics, the questions were written with input from 2 cardiologist experts (S.C.S., S.B.) and 1 maternal-fetal medicine expert (G.E.).

Prompted needs were knowledge gaps identified through describing a difficult case. In the prompted-needs section, we asked residents to describe difficult cases that they have experienced.

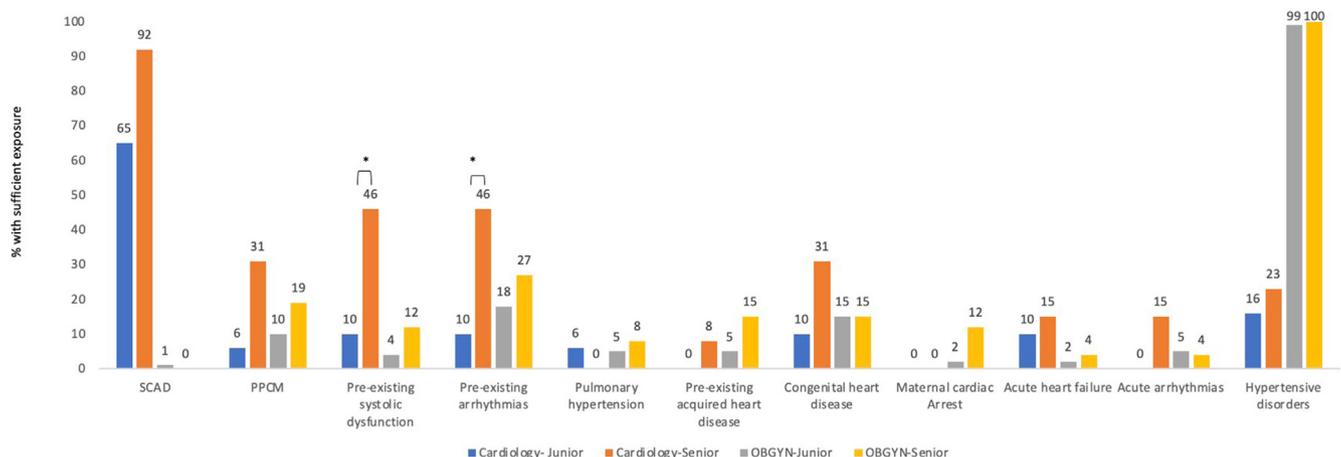
**Preferences for educational formats.** Residents indicated their preferences of in person and virtual educational formats.

## Analysis

Descriptive statistics were calculated for demographics, current exposures, and preferences for educational formats.

In the educational needs section, outcomes were the perceived needs (what residents thought they needed to learn more about), unperceived needs (identified through multiple-choice questions), and prompted needs (identified through describing a difficult case).

We used established cut-offs from a published end-user-centred educational needs assessment process to define high-, moderate-, and low-priority topics in the unperceived and perceived needs sections.<sup>5</sup> A high-priority topic was defined as a perceived need when  $\geq 50\%$  of participants indicated that it was a perceived need or answered the multiple-choice questions incorrectly. A moderate-priority topic was a topic in which 31% to 49% of participants indicated that it was a perceived need or answered a multiple-choice question incorrectly. A low-priority topic was a topic in which  $< 30\%$



**Figure 1.** Current exposures to cardiac disorders in pregnancy for each specialty. Aside from hypertensive disorders for OBGYN residents and SCAD for cardiology residents, a low proportion of cardiology and OBGYN residents had sufficient exposure to cardiac disorders of pregnancy. \*Statistically significant difference. OBGYN, obstetrics and gynecology; PPCM, peripartum cardiomyopathy; SCAD, spontaneous coronary artery dissection.

of participants indicated that it was a perceived need or answered a multiple-choice question incorrectly. These cut-offs have been used in a previous educational needs assessment relating to hematology topics.<sup>5</sup>

In assessing differences among training levels, we defined final-year residents in cardiology as postgraduate year (PGY) 6, in OBGYN as PGY5, and junior residents as all other years of training. Of note, there are no PGY 1, 2, or 3 residents in cardiology, as residents enter cardiology training programs in PGY 4 in Canada.

We used Chi square tests to compare sufficient exposures to common cardiac disorders between junior and final-year cardiology residents, sufficient exposures to common cardiac disorders between junior and final-year OBGYN residents, and the proportion of junior and final-year residents desiring to learn more about each cardio-obstetrics topic in the perceived-needs section. Independent sample Mann-Whitney U tests were used to compare unperceived needs between junior and final-year residents and cardiology and OBGYN residents. Analyses were conducted using IBM SPSS Statistics Version 26 (IBM SPSS, Chicago, IL).

This study received approval from Western University Research Ethics Board (REB #120439).

## Results

The survey was distributed to 405 residents in 19 residency programs, of a possible 598 residents (cardiology = 162, OBGYN = 436) in 31 residency programs across Canada. The survey was completed by 154 residents (cardiology, n = 44; OBGYN, n = 110). The overall response rate was 38% (154 of 405; cardiology 47%, OBGYN 35%). Demographics are summarized in Table 1. With respect to final-year residents, 30% of cardiology residents were in their final year, and 24% of OBGYN residents were in their final year.

### Current exposure to cardio-obstetrics

Residents in both specialties had low rates of sufficient clinical exposures to nearly all cardio-obstetrics topics (Fig. 1).

**Table 1. Demographic characteristics**

| Demographic characteristics                        | Overall | Cardiology residents | OBGYN residents |
|--|---------|----------------------|-----------------|
| Gender   |         |                      |                 |
| Male   | 34      | 26                   | 8               |
| Female   | 118     | 16                   | 102             |
| Prefer not to say                                  | 2       | 2                    | 0               |
| Year of training                                   |         |                      |                 |
| PGY1   | 21      | N/A                  | 21              |
| PGY2   | 20      | N/A                  | 20              |
| PGY3   | 20      | N/A                  | 20              |
| PGY4   | 37      | 15                   | 22              |
| PGY5   | 42      | 16                   | 26              |
| PGY6   | 13      | 13                   | 0               |
| Not reported                                       | 1       | 0                    | 1               |
| Final-year residents (cardiology PGY6, OBGYN PGY5) | 39      | 13                   | 26              |
| Program location                                   |         |                      |                 |
| Western provinces                                  | 46      | 13                   | 33              |
| Prairie provinces                                  | 16      | 8                    | 8               |
| Central provinces                                  | 65      | 19                   | 46              |
| Eastern provinces                                  | 26      | 4                    | 22              |

Residents enter general cardiology subspecialty programs in PGY4. OBGYN, obstetrics and gynecology; PGY, postgraduate year.

As summarized in Figure 1, a larger proportion of final-year cardiology residents had sufficient clinical exposure than junior cardiology residents to pre-existing systolic dysfunction (46 vs 10%,  $P = 0.012$ ) and pre-existing arrhythmias (46 vs 10%,  $P = 0.012$ ). There were no significant differences in exposures between junior and final-year OBGYN residents. Aside from hypertensive disorders of pregnancy for OBGYN residents and SCAD for cardiology residents, the majority of final year residents in cardiology and in OBGYN did not have sufficient clinical exposures to cardio-obstetrics topics.

Residents encountered cardio-obstetrics topics through clinical care (cardiology 89%, OBGYN 92%), didactic sessions (cardiology 89%, OBGYN 76%), and grand rounds (cardiology 61%, OBGYN 63%), with a minority engaging in simulation sessions (cardiology 34%, OBGYN 37%).

Residents from both specialties most frequently encountered cardio-obstetrics patients as inpatients when on call (cardiology 41%, OBGYN 66%). Whereas cardiology residents often encountered cardio-obstetrics patients in ambulatory clinics (41%), OBGYN residents encountered these patients in ambulatory clinics less frequently (16%). Thirty-three percent of clinical or educational exposures occurred in a multidisciplinary context (cardiology 30%, OBGYN 35%).

### Perceived, unperceived, and prompted needs

**Perceived needs.** All topics except for hypertensive disorders of pregnancy were categorized as high priority (Fig. 2). As summarized in Table 2, there were statistically significant differences between junior and final-year residents in perceived needs relating to assessing medication safety (junior 89% vs final year 74%,  $P < 0.001$ ), and antepartum management (junior 89% vs final year 75%,  $P = 0.009$ ).

**Unperceived needs.** Unperceived needs were assessed using multiple-choice questions, with high-priority topics, defined as topics in which > 50% of residents answered the multiple-choice question(s) on that topic incorrectly. Overall, there were fewer high-priority unperceived needs than high-priority perceived needs (Fig. 2). Pre-existing congenital heart disease and pre-existing acquired heart disease were high-priority unperceived needs for both OBGYN and cardiology residents. There were 3 additional distinct high-priority needs for OBGYN residents that were moderate priorities for cardiology residents: medication safety, peripartum management, and pregnancy-related heart disease.

As summarized in Table 2, there were significant differences in the rates of correct answers in the unperceived needs between junior and final-year residents relating to pre-existing acquired heart disease (junior 39 vs final year 49%,  $P = 0.028$ ), arrhythmias (junior 60% vs final year 75%,  $P = 0.041$ ), antepartum management (junior 66 vs final year 80%,  $P = 0.008$ ), cardiac arrest (junior 79 vs final year 94%,  $P = 0.041$ ). The total score was significantly lower in junior residents compared with final-year residents ( $59\% \pm 16\%$  vs  $67\% \pm 11\%$ ,  $P = 0.01$ ).

Table 3 presents the rates of correct answers in cardiology and in OBGYN residents. Cardiology residents had significantly higher total scores than OBGYN residents (72% vs 57

|                          |                                       | Cardiology Residents |                      | Obstetrics Residents |                      |
|--------------------------|---------------------------------------|----------------------|----------------------|----------------------|----------------------|
|                          |                                       | Perceived priority   | Unperceived priority | Perceived priority   | Unperceived priority |
| Cardio-Obstetrics Topics | Medication safety                     | 81%                  | 44%                  | 77%                  | 55%                  |
|                          | Safety of investigations              | 61%                  | 49%                  | 62%                  | 32%                  |
|                          | Pre-existing congenital heart disease | 76%                  | 53%                  | 69%                  | 58%                  |
|                          | Pre-existing acquired heart disease   | 59%                  | 55%                  | 72%                  | 58%                  |
|                          | Arrhythmias                           | 72%                  | 15%                  | 86%                  | 45%                  |
|                          | Hypertensive disorders of pregnancy   | 42%                  | 3%                   | 24%                  | 10%                  |
|                          | Maternal cardiovascular risks         | 71%                  | 38%                  | 76%                  | 41%                  |
|                          | Obstetrical and Fetal risks           | 54%                  | 43%                  | 79%                  | 32%                  |
|                          | Antepartum management                 | 74%                  | 17%                  | 90%                  | 36%                  |
|                          | Peripartum management                 | 74%                  | 33%                  | 91%                  | 68%                  |
|                          | Cardiac arrest                        | 74%                  | 5%                   | 80%                  | 23%                  |
|                          | Pregnancy related heart disease       | 51%                  | 39%                  | 80%                  | 55%                  |

**Figure 2.** Educational needs of cardio-obstetrics topics. In perceived needs, all topics except hypertensive disorders (both specialties) and obstetric and fetal risks (cardiology) were high priorities. In unperceived needs, pre-existing congenital heart disease and pre-existing acquired heart disease were high priority for both specialties, with medication safety, peripartum management, and pregnancy-related heart disease also high priority for obstetrics and gynecology residents.

%,  $P < 0.001$ ). Cardiology residents had higher scores in medication safety (58% vs 45%,  $P = 0.01$ ), arrhythmias (85% vs 55%,  $P < 0.001$ ), antepartum management (83% vs 64%,  $P < 0.001$ ), peripartum management (67% vs 32%,  $P < 0.001$ ), cardiac arrest (95% vs 77%,  $P = 0.004$ ), and pregnancy-related heart disease (61% vs 54%,  $P < 0.001$ ). Similar scores were observed in the remaining 5 topics: safety of investigations, pre-existing congenital heart disease, pre-existing acquired heart disease, maternal cardiovascular risks, obstetric and fetal risks, and hypertensive disorders of pregnancy.

**Prompted needs.** There were additional educational needs raised on the written descriptions of difficult cases encountered by residents: approaches to balancing decisions around lactation with medication safety or maternal cardiovascular conditions, recognition and management of shock, and practical aspects of multidisciplinary care. Practical aspects included how to contact the cardio-obstetrics team, where patients should be admitted, and how to arrange cardiac monitoring. Residents also reported a tendency to defer management of pregnant patients with heart disease to advanced fellows or cardio-obstetrics teams, which may contribute to limited clinical exposure to this patient population.

### Preferred educational formats

As summarized in Table 4, residents in both specialties had preferences for in person and virtual educational formats. Simulations, clinical care of inpatients and outpatients, as well

as didactic sessions were preferred in person formats. Virtual simulation, online modules, Nationwide Cardio-Obstetrics Day, podcasts, and virtual patients were preferred virtual formats.

Residents saw value in incorporating input from other specialties asynchronously and synchronously. In synchronous formats, residents from other specialties would attend the same session at the same time. In asynchronous formats, residents from both specialties would not attend the same sessions together, but perspectives of both specialties would be included. Overall, residents saw value in both asynchronous (cardiology 68%, OBGYN 80%) and synchronous educational formats (cardiology 68%, OBGYN 83%).

### Discussion

Our national survey to characterize the perspectives of General Canadian Cardiology and OBGYN residents has 5 important findings: clinical exposure to patients with cardio-obstetrics needs is insufficient; 33% of current exposures to cardio-obstetrics topics occur in multidisciplinary contexts; both cardiology and OBGYN residents shared perspectives on perceived educational needs for a breadth of high-priority cardio-obstetrics topics; cardiology and OBGYN residents shared some unperceived needs, and OBGYN trainees had 3 distinct additional high-priority unperceived needs relating to medication safety, peripartum management, and pregnancy-related heart disease; and virtual educational formats were seen as potentially helpful, with specialties attending asynchronously or synchronously.

**Table 2. Perceived and unperceived educational needs based on level of training**

|                                       | Perceived needs   |   |                | Unperceived needs                         |   |                |
|---------------------------------------|---|---|----------------|---|---|----------------|
|                                       | Junior trainees<br>Proportion wanting<br>to learn more about<br>topic n (%) | Final-year trainees<br>Proportion wanting<br>to learn more about<br>topic n (%) | <i>P</i> value | Junior trainees<br>Mean %<br>correct ± SD | Final-year trainees<br>Mean %<br>correct ± SD | <i>P</i> value |
| Medication safety                     | 35 (89%)  | 85 (74%)  | 0.006          | 48 ± 23                                   | 50 ± 25                                       | 0.662          |
| Safety of investigations              | 25 (65%)  | 61 (53%)  | 0.08           | 66 ± 48                                   | 56 ± 50                                       | 0.25           |
| Pre-existing congenital heart disease | 27 (70%)  | 84 (73%)  | 0.638          | 39 ± 21                                   | 49 ± 20                                       | 0.219          |
| Pre-existing acquired heart disease   | 28 (72%)  | 76 (66 %)   | 0.35           | 39 ± 27                                   | 48 ± 18                                       | 0.028          |
| Arrhythmias                           | 33 (85%)  | 86 (75%)  | 0.07           | 60 ± 36                                   | 75 ± 20                                       | 0.041          |
| Hypertensive disorders of pregnancy   | 11 (28%)  | 37 (32%)  | 0.53           | 91 ± 28                                   | 94 ± 23                                       | 0.551          |
| Maternal cardiovascular risks         | 30 (76%)  | 82 (71%)  | 0.42           | 59 ± 17                                   | 63 ± 17                                       | 0.206          |
| Obstetric and fetal risks             | 28 (73%)  | 81 (70%)  | 0.638          | 66 ± 30                                   | 66 ± 23                                       | 0.804          |
| Antepartum management                 | 35 (89%)  | 86 (75%)  | 0.009          | 66 ± 28                                   | 80 ± 23                                       | 0.008          |
| Peripartum management                 | 34 (87%)  | 97 (84%)  | 0.546          | 59 ± 25                                   | 67 ± 24                                       | 0.146          |
| Cardiac arrest                        | 32 (81%)  | 82 (71%)  | 0.669          | 79 ± 41                                   | 94 ± 23                                       | 0.041          |
| Pregnancy-related heart disease       | 28 (72%)  | 81 (70%)  | 0.755          | 59 ± 24                                   | 63 ± 22                                       | 0.479          |
| Total score                           | N/A   | N/A   | N/A            | 59 ± 16                                   | 67 ± 11                                       | 0.01           |

SD, standard deviation.

Our study reinforces and adds to the findings from Bello et al.<sup>4</sup> Aligning with the findings from the cardiology-focused survey situated in the United States by Bello et al.,<sup>4</sup> we identified broad high-priority unperceived or perceived educational needs in pregnancy-related heart disease, arrhythmias, pre-existing acquired heart disease, pre-existing congenital heart disease, medication safety, and safety of cardiovascular investigations in Canadian general cardiology and OBGYN residents. We also identified additional high-priority topics, including assessment of maternal cardiovascular risk, peripartum management, and management of maternal cardiac arrest. Our methodology offered distinct advantages in defining multidisciplinary educational needs. First, we surveyed both cardiology and OBGYN residents, which provides insights on the educational needs of both essential cardio-obstetrics specialties from the resident perspective. Second, in addition to surveying on subjective (perceived and prompted) educational needs, we also captured objective (unperceived) educational needs through assessing knowledge on multiple-choice questions. This objective perspective enhances our understanding of educational needs. The unperceived needs and perceived needs within a specialty

inconsistently aligned, highlighting the value of incorporating both unperceived and perceived needs into the survey. Finally, our focus on multidisciplinary interactions identified that residents have infrequent exposure to collaborating with the other specialty. This highlights the need to increase multidisciplinary clinical exposures and education to ensure residents understand their role on cardio-obstetrics teams, understand team functioning, and possess communication skills for effective collaboration with the other specialty.

The differences in how cardiology and OBGYN residents prioritized educational needs may be explained by clinical exposures and roles of each speciality in cardio-obstetric teams. First, cardiology residents may deem obstetric and fetal risks to be the role of OBGYN team members. Nonetheless, cardiology residents will benefit from further education, as these complications occur frequently in patients with heart disease.<sup>2</sup> Second, the higher unperceived needs relating to medication safety and peripartum management by OBGYN residents may reflect less clinical experience with these topics in pregnant patients with heart disease compared with cardiology residents. Cardiology residents routinely use cardiac medications and apply general cardiac management

**Table 3. Unperceived needs based on specialty of training**

|                                       | Unperceived needs                 |                              | <i>P</i> value |
|---------------------------------------|-----------------------------------|------------------------------|----------------|
|                                       | Cardiology<br>Mean % correct ± SD | OBGYN<br>Mean % correct ± SD |                |
| Medication safety                     | 58 ± 20                           | 45 ± 24                      | 0.01           |
| Safety of investigations              | 51 ± 50                           | 68 ± 47                      | 0.062          |
| Pre-existing congenital heart disease | 47 ± 20                           | 42 ± 20                      | 0.097          |
| Pre-existing acquired heart disease   | 45 ± 19                           | 42 ± 20                      | 0.183          |
| Arrhythmias                           | 85 ± 28                           | 55 ± 35                      | < 0.001        |
| Hypertensive disorders of pregnancy   | 97 ± 16                           | 90 ± 31                      | 0.136          |
| Maternal cardiovascular risks         | 62 ± 17                           | 59 ± 18                      | 0.451          |
| Obstetric and fetal risks             | 57 ± 30                           | 68 ± 28                      | 0.123          |
| Antepartum management                 | 83 ± 26                           | 64 ± 26                      | < 0.001        |
| Peripartum management                 | 67 ± 33                           | 32 ± 30                      | < 0.001        |
| Cardiac arrest                        | 95 ± 16                           | 77 ± 42                      | 0.004          |
| Pregnancy-related heart disease       | 61 ± 17                           | 45 ± 23                      | < 0.001        |
| Total score                           | 72 ± 14                           | 57 ± 13                      | < 0.001        |

OBGYN, obstetrics and cardiology; SD, standard deviation.

**Table 4. Resident preferences for educational formats**

| Education formats                | Cardiology residents n (%) | OBGYN residents n (%) |
|----------------------------------|----------------------------|-----------------------|
| In person                        |                            |                       |
| Grand rounds                     | 28 (64 %)                  | 65 (59 %)             |
| Didactic sessions                | 30 (68 %)                  | 82 (75 %)             |
| Clinical care of outpatients     | 31 (71 %)                  | 98 (89 %)             |
| Clinical care of inpatients      | 39 (89 %)                  | 79 (72 %)             |
| Simulations                      | 34 (77 %)                  | 93 (85 %)             |
| Virtual                          |                            |                       |
| Blogs                            | 8 (18 %)                   | 24 (22 %)             |
| Virtual patients                 | 19 (43 %)                  | 52 (47 %)             |
| Podcasts                         | 24 (54 %)                  | 65 (59 %)             |
| Nationwide Cardio-Obstetrics Day | 29 (66 %)                  | 70 (72 %)             |
| Online modules                   | 29 (66 %)                  | 76 (80 %)             |
| Virtual simulation               | 27 (61 %)                  | 82 (75 %)             |

OBGYN, obstetrics and gynecology.

principles in nonpregnant patients, whereas OBGYN residents may have less familiarity with cardiac medication-safety considerations or cardiac-management principles. Nonetheless, both specialties rated medication safety and peripartum management as a high-priority perceived need, highlighting how their subjective needs align. Third, the higher unperceived need for education on pregnancy-related heart disease for OBGYN residents may reflect how PPCM and SCAD are commonly managed in nonobstetric settings in the postpartum period. However both conditions could present during pregnancy, highlighting the relevance to general OBGYN residents.

Our data, along with the data from Bello et al.,<sup>4</sup> can guide the path toward enhancing multidisciplinary cardio-obstetrics education. First, a supplementary curriculum is needed, as clinical exposures in cardiology and OBGYN training programs do not currently provide the trainees with the required knowledge and skills. Second, our data highlight potential approaches for organizing a multidisciplinary curriculum for cardio-obstetrics. Although separate, specialty-specific curricula could be designed for cardiology and OBGYN trainees; a curriculum with shared content for both specialties with additional specialty-specific content relevant to each specialty could be advantageous. The shared component of the curriculum could limit redundancy in resource development and ensure that all cardiology and OBGYN trainees are aware of the principles of caring for pregnant patients with heart disease. The shared component could also allow for instruction of nonmedical expert competencies required for cardio-obstetrics care, as cardiology and OBGYN residents also require orientation to their role on cardio-obstetrics teams and instruction on team functioning and communication skills.<sup>14</sup> Furthermore, the specialty-specific content could allow elaboration of specific topics more relevant to cardiology (eg, management of PPCM) and OBGYN (eg, peripartum management). Third, educators should prioritize the high priority needs identified in our study and in the survey by Bello et al.<sup>4</sup> in the curricula, with the shared curricula prioritizing pre-existing congenital heart disease, pre-existing acquired heart disease, safety of investigations, and maternal cardiovascular risk. Additional curricular activities geared to general cardiology residents may prioritize elaboration on pregnancy-related heart disease in addition to other topics.

Curricular activities targeted to OBGYN residents may further elaborate on safety of cardiac medications, arrhythmias, management of cardiac arrest, and antepartum and peripartum management specific to patients with heart disease. The curriculum should incorporate diagnosis and management in both ambulatory and inpatient contexts, as well as logistical considerations for providing team-based cardio-obstetrics care. Finally, the curriculum could be delivered via the preferred in person or virtual formats. Residents from both specialties could attend preferred in-person formats (eg, simulation, didactic sessions) synchronously, whereas residents could attend preferred virtual formats (simulation, modules, podcasts, virtual patients) either synchronously or asynchronously. We recognize that delivering a synchronous multidisciplinary curriculum may present logistic challenges in many settings. Innovative asynchronous, virtual multidisciplinary instructional formats (eg, online modules, virtual simulation, virtual patients) may be needed to meet the multidisciplinary educational needs. Collaborative efforts among centres to develop shared resources (eg, Nationwide Cardio-Obstetrics Day, online modules) could be of benefit in limiting redundancy in developing educational resources.

Barriers may exist to implementing additional cardio-obstetrics educational activities into cardiology and OBGYN residency programs. Although there is limited published literature on barriers to implementing additional cardio-obstetrics educational activities, educators may face variability in local expertise or clinical volumes and limited educational resources. Furthermore, there is finite dedicated time for teaching, and the limited emphasis on cardio-obstetrics in defined competencies of each specialty may mean cardio-obstetrics topics are deprioritized compared with other topics. The limited emphasis on cardio-obstetrics in training standards has been cited as a barrier in the American context, in which cardio-obstetrics topics are not included in the formal objectives of training.<sup>15</sup> There are also logistic challenges of coordinating synchronous multidisciplinary sessions in which cardiology and OBGYN trainees attend at the same time. Another potential barrier is recognition of the importance of cardio-obstetrics topics by residents, as only 46% of American cardiology residents thought it was important.<sup>4</sup> Further study is required to explore barriers to implementing enhanced multidisciplinary cardio-obstetrics curricula.

## Limitations

There are important limitations to our study. First, although our response rate of 38% and number of trainees ( $n = 154$ ) surveyed is higher than the Bello et al.<sup>4</sup> survey on cardio-obstetrics educational needs (response rate 9%, trainees surveyed = 139), the response rate raises the possibility of response bias and limited our ability to adjust for training program. We believe our data represent the larger population of Canadian cardiology and OBGYN residents because residents from 19 individual training programs participated. However, as with any voluntary survey, residents who completed the survey may have more interest than nonresponders, and our findings may consequently represent an overestimation of the needs of all residents. Second, our findings represent the views of the residents surveyed during

their training. It may be difficult for trainees to recognize when they have sufficient clinical exposure or to identify perceived needs, given that they do not always know what they do not know. We also do not know if these residents intend to care for pregnant patients with heart disease on completion of training, which may affect their perceived educational needs. It is unclear as to how these views in training represent knowledge or abilities to care for pregnant patients with heart disease on completion of training. However, 46% of practicing American cardiologists rated their confidence to manage cardiovascular disease in a pregnant patient as  $\leq 3$  out of 5,<sup>4</sup> highlighting how practicing cardiologists also have knowledge gaps relating to cardio-obstetrics. Incorporation of perspectives of recent graduates, program directors, and faculty from cardiology and OBGYN residency programs may yield additional insights. Finally, we developed our own survey, given the lack of a robustly validated tool to measure educational needs. Although the aim of our study was not to validate our survey, there are features that support the validity of our survey. We designed the survey using principles from a validated, published framework on assessing educational needs.<sup>5</sup> To inform content validity, we sought input from cardiologists and OBGYN specialists who practice cardio-obstetrics. Validity of the survey is also supported by the final-year residents scoring higher on questions in the unperceived needs section and reporting more clinical exposures to some cardio-obstetrics topics.

### Conclusions

We describe educational needs of cardiology and OBGYN residents. These data complement the findings described in an American context of educational needs of cardiology trainees and faculty<sup>4</sup> and can inform the design of a multidisciplinary cardio-obstetrics curriculum that can be incorporated into general cardiology and general OBGYN training programs.

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### Ethics Statement

This research has adhered to the relevant ethical guidelines.

### Patient Consent

The authors confirm that patient consent is not applicable to this article, as this was a cross-sectional survey-based study of residents. All residents provided informed consent to participate.

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### Disclosures

The authors have no conflicts of interest to disclose.

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### Supplementary Material

To access the supplementary material accompanying this article, visit *CJC Open* at <https://www.cjcopen.ca/> and at <https://doi.org/10.1016/j.cjco.2023.12.014>.