



SHORT REPORT OPEN ACCESS

Improving Knowledge Dissemination of Rheumatic Toxicities of Cancer Immunotherapy: A Web-Based Educational Initiative

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Received: 21 January 2025 | **Revised:** 28 January 2025 | **Accepted:** 30 January 2025

Funding: This study was supported by a Canadian Initiative for Outcomes in Rheumatology Care (CIORA) grant from the Canadian Rheumatology Association.

Keywords: arthritis | continuing medical education | immunotherapy | medical oncology | rheumatology

1 | Introduction

Immunotherapy, including the use of immune checkpoint inhibitors (ICI), is now a well-established pillar of cancer therapy. Exploitation of regulatory immune mechanisms through the inhibition of immune checkpoints has led to unprecedented responses in advanced malignancies, heralded as one of the most promising therapeutics in the history of cancer treatment (Hargadon, Johnson, and Williams 2018). Since the FDA approval of ipilimumab for the treatment of metastatic melanoma in 2011, there have been an additional eight ICI to receive regulatory approval for over a dozen different indications (Luke 2025). The success of these agents is tempered by off-target effects which can mimic idiopathic autoimmune diseases, affect all major organ systems, and are termed immune-related adverse events (irAE) (Blidner et al. 2020; Ye et al. 2019; Jamal et al. 2020). The rapidly evolving nature of this field of medicine has presented challenges for oncologists and sub-specialists alike to keep abreast of the vast amount of emerging evidence to optimise the management of patients treated with ICI, particularly those who develop autoimmune toxicities. The role of digital education on clinical competence and practice patterns, in the provision of immunotherapy, has been explored in the oncology setting and shown to be

effective (Ackbarali et al. 2021). There have been no such studies looking at the education of rheumatologists on this specific topic.

For practicing rheumatologists, navigating not only timely diagnosis and management of de-novo rheumatic irAE (Rh-irAE) but also safety and efficacy of ICI in patients with pre-existing rheumatic disease (PRD) has proven to be a unique challenge. Recent surveys of rheumatologists in the United States, France and Canada have revealed that many lack experience and confidence in the management of these patient populations (Maltez et al. 2019; Kostine et al. 2019). The paramount question, of how the rheumatology community will meet the urgent need for education on this topic, to ensure they are optimally positioned to manage this patient population in coalition with oncology partners, remains unanswered (Calabrese and Mariette 2018).

Continuing medical education in such a rapidly evolving field requires unique educational tools with the capacity to easily adapt as new evidence becomes available. We developed a web-based educational platform (www.canrio.ca) to house learning materials for practicing rheumatologists and to facilitate national and international collaboration within both the clinical and research community. As part of this educational initiative,

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we created five case-based learning modules on the topics of ICI-related inflammatory arthritis (ICI-IA), myositis (ICI-myositis), vasculitis (ICI-vasculitis), sarcoid-like reactions (ICI-SLR), and the management of patients with PRD (ICI-PRD). In addition, case-based rounds accessible to any health-care provider around the world were initiated in May 2021 to provide a forum for cross-discipline, and regional collaboration in problem-solving difficult cases. The overarching goal of the project was to improve knowledge, confidence, and awareness of rheumatic complications of cancer immunotherapy in practicing rheumatologists and to ultimately improve the care of patients with Rh-irAE and PRD receiving ICI.

2 | Materials and Methods

We followed the steps outlined by Grienbenow et al. to guide the development and delivery of continuing medical education (CME) and ensure that all key steps were addressed (Griebenow et al. 2017). This framework was designed to provide a description of the roles and responsibilities of stakeholders involved in the different stages of planning, delivery, and evaluation of CME. For this project, content experts including CanRIO specialists, medical oncologists and a pharmacist were involved in the development and delivery of the CME programme. It has been disseminated to rheumatologists across Canada through the Canadian Rheumatology Association (CRA) and to Oncologists through the Canadian Association of Medical Oncologists (CAMO).

Five content experts developed interactive case-based learning modules on the topics of ICI-IA, ICI-myositis, ICI-vasculitis, ICI-SLR and ICI-PRD. Modules included information regarding ICI mechanism of action and the presentation, management, and prognosis of Rh-irAE and in the case of the PRD module, both safety and efficacy of ICI in this patient population. Pre- and post-module tests were administered with each learning module and consisted of 10 identical multiple-choice questions to assess immediate knowledge acquisition. Knowledge transfer was assessed by comparing the pre- and post-module tests.

An educational platform, www.canrio.ca, was developed to house the learning modules and other educational content and

resources such as registration for interactive virtual case rounds, an up-to-date compilation of relevant research, patient resources, healthcare provider resources and a list of rheumatologists with expertise in the management of these patients practicing across Canada. Google Analytics was embedded within the website and used to track website traffic, including user location. At the time of case-round registration, demographic information regarding the profession, years in practice and experience in the management of these patients was collected.

2.1 | Statistical Analysis

Descriptive statistics are reported as median and interquartile range for non-normal continuous variables and frequency and proportions for categorical variables. Normal distribution was evaluated with the Shapiro-Wilk distribution test and module test scores did not follow a normal distribution. Pre- and post-module test scores were paired and then compared using the non-parametric Wilcoxon signed rank test to assess immediate knowledge retention. Statistical significance was defined as a two-sided *p* value less than 0.05. Statistical analysis was completed using Stata 17 (StataCorp 2021).

3 | Results

From February 2021 to August 2024, 4458 users from 99 different countries accessed the educational platform (www.canrio.ca). The top three countries from which users accessed the site were Canada, the United States and China (Figure 1). A total of 92 people, from Canada, the United States, France and the Netherlands have registered for case rounds since their inception. Most participants were rheumatologists (41%) or trainees (43%). Trainees in oncology, internal medicine and neurology as well as oncologists, research coordinators, and pharmacists also participated in the interactive case rounds. Of the 92 individuals who registered for rounds, 68% were in practice < 5 years and 32% were in practice over 5 years. The level of experience in managing patients on ICIs varied, with 73% of individuals having managed fewer than 5 such patients, 16% 5–15 patients and 11% more than 15 patients.



FIGURE 1 | Map of locations from which users have accessed the www.canrio.ca website between February 2021 and August 2024.

There were a total of 169 pre-module test entries. A total of 45 individuals completed the ICI-IA module, 42 the ICI-vasculitis module, 34 the ICI-PRD module, 28 the ICI-myositis module and 20 the ICI-SLR module. There were a total of 112 completed post-module test entries across these 5 modules. The median test scores increased from 4 to 7 out of 10 (50%–88%, $p < 0.0001$) for the

ICI-IA module, from 5 to 6 (63%–75%, $p = 0.093$) for the ICI-myositis module, 4 to 7 (50%–88%, $p < 0.0001$) for the ICI-PRD module, 3.5 to 7 (38%–88%, $p = 0.001$) for the ICI-SLR module and 3 to 6 (38%–75%, $p < 0.0001$) for the ICI-vasculitis module, with the improvement between pre- and post-module scores reaching statistical significance in all but the ICI-myositis module (Figure 2).

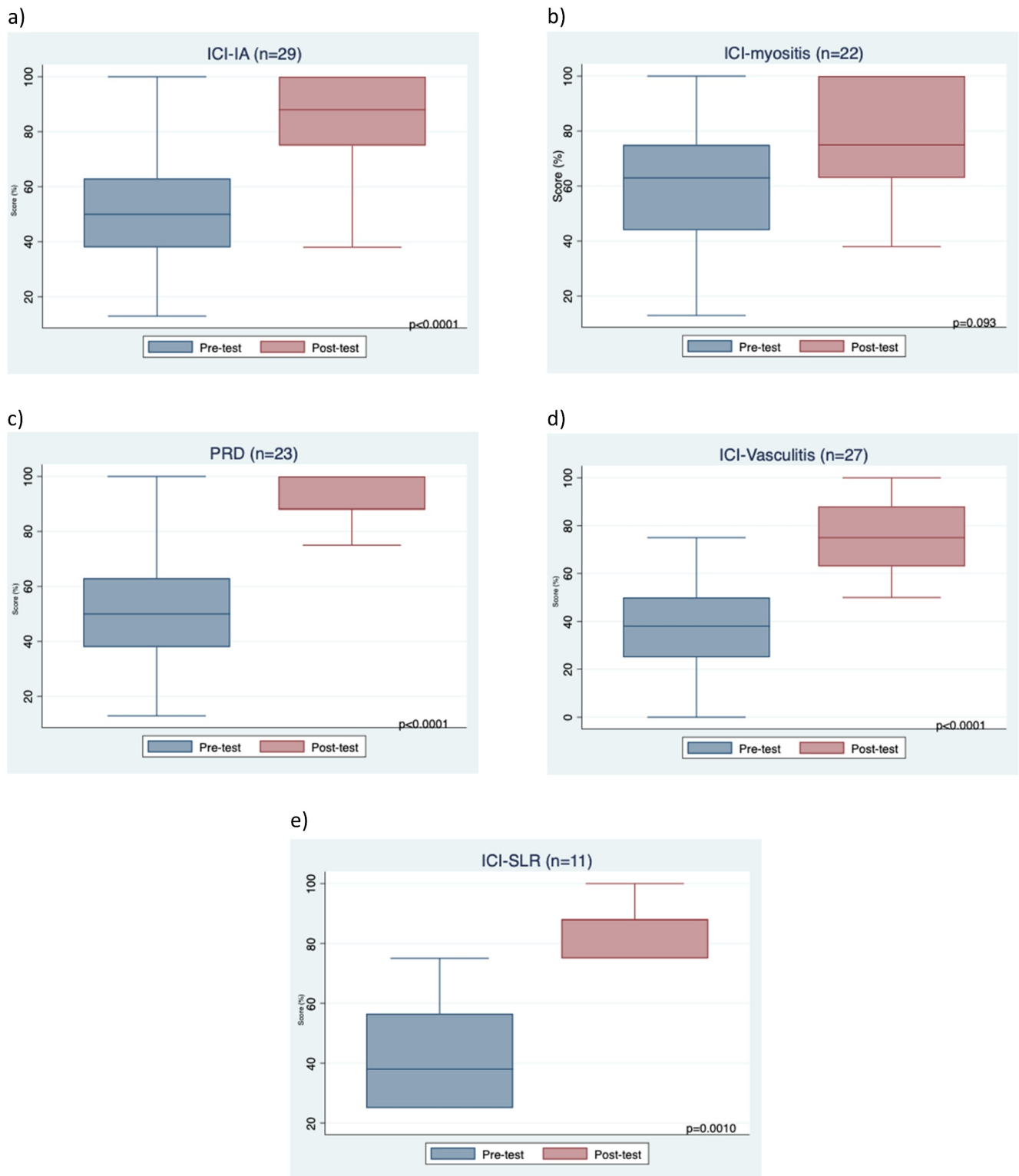


FIGURE 2 | Box plots of pre-test entries with paired post-test entries for the five modules. (a) ICI-inflammatory arthritis; (b) ICI-myositis; (c) ICI-pre-existing rheumatic disease; (d) ICI-vasculitis; (e) ICI-sarcoid-like reactions.

4 | Discussion

This study showed that baseline knowledge of common RhirAE issues is suboptimal, but that a web-based education platform is an effective tool to increase knowledge dissemination regarding Rh-irAE. The learning modules were successful in generating immediate knowledge acquisition and the website and case rounds reached an international target audience of predominantly rheumatologists.

To optimise patient outcomes, clinicians need to be aware of the most current evidence to guide the management of rheumatic complications of immunotherapy. This has historically been challenging, given the rapidly evolving nature of this area of medicine, with another major barrier being the absence of an easily accessible resource housing the most up-to-date evidence. This is the first web-based educational platform to address the urgent unmet need to educate the medical community on rheumatic complications of cancer immunotherapy. This platform has enabled health care-providers from all around the world to have equitable access to high quality, free educational resources.

Given the overwhelming quantity of literature and the time restraints physicians are faced with on a day-to-day basis continuing medical education (CME) must be convenient, concise, and clinically relevant. Physicians are increasingly turning to web-based educational initiatives to meet their learning needs, which have been shown to be more effective and efficient than traditional didactic educational sessions (Cullen et al. 2019). It has been consistently shown in studies on CME effectiveness that multiple exposures are more effective than a single exposure and that interactive techniques, including those employed in a case-based rounds, are more effective and may lead to both improved physician performance and patient outcomes (Cervero and Gaines 2015). In addition, CME activities that use multiple educational techniques have been shown to have a greater overall positive effect than those that use a single technique (Cervero and Gaines 2015). In creating this educational platform, we incorporated these aspects of CME that are proven most effective through the utilisation of live media and the incorporation of multiple interactive educational techniques including both enduring material and access to case rounds. Comparison of pre- and post-module test scores confirmed that the learning modules were effective in immediate knowledge acquisition. Furthermore, this platform has provided a unique opportunity for collaboration across both geographic locations and disciplines through participation in the case rounds. A recent scoping review exploring the advantages and disadvantages of virtual CME reported opportunities for collaboration as one of the most cited advantages by participants (Cheng et al. 2023).

A limitation of this study was the lack of data on whether this knowledge dissemination has ultimately impacted physician practices or patient outcomes, as assessment of these elements of knowledge translation was beyond the scope of this study. Furthermore, at present, our educational resources are only available in English; however, the amount of global website traffic has highlighted the need for translation into other languages.

In summary, the CanRIO website, a comprehensive knowledge dissemination platform on Rh-irAE of cancer immunotherapy, has been accessed by the global medical community. Further research is needed to evaluate whether this knowledge dissemination will lead to changes in physician practice and patient outcomes. Future initiatives will continue to foster international collaboration from a clinical, education and research perspective.

Author Contributions

Janet Roberts: conceptualization, data curation, formal analysis, funding acquisition, methodology, investigation, methodology, project administration, resources, software, validation, visualization, writing—original draft, writing—review & editing. **Shahin Jamal:** conceptualization, data curation, funding acquisition, methodology, writing—review & editing, visualization, resources. **Marie Hudson:** conceptualization, data curation, funding acquisition, methodology, writing—review & editing, visualization, resources. **Steven Katz:** conceptualization, data curation, funding acquisition, methodology, writing—review & editing, visualization, resources. **Daniel Ennis:** conceptualization, data curation, funding acquisition, methodology, writing—review & editing, visualization, resources. **Nancy Maltez:** conceptualization, data curation, funding acquisition, methodology, writing—review & editing, visualization, resources. **Keith Lau:** formal analysis, methodology, validation, writing—review & editing. **Carrie Ye:** conceptualization, data curation, formal analysis, funding acquisition, methodology, investigation, methodology, project administration, resources, software, validation, visualization, writing—original draft, writing—review & editing.

Ethics Statement

This study was exempt from the research ethics board review.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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