TRAINEE SECTION

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It begins with the right supervisor: Importance of mentorship and clinician-investigator trainee satisfaction levels in Canada

Abstract

Purpose: Clinician Investigator Trainee Association of Canada/ Association des cliniciens-chercheurs en formation du Canada (CITAC/ACCFC) represents the interests of clinician-investigator (CI) trainees across Canada. To better advocate for the successful training of CI trainees in Canada, CITAC/ACCFC conducted a survey to assess satisfaction with their training and to find what factors were most associated with satisfaction level.

Methods: A nominal scale-based psychometric survey was conducted online in 2009 on CI trainees in Canada (including MD/MSc, MD/PhD, or CIP/SSP). One hundred fifteen out of a target population of approximately 350-400 responded. Survey respondents were asked to rate their level of satisfaction in four areas: 1) quality of training, 2) financial support, 3) mentorship satisfaction and 4) program structure. Ratings in these four areas were also combined to produce a measure of overall satisfaction.

Results: At least half of the respondents were 'completely satisfied' in each of the four categories other than mentorship. While 98% of respondents considered mentorship as important to their success, 62% expressed some level of dissatisfaction with the level of mentorship received. Moreover, increased levels of mentorship were strongly associated with increased levels of overall satisfaction.

Conclusion: The discrepancy between CI trainees' perceived importance of mentorship and the level of satisfaction in mentorship received reveals a strategic area where CI training should be improved. Recognizing that good mentorship in a CI training program often begins with one's research supervisor, the CITAC/ACCFC has compiled six specific recommendations for finding a good supervisor.

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With training in both medicine and research methodologies, Clinician Investigators (CIs, also termed Clinician Scientists, Physician Scientists) are in a unique position to bridge the gap between the basic sciences and clinical medicine [1,2]. CIs have the advantage of bedside observations that can lead to clinically-oriented research questions and the ability to answer such questions via clinical trials or at the bench [1].Despite this unique aptitude, there is a perceived shortage of Clinician Investigators, which has been a topic of discussion for the last 30 years [3, 4]. The training path to become a CI is particularly lengthy, with a number of training stages and transitions that can exacerbate attrition. The reported attrition rates in the Unites States for students enrolled in the MD/PhD program range from 10-28% [5, 6], while attrition in the Clinician Investigator Programs (CIP) and Surgeon Scientist Programs (SSP), which allow medical residents to pursue a minimum of two years of research during their residency in Canada, are only 2% [7]. A study of over two thousand alumni in the US suggests that the majority of trainees go on to pursue a career as a CI following the completion of their MD/PhD training, with 81% employed in academia, research institutes, or industry, and only 16% in private practice [6]. The data suggests that the completion of one's CI training program may be a rate-limiting step in a CI trainee's path toward becoming a CI.

Clinician Investigator Trainee Association of Canada/ Association des cliniciens-chercheurs en formation du Canada (CITAC/ACCFC) is a national organization that represents the CI trainees in institutions across Canada. One of the mandates of CITAC/ACCFC is to represent the interests of CI trainees in Canada with the goal of promoting the success of our members. With this aim, CITAC/ACCFC conducted a survey of 115 CI trainees on program structure, perceived quality of training, financial support, and mentorship. The results of this survey suggest mentorship is the factor most strongly associated with trainee satisfaction. Additionally, while 98% of respondents declare mentorship as important for their success, 62% are dissatisfied with the mentorship they currently receive. The laboratory setting is where most CI trainees receive mentorship and developmental supports, predominantly from their research supervisor. Based on these results, we have compiled a set of recommendations for new CI trainees to consider in choosing their research supervisor.

Methods

Survey

A cross-sectional study was performed using an online survey of CITAC/ACCFC members and other Canadian MD/MSC, MD/PhD, CIP and SSP trainees. The study was performed in agreement with the Research Ethics Board at the Western University. CITAC/ACCFC members were e-mailed directly, and non-member CI trainees were contacted through the designated institution representatives. The target population size of all CI trainees in Canada in 2009 is estimated to be about 350-400 trainees, based on the published 2010 figure [8]. A total of 115 members responded to this nominal scale-based psychometric survey, with all data collected between February and June of 2009. In general, the number of respondents from the different institutions corresponded with the size of their respective programs. Our survey respondent pool was 59% male and 41% female trainees, the majority of which are 25-29 years of age.Survey respondents were asked to rate their level of satisfaction (from zero to three) in four areas: 1) quality of training, 2) financial support, 3) mentorship satisfaction, and 4) program structure.The nominal scale was text-anchored as 0 = completely dissatisfied, 1 = unsatisfied, 2 = mildly unsatisfied, and 3 = completely satisfied. A set definition of mentorship was not defined in the survey.

Combining the four measures of satisfaction discussed above, we were able to generate a measure of overall satisfaction. Simply, a trainee's satisfaction score (0-3) for each training element was summed, producing a value between 0 and 12, with 0 being 'completely dissatisfied' and 12 being 'completely satisfied'.

Statistical analysis

Associations between a categorical variable and a numerical variable were examined using either the Mann-Whitney (for two categories) or Kruskal-Wallis (for three or more categories) test. All statistical tests were performed using GraphPad Prism 4, using two-sided tests and p-value of 0.05 as the cut-off for statistical significance.

Results

CITAC/ACCFC Membership Trainee Satisfaction

CITAC/ACCFC performed a survey of our membership to elucidate the factors associated with higher level of satisfaction among CI trainees. A 12-point scale of overall satisfaction was used, which comprised of equal contributions of 0-3 points from the following categories: 1) quality of training, 2) financial support, 3) mentorship satisfacton, and 4) program structure. A total of 115 members responded to this nominal scale-based psychometric survey, with all data collected between February and June of 2009.The distribution pattern of the overall score from our survey resulted in a left-skewed histo-
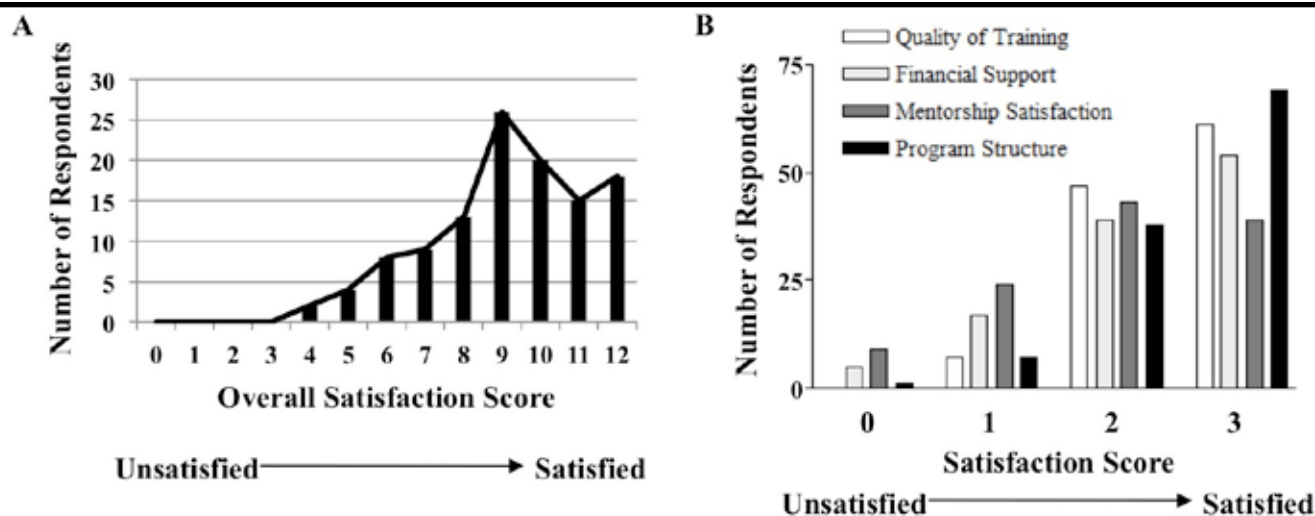
FIGURE 1. A) Distribution of respondents' overall satisfaction score. Responses on the four categories were summed in order to create a single score, with the four categories weighted equally. B) Distribution of the survey responses regarding the individual four categories of satisfaction: quality of training, financial support received, mentorship received and training program structure. Scale was 0-3, with 3 being "completely satisfied".

gram, with a median score of 9, mean of 9.2, and range of 4-12 (Figure 1A). When the scores of the categories were examined, with the exclusion of mentorship, at least half of the respondents were 'completely satisfied' with each of the categories (Figure 1B). There were no statistically significant differences in the level of satisfaction based on age, sex, size of institution (small institutions, defined as having less than10 respondents per institution, *vs.* large institutions), or the type of CI training program (MD/MSc, MD/PhD or CIP/SSP).

Statistically significant differences in overall satisfaction level were observed with respect to the financial support and the level of mentorship. There was a trend of increasing level of overall satisfaction with greater financial support, with the difference between the groups that received the lowest and the highest levels of financial support was significantly different (p < 0.05) (Figure 2A).An overt association was seen between satisfaction and the perceived level of mentorship received, categorized into four categories: "None" = 0, "Some" = 1, "Sufficient" = 2, and "Abundant" = 3. Overall satisfaction increased between each and every category for the level of mentorship received (p <0.001, Kruskal-Wallis and Dunn's multiple comparison test) (Figure 2B).

To the subsequent question "How important do you feel adequate mentoring is to your success in your clinician investigator training program?", 70.4% of respondents (81/115) answered "Extremely important" and 27.8% (32/115) answered "Important". To the question "How satisfied are you with the level of mentoring you receive through your clinician investiga-

tor training program?", 28.7% respondents (33/115) answered they were "Unsatisfied" or "Completely dissatisfied", and 37.4% (43/115) answered "Mildly unsatisfied".

In summary, nearly all CI trainees concur on the importance of mentorship as an important contributing factor to the quality of CI training, even greater than monetary and programmatic support. Moreover, a certain "dose-dependent" relationship exists, as increasing level of mentorship received was highly associated with increasing level of overall satisfaction. Unfortunately, 66.1% (76/115) of respondents expressed some level of dissatisfaction with the level of mentorship received. This dichotomy highlights an area where CI training programs must improve.

Discussion

CITAC/ACCFC Recommendations on the Supervisor Search

While mentorship takes place in many different settings, the CI trainees' research setting (i.e.,clinic and laboratory) is a particularly important setting. Finding good mentorship begins with finding a good supervisor, and supervisor-trainee mentoring contributes to trainee productivity [9]. In consideration of our survey results, the CITAC/ACCFC executive council has compiled a list of factors to consider in choosing the right supervisor. It is crucial that trainees have an amicable working relationship with their supervisor during their studies; unfortunately, this does not always occur. CITAC/ACCFC is not
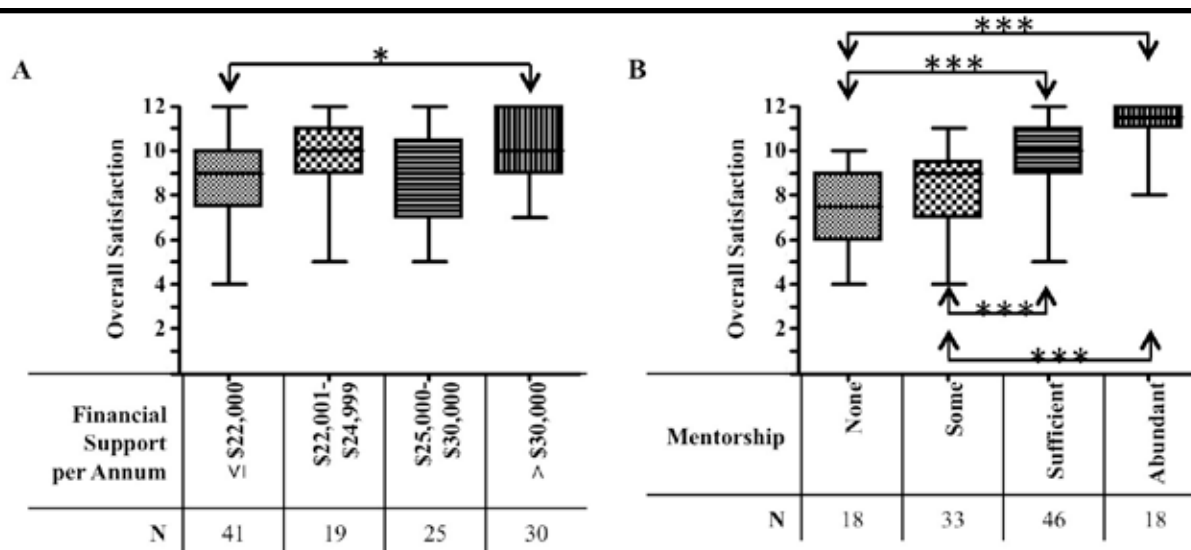
FIGURE 2. A) Overall satisfaction scores of survey participants grouped by their reported level of financial support. B) Overall satisfaction scores of survey participants grouped by their reported level of mentorship available. * indicates *p*-value < 0.05. *** indicates *p*-value< 0.001. Unmarked associations are non-significant (*p*> 0.05).

the first organization to compile such a list, and interested readers are directed to other references on the topic [10-13].

1. Begin with a little "self-research"

Self-ratings of one's own personality, affectivity and attachment have a higher predictive power on one's satisfaction in a marriage than that reported by the spouse [14].Extrapolating from these results, it may be argued that acquiring data about oneself would help to clarify the traits of an optimal supervisor. Based on various recommendations available elsewhere and on the authours' experiences, we recommend that trainees consider the following questions:

i) What do I hope to achieve at the end of my training? Some trainees are content to focus on one area and strive to publish the maximal number of papers, while others may be in search of broad training, aiming to engage in a range of basic, translational and clinical research. Trainees should also consider the number of conferences they want to attend, the desired length of the PhD training period and the preferred work environment. These factors can vary greatly across the laboratories one considers. Trainees' expectations will also depend on their career goals. While many CI trainees begin their training without a clear career path in mind, launching the thought process can start the moulding of their career and impact the type of mentor.

ii) How much supervision do I want/need? Supervisors vary in their style of supervision, ranging from the most 'hands on' supervisors to the 'hands off' types[15]. These attributes de-

pend on the amount of time available (which will depend on the size of the laboratory, as well as other engagements of the supervisors such as teaching and clinics), the supervisor's personality and the supervisor's teaching philosophy. Some trainees blossom under a supervisor with a certain "laissez faire" attitude about supervision. They enjoy the independence, are self-motivated, and are more productive and focused when in competition with themselves. The hands-off approach is not compatible with all trainees, as some trainees tend to wander aimlessly in such an environment. For certain trainees just starting their research, hands on supervision may be more appropriate, and hands on supervision has been linked to shorter time to completion[15]. Trainees must always beware of the "helicopter supervisor" who is looking over their shoulders at all times as this can be detrimental to the development of independent research aptitude. It is essential to ensure one knows which style of supervision one prefersand responds best to before approaching a potential supervisor. Moreover, trainees may require various styles at different times during the course of one's degree. Thus, trainees must have a supervisor they can comfortably speak with regarding a needed change in supervision style. No matter what style of supervision they seek or begin with receiving, their goal should be to become an independent researcher by the end of the research training.

iii) What are my clinical interests? This question may be more relevant to those interested in clinical research, but it is an important question for any CI trainees who have not yet committed to a residency program. For many practical and

obvious reasons, it is in one's interest to align the research interest with their clinical practice. Finding out about one's clinical interest through shadowing and early elective experiences can help the trainee to jumpstart that aligning process. Do keep in mind, however, that graduate training in a certain field does not restrict the trainee to research in that field. The research skills gained through the graduate training are likely useful in any field of medicine.

iv) What are the non-negotiable items? As the above questions are contemplated, the formed wish list can be extensive, and finding a supervisor that satisfies all the items on the list can be very difficult. While one is expected to compromise, prioritize the list and mark the items that one believes are required and non-negotiable. These deal breakers may be one of the aforementioned items, such as the expected duration of the PhD training, or may simply be a matter of chemistry between the trainee and the supervisor. Unfortunately, some of these non-negotiable items may not be apparent until trainees obtain firsthand experiences in their potential work setting, and thus more extensive data gathering is recommended.

2. Gather data in stages, and gather firsthand experiences

There are a number of ways to gather data on the future supervisor and research setting. These include visiting the lab's website, interviewing the potential supervisor, speaking with people from the lab (especially former trainees of the supervisor), and getting first-hand work experience in the lab itself. These various methods differ in the amount of time required and also the quality of data obtained. Thus, one can approach the data collection in steps and form a screening approach. After the first conversation with the CI Program Director at the institution, trainees may be provided with a list of potential supervisors to consider. Browsing through the lab website and PubMed search for the publication record can serve as a good initial screen to shorten the list or a good way to form the initial list of potential supervisors.

Talking to the potential supervisor and other lab personnel is the next step in data gathering. Since the subsequent steps can be time consuming, it is worth spending the time to gather as much information as possible at this stage. The topics of discussion would depend on your wish list (from above), but be sure to discuss each other's expectations during the PhD training. Trainees may also wish to discuss the supervisor's method of distributing authorship, sharing of intellectual property and a number of other topics discussed in the following sections.

After a series of first encounters, the list of potential supervisors should be shortened down to a few names. While this initial information provides useful evidence, firsthand experience is the highest quality evidence in assessing the fit within the research setting. An unfortunate drawback is the time requirement; however, spending a few weeks at the lab may be a worthwhile investment, especially for those trainees with little research experience.

There are multiple ways to gain firsthand experience at a lab, including a summer project, previous degree and the rotation system. For some CI trainees, the destined laboratory may also be the same setting where their MSc-level training was attained, and such trainees would have a very clear idea of the research setting. Among CITAC/ACCFC members where the degree obtained prior to CI training is known, less than 15% of trainees have a graduate degree (CITAC/ACCFC, unpublished), and thus most CI trainees do not have the luxury of knowing their research setting well prior to starting their CI training. A number of departments across the country employ the rotation system, and this usually requires new graduate students to rotate through a number of labs for a few weeks at a time. When such pre-set opportunities are lacking, it is fair for a trainee to request to spend a few weeks in a laboratory during a summer before fully committing to a PhD. It may also be of interest to attend a lab meeting or two in order to examine the dynamics between the trainees and the supervisor, as well as other members of the lab. Observe who dominates the discussions, the level of participation from trainees, and observe how the supervisor responds to the trainees' suggestions.

3. Find a lab where the research excites you

Getting a PhD is a long, arduous process, and the burnout often experienced by PhD students is exacerbated in the absence of intellectual stimulation. Phrased differently, a trainee should not choose a lab simply because the setting is comfortable or the funding is plentiful. The websites are often a good place to begin learning about the potential supervisor's research. Unfortunately, websites are often outdated, and the different research projects available to new trainees can be difficult to assess. Thus, the first encounter with the potential supervisor provides the opportunity to learn about the research projects available.

To learn more about the research projects, trainees may request a copy of the supervisor's latest grant or the grant associated with potential future project(s). Reading the grant allows trainees to ask: 1) is the preliminary data presented convincing, 2) am I convinced that the main research topic/question of the lab is important, and 3) how is the quality of the supervisor's writing? A good trainee takes ownership of their research projects, and, through reading the grants, one may find a project worth owning. If there is no grant funding

proposal for your prospective project yet, this should be a red flag.

You may also ask to attend a lab meeting to hear about the potential project(s). These are usually presented by the trainees in the lab, and they provide opportunities to assess the quality of the other trainees, the level of enthusiasm in other trainees, and the supervisor-trainee dynamics during lab meetings. Expect a wide range among the different members of the lab, but do consider the general level of enthusiasm about research. After all, enthusiasm is contagious, but so is apathy.

4. Examine the outcome data

Assessment of the potential supervisor and the future work environment should be performed diligently. When examining a research paper, trainees read not only the Materials and Methods, but progress to the Results section. In the same way, when evaluating potential supervisors, trainees should go beyond looking at the available resources and supervision style to the results of supervision, i.e., outcome of past trainees. For seasoned professors, their track record in trainee supervision can be easily assessed. Be wary of labs that only publish "the big paper" where data is aggressively pooled and students are forced to graduate without solid individual publication records. A PubMed search is an easy way of examining the publication record of the potential supervisor, as well as the trainees in their lab. Ask if there will be opportunities to write review papers and book chapters. Also determine which lab members have been publishing. A good research setting with abundant mentorship early in the training will allow undergraduate and master students to publish.

It may be difficult, but try to gauge the long-term outcomes. Ask about where previous trainees are now, especially the previous CI trainees. A successful supervisor produces successful scientists, and a good pedigree should quickly become obvious. A good supervisor may produce high impact publications, but a great supervisor produces high impact scientists.

5. Assess the lab resources and settings

While the term "materialism" has a certain negative connotation, trainees should perform a materialistic assessment of the research setting. In marriage, economic stressors can negatively impact the relationship, and financial concerns are associated with decreased marriage quality [16]. Similarly, in a supervisor-trainee relationship, financial stressors can also negatively impact the relationship, and financial stability (i.e., research grants) is an important criterion, especially if the trainee's stipend depends on it. Finances will also determine the available

reagents, the degree of freedom with ordering reagents and the travel opportunities.

Assess the tools available. Start with the basic equipment, constituents of which will depend on the research type. Ideally, basic equipment should never be an issue. Take a moment to assess the maintenance status of the lab equipment and examine how they are used. Often, an established lab has their own unique "Cadillac equipment" that sets it apart from other labs in the institution. Sometimes, the particular advantage of the lab may not be physical equipment, but resources available, such as access to patient tissue samples. Inquire about the equipment and opportunities unique to the lab, as these can open doors to unique opportunities for novel research and fruitful collaborations. Furthermore, many labs collaborate either within an institute or between multiple centres; training in such environments may greatly benefit one's future career.

For those interested in clinical research, the assessment of the research setting can involvement assessment of large-scale factors, as trainees can assess the study population available to them. Ask about the size of the hospital's catchment area, population characteristics (e.g., ethnic and socioeconomic status) and the charting system (paper vs. electronic). Being able to access the supervisor's clinical practice and access to office space would also be important for to CI trainees interested in clinical research.

Lastly, examine the help available. Seasoned technicians, senior PhD students and post-doctoral fellows can provide valuable advices for trainees' research, while the presence of other junior graduate students can provide moral support. Technical support should be freely available. Technical troubleshooting can be a fun challenge, and likely one's search path will be full of such challenges; however, for a CI trainee, such challenges should be minimized, as our time dedicated for research is often limited. The supervisor's time is another important resource; a trainee should not have to wait for a year for the supervisor to comment on the thesis draft. Be sure to ask a current lab member about this issue; supervisors tend to overstate their availability to students. A full assessment of the research setting involves examining the components outside of the lab, including the connectivity of the potential supervisor to collaborators, and the neighbouring labs (especially in open-concept research institutions). For budding clinical researchers, easy access to help with statistics (including help with statistical programs like SAS) will go a long way in enhancing your research experience.

TABLE 1. Summary of Recommendations on the Supervisor Search.

1. Begin with a little "self-research". Form a wish list by asking the following questions:
i) What do I hope to achieve at the end of my training?
ii) How much supervision do I want/need?
iii) What are my clinical interests?
iv) What are the non-negotiable items?

2. Gather data in stages, and gather firsthand experiences. Begin with the lab website and a PubMed search to begin narrowing down and form a list of potential supervisors. Speak with other members of the lab and the potential supervisors to further narrow down the list. Finally, attaining some firsthand experiences at the potential labs allow trainees to identify potential issues with research settings.

3. Find a lab where the research excites you. Request a copy of the research grants and attend lab meetings to identify the research settings where intellectually stimulating research takes place.

4. Examine the outcome data. Assess the publication record of the trainees and inquire about the success of the past trainees in finding desirable posts. Find a supervisor who can train successful researchers.

5. Assess the lab resources and settings. Examine the research setting for the available funding, opportunities to attend conferences, and look for a setting where one can network and collaborate with other clinicians and researchers. Examine the equipment and the amount of technical support available.

6. Find a setting with good mentors. Mentorship need not be restricted to the trainee-supervisor relationship. Look for an environment with ample opportunities for mentors other than a research supervisor.

6. Find a setting with good mentors

Finding good mentorship begins with finding a good supervisor, and supervisor-trainee mentoring contributes to trainee productivity [9]. A number of definitions for mentorship exist in the literature. Sosa *et al*. defined mentorship as a "series of complex interactions between two individuals who have as their primary purpose the growth of the mentee"[17]. Mentorship often takes place outside of the trainee-supervisor relationship, and mentorship can take place in many different settings. The power of mentorship extends beyond the trainees' academic life, and studies have reported a higher level of satisfaction in career and personal life associating with strong mentor-mentee relationships [18]. Unfortunately, in the general medical student population, it has been reported that fewer than 50% of students had a mentor [19]. While most CI trainees, as part of their graduate program structure, receive mentorship from their supervisor and their advisory committee members, the majority of the respondents from the CITAC/ACCFC survey noted the level of mentorship received as inadequate. While a trainee's supervisor is a good starting point, trainees should choose a setting with ample opportunities to interact with many other potential mentors, including clinicians, clinician-scientists and basic scientists.

With these considerations in mind, a CI trainee may consider joint supervision, and being co-supervised by a clinician and a basic scientist can provide the benefit of having multiple mentors. The two supervisors can provide complementary knowledge sets, which may be required in a cross-disciplinary research project. For the CI trainees whose primary supervisors are basic scientists, the clinician mentor can provide opportunities for clinical exposures during their research years. Co-supervision certainly has its drawbacks. While some may envision joint supervision as arranging a safety net, the distance between the supervisor and the trainee could potentially grow, resulting in the trainee falling through the gap [20]. Receiving contradicting directions from two supervisors is another challenge that trainees may face. It is advisable to research the dynamics between the two potential supervisors when joint supervision is being considered.

Closing remarks

A supervisor fulfills many roles—a scientific advisor, a coach, a manager and, among other things, a mentor. Strong mentorship during your CI training begins with finding a good supervisor; however, it is unlikely that all of trainee's mentorship needs would be met in one person, especially given the increasingly interdisciplinary nature of research. Moreover, a trainee's mentorship needs will change over the course of their training—for example during transitions between graduate studies and clerkship or core residency training. It is worthwhile to have mentors in addition to the research supervisor and advisory committee as they can provide a perspective devoid of conflicts of interest regarding publications or evaluation[21]. Mentorship can take place in many settings, formal and informal, including journal clubs, student seminars and grand rounds. Conferences, workshops and presentations

may be another opportunity for potential networking and mentorship opportunities. For CI trainees interested in mentorship from and networking with fellow CI trainees, CI trainees in Canada need not look far. CITAC/ACCFC is composed of over 300 members, and CITAC/ACCFC has grown by leaps and bounds since its establishment seven years ago [22]. The number of opportunities for CI trainees to interact with one another is often limited, especially in smaller institutions where the number of CI trainees may be small. Through our website and the annual general meeting, CITAC/ACCFC serves an important role in providing a meeting ground for CI trainees to network with one another and to find mentors from other institutions engaged in a similar type of research. Providing networking opportunities can bring CI trainees out of obscurity and imbue them with a heightened sense of direction and purpose. While strong curricula and funding support for CI training programs are essential for long-term health, some rapid and feasible improvements to Canadian CI training programs can be made by generating and/or enhancing program-based and informal mentorship opportunities.

Acknowledgments

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