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ORIGINAL ARTICLE

Does dissemination of guidelines alone increase the use of palliative single-fraction radiotherapy? Initial report of a longitudinal change management campaign at a provincial cancer program

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ABSTRACT

Background Despite level 1 evidence demonstrating the equivalence of single-fraction radiotherapy (SFRT) and multiple-fraction radiotherapy (MFRT) for the palliation of painful bone metastases, SFRT remains underused. In 2015, to encourage the sustainable use of palliative radiation oncology resources, CancerCare Manitoba disseminated, to each radiation oncologist in Manitoba, guidelines from Choosing Wisely Canada (CWC) that recommend SFRT. We assessed whether dissemination of the guidelines influenced SFRT use in Manitoba in 2016, and we identified factors associated with MFRT.

Methods All patients treated with palliative radiotherapy for bone metastasis in Manitoba from 1 January 2016 to 31 December 2016 were identified from the provincial radiotherapy database. Patient, treatment, and disease characteristics were extracted from the electronic medical record and tabulated by fractionation schedule. Univariable and multivariable logistic regression analyses were performed to identify risk factors associated with MFRT.

Results In 2016, 807 patients (mean age: 70 years; range: 35–96 years) received palliative radiotherapy for bone metastasis, with 69% of the patients having uncomplicated bone metastasis. The most common primary malignancies were prostate (27.1%), lung (20.6%), and breast cancer (15.9%). In 62% of cases, MFRT was used—a proportion that was unchanged from 2015. On multivariable analysis, a gastrointestinal [odds ratio (OR): 5.3] or lung primary (OR: 3.3), complicated bone metastasis (OR: 4.3), and treatment at a subsidiary site (OR: 4.4) increased the odds of MFRT use.

Conclusions Dissemination of CWC recommendations alone did not increase SFRT use by radiation oncologists in 2016. A more comprehensive knowledge translation effort is therefore warranted and is now underway to encourage increased uptake of SFRT in Manitoba.

Key Words Single-fraction radiotherapy, bone metastasis, palliation, knowledge translation, guideline adherence, quality improvement, behaviour change

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BACKGROUND

Palliative single-fraction radiotherapy (SFRT) has been shown in prospective randomized trials[1–4] and meta-analyses[5–8] to have efficacy equivalent to that with multiple-fraction radiotherapy (MFRT) for the management of painful bone metastasis. Compared with MFRT, SFRT does not increase levels of acute treatment-related toxicity[9] and does result in equivalent quality-of-life outcomes[10]. Compared with SFRT, MFRT requires more visits to a radiotherapy (RT) centre, is less convenient for patients, and is associated with greater out-of-pocket expenses[11], which can lead to

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significant financial toxicity for patients or their families[12]. For those reasons, SFRT is the fractionation schedule preferred by patients[13]. Moreover, compared with MFRT, SFRT consumes less linear accelerator machine time and reduces workload for radiation therapists. Thus, SFRT carries considerable economic advantages[3,14,15] and frees up RT resources to meet the growing demand for RT arising from an aging population. Despite the considerable advantages of SFRT over MFRT, and recommendations from influential guideline groups supporting SFRT use[16–18], SFRT remains underused worldwide in the clinical management of patients with bone metastasis[19–21].

Choosing Wisely Canada (CWC), a national taskforce of Canadian health care stakeholders, aims to encourage the sustainable use of health care resources by advocating for the reduction of unnecessary, low-value treatments across a broad range of health care disciplines, including oncology[22]. In 2015, CWC published oncology recommendations, jointly authored and endorsed by the Canadian Association of Radiation Oncology and the Canadian Partnership Against Cancer, which recommended SFRT as the fractionation schedule of choice for the palliative management of uncomplicated bone metastasis[23]. In 2015, the Canadian Partnership Against Cancer, in partnership with CWC, conducted an analysis of Canadian provincial cancer registry data to quantify the use of low-value RT practices, including MFRT for the palliation of bone metastases[21]. Their study found that, in Manitoba, a disproportionately large group of patients treated with palliative RT for a bone metastasis received MFRT (68.8%) rather than SFRT.

In response to the study findings, a multiyear collaborative pilot project was initiated between the Canadian Partnership Against Cancer and CancerCare Manitoba, with the aim to increase the sustainability of RT delivery in Manitoba by increasing the use of SFRT for the management of painful bony metastases. A preliminary step in the initiative was to electronically disseminate the CWC oncology guidelines locally to each radiation oncologist (RO) in Manitoba in the final quarter of 2015. The present study was conducted to assess whether the electronic dissemination of CWC guidelines to ROs in Manitoba led to increased use of SFRT during the 2016 calendar year and thus to lay the foundation for a multiyear knowledge translation and change management campaign in future years.

METHODS

CancerCare Manitoba is the provincially mandated and publically funded sole provider of RT services for the Canadian province of Manitoba, with a catchment population of approximately 1.3 million.

Guideline Dissemination

During the final quarter of 2015, the CWC oncology guidelines were disseminated by e-mail every 4 weeks to each RO in Manitoba. The portion of the CWC guidelines pertaining to the SFRT recommendation was placed into the body of the e-mail correspondence so as to specifically direct the attention of ROs to the recommendation. The present study was conducted to assess whether the electronic dissemination of the CWC guidelines to ROs led to a change in clinical practice at the population level: Specifically, was there, in 2016, any increase in the use of SFRT in Manitoba over the previously reported 2015 use of SFRT in Manitoba (38.1%)[24]?

Data Sources, Data Extraction, Patient Variables

All patients treated with palliative RT for bone metastasis in Manitoba during the study period (1 January 2016 to 31 December 2016) were identified using the CancerCare Manitoba medical physics database, a prospectively maintained electronic administrative database populated with data fields from the RT treatment directive completed by a prescribing RO before the initiation of any RT-related treatment procedures. The following variables were electronically extracted from the database for each patient: RT treatment intent, patient age at time of RT, target volumes, RT dose, RT fractionation schedule, CancerCare Manitoba site of RT delivery [Winnipeg or the Western Manitoba Cancer Centre (WMCC) in Brandon], and RT delivery technique [2- or 3-dimensional RT compared with stereotactic body RT (SBRT)]. The remaining pretreatment characteristics—including sex, primary tumour type (diagnostic code from the *International Statistical Classification of Diseases and Related Health Problems,* revision 10), anatomic treatment site, Eastern Cooperative Oncology Group performance status, and score on the Charlson comorbidity index—were manually extracted from the CancerCare Manitoba electronic medical record.

Diagnostic imaging reports were used to determine the presence of a fracture of the bone receiving RT, presence of significant extension of the bone metastasis into surrounding soft tissues, presence of spinal cord compression, and presence of cauda equina compression. Bone metastases were classified as complicated based on the definition of Cheon *et al.*[25], who defined a complicated bone metastasis as one associated with any of cauda equina compression, spinal cord compression, or pathologic fracture. Patients were excluded from the analysis if the metastasis receiving palliative RT was primarily a soft-tissue metastasis with only a minor component of bony invasion (defined as a bone metastasis volume of less than 10% of the target volume). Radiation oncologist experience level (years in practice) was calculated by subtracting the year of RO specialist certification (obtained online from the College of Physicians and Surgeons of Manitoba) from 2016.

Statistics

Baseline characteristics were tabulated for the entire cohort and by fractionation schedule subgroup (SFRT vs. MFRT). Differences in the distribution of baseline characteristics by fractionation schedule were assessed using standard statistical tests (chi-square, Student *t*-test). The proportion of patients who received SFRT in 2016 was compared with the proportion treated with SFRT in 2015 (38.1%) using the one-sample *z*-test test for proportions. The proportion of patients treated with SFRT by each individual RO for both uncomplicated and all bone metastases was visualized using bar graphs. Univariable logistic regression analysis was used to assess patient, disease, and treatment variables for potential associations with receipt of MFRT. A multivariable logistic regression model was built using a forward stepwise approach. Variables with univariable associations of $p \leq 0.2$

were considered for inclusion in the multivariable model, and variables were assessed for collinearity in the model by assessing change in model variance during the forward stepwise selection process. Multivariable associations at $p \leq 0.05$ were considered statistically significant. All analyses were conducted using the Stata software application (version 12: StataCorp LP, College Station, TX, U.S.A.).

The study was conducted with the prior written approval of the University of Manitoba Health Research Ethics Board and the CancerCare Manitoba Research Resource Impact Committee.

RESULTS

From 1 January 2016 to 31 December 2016, 907 patients in Manitoba were identified as having received palliative RT to a site of bone metastasis. Upon manual review of each RT treatment plan, 83 patients were excluded from the cohort because their metastasis was a soft-tissue-predominant metastasis, with only a minor component of bony invasion. During the study period, 17 patients were treated with SBRT to a bone metastasis of the spine; they were excluded from the cohort given that the fractionation schedule used for SBRT included considerations such as clinical trial enrolment and other special considerations outside the scope the present study.

The analysis thus included 807 patients [327 women (40.5%), Table I] with a median age of 70 years (range: 35–96 years). The most common primary tumour types were prostate (27.1%), lung (20.6%), and breast cancer (15.9%). The sites most commonly treated with RT were spine or skull (43.9%), pelvis (30.6%), and a lower extremity (9.7%). Re-treatment—that is, RT to a previously irradiated bone metastasis—was seen in 96 cases (11.9%).

TABLE I Baseline characteristics of the patient cohort, overall and by fractionation schedule

Variable	Patient cohort			*p* Value
	Overall	SFRT	MFRT	
Patient characteristics				
Patients *(n)*	807	307	500	
Age (years)				0.0005
Mean	70	71	67	
Range	35–96	38–94	35–96	
Sex [*n* (%)]				0.001
Women	327 (40.5)	101 (32.9)	226 (45.2)	
Men	480 (59.5)	206 (67.1)	274 (54.8)	
ECOG PS [*n* (%)]				0.670
0–1	312 (38.7)	126 (41)	186 (37.2)	
2	231 (28.6)	82 (26.7)	149 (29.8)	
3–4	172 (21.3)	66 (21.5)	106 (21.2)	
Unknown	92 (11.4)	33 (10.8)	59 (11.8)	
Score on the CCI [*n* (%)]				0.036
0	427 (52.9)	144 (46.9)	283 (56.6)	
1	199 (24.7)	87 (28.3)	112 (22.4)	
2	83 (10.3)	33 (10.8)	50 (10)	
≥3	55 (6.8)	28 (9.1)	27 (5.4)	
Unknown	43 (5.3)	15 (4.9)	28 (5.6)	
Disease characteristics				
Tumour type [*n* (%)]				<0.0001
Prostate	219 (27.1)	114 (37.1)	105 (21)	
Breast	128 (15.9)	43 (14.0)	85 (17)	
Lung	166 (20.6)	47 (15.3)	119 (23.8)	
Hematologic	90 (11.1)	36 (11.7)	54 (10.8)	
Non-prostate genitourinary	78 (9.7)	34 (11.0)	44 (8.8)	
Gastrointestinal	62 (7.7)	21 (6.8)	41 (8.2)	
Other	64 (7.9)	12 (3.9)	52 (10.4)	
Treatment site [*n* (%)]				<0.0001
Skull and spine	354 (43.9)	90 (29.3)	264 (52.8)	
Upper extremity	71 (8.8)	42 (13.7)	29 (5.8)	
Chest (including ribs)	57 (7.1)	34 (11.1)	23 (4.6)	
Pelvis	247 (30.6)	107 (34.9)	140 (28)	
Lower extremity	78 (9.7)	34 (11.1)	44 (8.8)	

TABLE I Continued

Variable	Patient cohort			*p* Value
	Overall	SFRT	MFRT	
Complicated metastasis [*n* (%)]				<0.0001
No	557 (69.0)	257 (83.7)	300 (60)	
Yes	250 (31.0)	50 (16.3)	200 (40)	
Fracture [*n* (%)]				<0.0001
No	603 (74.7)	256 (83.4)	347 (69.4)	
Yes	190 (23.5)	46 (15)	144 (28.8)	
Unknown	14 (1.7)	5 (1.6)	9 (1.8)	
Spinal cord compression [*n* (%)]				<0.0001
No	720 (89.2)	302 (98.4)	418 (83.6)	
Yes	79 (9.8)	5 (1.6)	74 (14.8)	
Unknown	8 (1)	0 (0)	8 (1.6)	
Treatment characteristics				
Re-treatment [*n* (%)]				<0.0001
No	711 (88.1)	248 (80.8)	463 (92.6)	
Yes	96 (11.9)	59 (19.2)	37 (7.4)	
CancerCare Manitoba site [*n* (%)]				0.006
MacCharles Unit	718 (89)	285 (92.8)	433 (86.6)	
Western Manitoba Cancer Centre	89 (11)	22 (7.2)	67 (13.4)	
Driving distance [*n* (%)]				0.522
0.77 km to ≤5.4 km	201 (25)	69 (22.5)	132(26.4)	
>5.4 km to ≤9.6 km	202 (25)	77 (25.1)	125 (25)	
>9.6 km to ≤55 km	202 (25)	84 (27.4)	118 (23.6)	
>55 km	202 (25)	77 (25.1)	125 (25)	
RO experience [*n* (%)]				0.005
1–7 Years	251 (31.1)	78 (25.4)	173 (34.6)	
8–15 Years	250 (31.0)	113 (36.8)	137 (27.4)	
≥16 Years	306 (37.9)	116 (37.8)	190 (38.0)	

SFRT = single-fraction radiation therapy; MFRT = multi-fraction radiation therapy; ECOG PS = Eastern Cooperative Oncology Group performance status; CCI = Charlson comorbidity index; RO = radiation oncologist.

Complicated bone metastasis accounted for 250 cases (31%) in the cohort. Specifically, 190 patients had fractures (23.5%), 79 had spinal cord compression (9.8%), and 26 had cauda equina compression (3.2%). Soft-tissue extension of the bone metastasis (any size) was observed in 168 cases (20.8%).

In 2016 in Manitoba, SFRT was used in 307 cases (38.0%), and MFRT was used in 500 cases (62.0%). For patients treated with MFRT, the most common fractionation schedules were 20 Gy in 5 fractions (79%), 30 Gy in 10 fractions (14.4%), and another MFRT schedule (6.6%, Figure 1). The proportion of complicated metastases in 2016 (31.0%) was slightly lower than that in 2015 (36.4%); re-treatment proportions were very similar year over year (2016: 11.9%; 2015: 12.5%). The proportion of patients treated with SFRT in 2016 (38%) did not differ statistically from the 2015 proportion (38.1%, $p = 0.486$), indicative of a lack of effectiveness of electronic dissemination of guidelines to individual ROs as a means of improving the use of SFRT.

Use of SFRT by individual ROs within the provincial complement of 17 ROs was found to range considerably, from as high as 77% to as low as 0% for all bone metastases and to as high as 80% and as low as 0% for uncomplicated bone metastases (Figure 2).

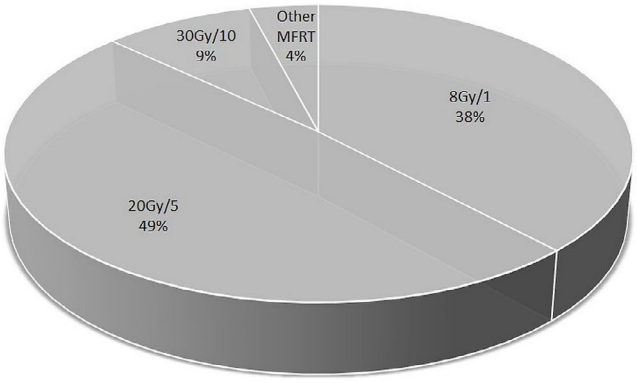

FIGURE 1 Palliative radiotherapy fractionation schedules used in 2016 in Manitoba.

Multivariable logistic regression analysis (Table II) revealed that the following factors were associated with increased odds of MFRT use: a primary tumour type of breast cancer [odds ratio (OR): 2.54; 95% confidence interval (CI): 1.17 to 5.44], hematologic cancer (OR: 2.07; 95%

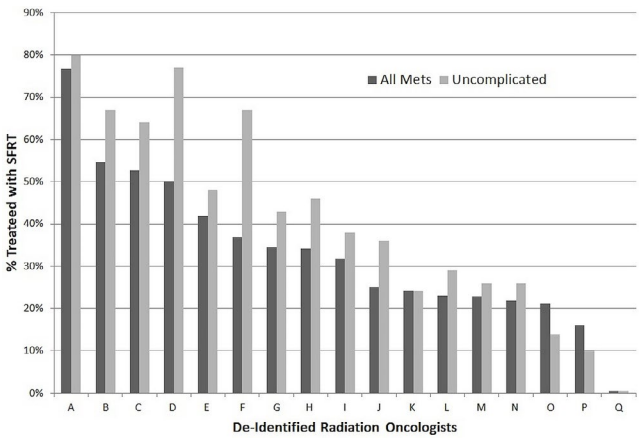

FIGURE 2 Proportion of single-fraction radiotherapy (SFRT) used in 2016 by radiation oncologists for uncomplicated and complicated bone metastases (Mets).

CI: 1.03 to 4.18), or gastrointestinal cancer (OR: 2.16; 1.01 to 4.58); a complicated metastasis (OR: 2.90; 95% CI: 1.87 to 4.49); and treatment at WMCC (OR: 3.84; 95% CI: 1.88 to 7.86). Factors associated with reduced odds of MFRT use included a score on the Charlson comorbidity index of 3 or greater (OR: 0.45; 95% CI: 0.22 to 0.93), re-treatment (OR: 0.38; 95% CI: 0.22 to 0.66), and treatment to a non-spine site. Experience level of the RO (years in practice) was not significantly associated with MFRT use after multivariable adjustment (p = nonsignificant).

DISCUSSION

It is commonplace for gaps to exist between the best available scientific evidence or guidelines and real-world clinical practice[26]. In the present study, we identified a significant gap between the strong, uncontroversial evidence supporting the use of SFRT and clinician behaviour in Manitoba with respect to the choice of a palliative RT dose and fractionation schedule for the management of painful bone metastases. Furthermore, we also observed that the repeated electronic dissemination of the CWC oncology guidelines to each RO in the province was an ineffective means to increase SFRT use in 2016 over use in 2015. Our study's findings appear to be in keeping with the experiences of other clinicians who have found that, where considerable gaps exist between guideline recommendations and clinician behaviour, the dissemination of guidelines alone is ineffective as a means to drive change in clinician behaviour[27–29].

There are several plausible explanations for the lack of guideline buy-in by ROs in Manitoba. First, individual physicians have been shown to perceive external guidelines as a challenge to their clinical decision-making autonomy[30–32]. That sentiment is potentially exacerbated when guidelines are disseminated as part of an external review (which was the case with our study); the dissemination process can further potentiate the perception of external restriction of physician decision-making independence and could lead to an attitude of noncompliance toward the guideline recommendations[30]. Second, physician confidence in guidelines has been shown to depend on the physician's affiliation with the guideline-authoring organization[30,33]. Although CWC is a respected guideline-generating organization of Canadian health care stakeholders, the CWC oncology guideline disseminated in the present study was CWC's first oncology guideline, and despite Canadian Association of Radiation Oncology participation in the writing of the guideline, ROs were potentially unfamiliar with the CWC organization. That unfamiliarity might have contributed to skepticism by ROs toward the guideline, leading to the assumption that the guideline was less informative then their own individual clinical experiences pertaining to the use of SFRT. Third, practical issues—namely, a lack of dedicated time[34] for busy oncologists, both individually and collectively, to review, discuss, and consider the guideline in the context of their own clinical practice—might have contributed to the lack of uptake of the CWC guideline. Physicians receive, on average, dozens of e-mail messages daily[35], and it is conceivable that, given the daily time pressures associated with modern oncologic care, e-mail dissemination of the CWC guidelines might have been an ineffective medium for delivering the guideline message.

Encouraging the adoption of guideline recommendations in the clinical setting is a challenging task, especially when guideline recommendations run contrary to entrenched clinical habits or workplace culture. Our study highlights the need for a coordinated knowledge translation effort to reduce the use of low-value MFRT in Manitoba. Our study identified several clinical subgroups, for which, in 2016, there was a notable reluctance to use SFRT, including patients with bone metastases originating from non-prostate primaries or with metastases located in the spine, and patients receiving treatment at a regional cancer centre (the WMCC). Because distance to the RT treatment centre (a surrogate for rural compared with urban residence) was not associated with use of MFRT, an unmeasured factor, perhaps pertaining to workplace culture at WMCC, might be responsible for the high use of MFRT at that centre. It is conceivable that concern about the possible need for re-treatment after SFRT might play a role in the choice for use of MFRT; however, measurement of the level of concern for re-treatment was not possible given the retrospective nature of the study. Future knowledge translation efforts geared to increasing use of SFRT at all of the RT centres in Manitoba will have to reinforce the safety of SFRT in all the aforementioned patient subgroups.

Knowledge translation research has evaluated the effectiveness of various approaches aimed at improving guideline adherence. Educational outreach visits, consisting of a visit by respected health care professionals to a specifically targeted audience at the local site of clinical practice to deliver a simple message has been shown in a Cochrane analysis[36] to consistently improve guideline compliance, especially with respect to influencing physician prescribing behaviour. Audit and feedback interventions, consisting of a summary of the clinical performance of a health care provider over a period of time, typically obtained from an administrative data source, followed by provision of performance indicators back to the health care providers on either the group or an individual level has been

TABLE II Univariable and multivariable logistic regression analysis for receipt of multi-fraction radiation therapy

Variable	Univariable analysis			Multivariable analysis		
	OR	95% CI	*p* Value	OR	95% CI	*p* Value
Age group						
35 to ≤59 Years		Reference			Reference	
60 to ≤69 Years	0.70	0.46 to 1.06	0.089	1.14	0.67 to 1.93	0.627
70 to ≤75 Years	0.88	0.57 to 1.36	0.576	2.10	1.15 to 3.82	0.016
≥76 Years	0.52	0.35 to 0.77	0.001	0.95	0.56 to 1.63	0.861
Sex						
Women		Reference			Reference	
Men	0.59	0.44 to 0.80	0.001	0.88	0.53 to 1.44	0.607
ECOG PS						
0–1		Reference			Reference	
2	1.23	0.86 to 1.75	0.247	0.90	0.59 to 1.36	0.604
3–4	1.09	0.74 to 1.59	0.665	0.77	0.48 to 1.24	0.282
Score on the CCI						
0		Reference			Reference	
1	0.66	0.46 to 0.92	0.016	0.65	0.43 to 1.00	0.051
2	0.77	0.48 to 1.25	0.291	0.69	0.39 to 1.23	0.212
≥3	0.49	0.28 to 0.86	0.014	0.44	0.22 to 0.91	0.027
Tumour type						
Prostate		Reference			Reference	
Breast	2.15	1.36 to 3.37	0.001	2.63	1.12 to 5.68	0.014
Lung	2.75	1.79 to 4.22	<0.0001	3.37	1.82 to 6.22	<0.0001
Hematologic	1.63	0.99 to 2.68	0.055	2.21	1.09 to 4.50	0.029
Non-prostate genitourinary	1.41	0.84 to 2.36	0.200	1.68	0.87 to 3.24	0.120
Gastrointestinal	2.12	1.18 to 3.82	0.012	2.17	1.02 to 4.62	0.045
Other	4.70	2.38 to 9.30	<0.001	6.46	2.75 to 15.14	<0.0001
Treatment site						
Skull or spine		Reference			Reference	
Pelvis	0.24	0.14 to 0.40	<0.0001	0.31	0.16 to 0.59	<0.0001
Upper extremity	0.23	0.13 to 0.63	<0.0001	0.25	0.12 to 0.50	<0.0001
Lower extremity	0.45	0.32 to 0.63	<0.0001	0.57	0.37 to 0.88	0.011
Thorax	0.44	0.27 to 0.73	0.002	0.43	0.23 to 0.79	0.006
Complicated metastasis						
No		Reference			Reference	
Yes	3.43	2.41 to 4.87	<0.0001	2.91	1.88 to 4.52	<0.0001
Re-treatment						
No		Reference			Reference	
Yes	0.34	0.22 to 0.52	<0.0001	0.37	0.21 to 0.65	<0.0001
CancerCare Manitoba site						
MacCharles Unit, Winnipeg		Reference			Reference	
Western Manitoba Cancer Centre, Brandon	2.00	1.21 to 3.32	0.007	3.45	1.58 to 7.52	0.002
Distance to treatment centre						
0.8 km to ≤5.4 km		Reference			Reference	
5.4 km to ≤9.6 km	0.85	0.57 to 1.27	0.429	1.07	0.63 to 1.80	0.808
9.6 km to ≤55.2 km	0.73	0.49 to 1.10	0.134	0.83	0.50 to 1.37	0.464
>55.2 km	0.85	0.57 to 1.27	0.429	0.93	0.55 to 1.55	0.767
RO experience						
1–7 Years		Reference			Reference	
8 to 15 Years	0.55	0.38 to 0.79	0.001	0.96	0.59 to 1.57	0.865
≥16 Years	0.74	0.52 to 1.05	0.093	0.73	0.45 to 1.16	0.181

OR = odds ratio; CI = confidence interval; ECOG PS = Eastern Cooperative Oncology Group performance status; CCI = Charlson comorbidity index; RO = radiation oncologist.

shown to improve guideline uptake[37,38]. Local consensus processes, which aim to involve local stakeholders in a series of roundtable discussions in which guidelines are reviewed and adapted or adopted for use by local providers, have also been found to improve guideline adherence[39], especially in cases in which guidelines are produced by an independent third party. Finally, leadership support by local clinical leaders—including creating a positive workplace environment in which guideline-compliant behaviours are encouraged, and facilitating organizational measures designed to improve guideline adherence—is also key in the development of effective knowledge translation initiatives[40]. Using the results of the present study, a comprehensive multistep knowledge translation and change management campaign was designed for stepwise implementation in Manitoba from 2017 to 2018 jointly with the Canadian Partnership Against Cancer. The campaign incorporated the aforementioned strategies to maximize the potential effectiveness of the overall effort. The results of that change management effort will be reported separately in the future.

It is unclear whether there is an ideal goal or threshold for SFRT use that radiation oncology programs should strive to achieve. Because the guidelines supporting SFRT pertain primarily to uncomplicated bone metastases, the upper limit of SFRT use in Manitoba would be approximately 69% (the case proportion of uncomplicated bone metastases in 2016). However, emerging evidence suggests that SFRT is noninferior to MFRT even for patients with metastatic spinal cord compression[41]. Because spinal cord compression accounted for approximately one third of cases of complicated bone metastasis in Manitoba, adoption of those emerging data in addition to the existing guidelines for uncomplicated bone metastasis might make it possible for SFRT use to reach levels higher than 69%.

Advanced RT techniques such as SBRT were rarely used in Manitoba during the study period, representing approximately 2% of all treated bone metastases. However, in subsequent years, increasing institutional familiarity with the use of SBRT for bone metastasis might lead to an increase in the proportion of patients treated with SBRT, as has been the case in other jurisdictions[42]. Still, given the current absence of any randomized evidence demonstrating an advantage of SBRT techniques over conventionally delivered palliative SFRT for bone metastasis, enthusiasm for the routine adoption of a resource-intensive technique (SBRT) in Manitoba's resource-constrained health care environment might be more muted than it is in jurisdictions in which remunerative considerations might provide ancillary motivation for more widespread use of SBRT.

Integrative approaches to palliative RT delivery using rapid-access clinics as described by Fairchild *et al.*[43] are increasingly being used to better serve the palliative care needs of patients with bone metastasis in a streamlined, holistic, and multidisciplinary manner. Multidisciplinary rapid-access clinics typically feature in-depth assessments of each patient's goals of care, symptom burden, and family member concerns, allowing for those factors to be integrated into decisions such as choice of fractionation schedule. Interestingly, in the setting of a rapid-access palliative RT clinic, use of SFRT is often higher than it is for bone metastasis managed in the same centres, but outside the auspices of the rapid-access clinic[43,44]. Thus, the establishment of a palliative rapid-access RT clinic model might represent another potential means to encourage SFRT use in the future in Manitoba.

CONCLUSIONS

In 2015, dissemination of CWC recommendations alone did not increase SFRT use in Manitoba in 2016. A comprehensive knowledge translation and change management campaign is therefore warranted and is currently underway in Manitoba to encourage increased uptake of SFRT.

CONFLICT OF INTEREST DISCLOSURES

We have read and understood *Current Oncology*'s policy on disclosing conflicts of interest, and we declare that we have none.

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REFERENCES

1. Chow E, Hoskin PJ, Wu J, *et al.* A phase III international randomised trial comparing single with multiple fractions for re-irradiation of painful bone metastases: National Cancer Institute of Canada Clinical Trials Group (NCIC CTG) SC 20. *Clin Oncol (R Coll Radiol)* 2006;18:125–8.
2. Roos DE, Turner SL, O'Brien PC, *et al.* on behalf of the Trans-Tasman Radiation Oncology Group. Randomized trial of 8 Gy in 1 versus 20 Gy in 5 fractions of radiotherapy for neuropathic pain due to bone metastases (Trans-Tasman Radiation Oncology Group, TROG 96.05). *Radiother Oncol* 2005;75:54–63.
3. Steenland E, Leer JW, van Houwelingen H, *et al.* The effect of a single fraction compared to multiple fractions on painful bone metastases: a global analysis of the Dutch Bone Metastasis Study. *Radiother Oncol* 1999;52:101–9.
4. Hartsell WF, Scott CB, Bruner DW, *et al.* Randomized trial of short- versus long-course radiotherapy for palliation of painful bone metastases. *J Natl Cancer Inst* 2005;97:798–804.
5. Chow E, Zeng L, Salvo N, Dennis K, Tsao M, Lutz S. Update on the systematic review of palliative radiotherapy trials for bone metastases. *Clin Oncol (R Coll Radiol)* 2012;24:112–24.
6. Wu JS, Wong R, Johnston M, Bezjak A, Whelan T on behalf of the Cancer Care Ontario Practice Guidelines Initiative Supportive Care Group. Meta-analysis of dose–fractionation radiotherapy trials for the palliation of painful bone metastases. *Int J Radiat Oncol Biol Phys* 2003;55:594–605.
7. Sze W, Shelley MD, Held I, Wilt TJ, Mason MD. Palliation of metastatic bone pain: single fraction versus multifraction radiotherapy—a systematic review of randomised trials. *Clin Oncol (R Coll Radiol)* 2003;15:345–52.
8. Chow R, Hoskin P, Schild SE, *et al.* Single vs. multiple fraction palliative radiation therapy for bone metastases: cumulative meta-analysis. *Radiother Oncol* 2019;141:56–61.
9. Westhoff PG, de Graeff A, Monninkhof EM, *et al.* Effectiveness and toxicity of conventional radiotherapy treatment for painful spinal metastases: a detailed course of side effects after opposing fields versus a single posterior field technique. *J Radiat Oncol* 2018;7:17–26.
10. Westhoff PG, Verdam MGE, Oort FJ, *et al.* Course of quality of life after radiation therapy for painful bone metastases: a detailed analysis from the Dutch Bone Metastasis Study. *Int J Radiat Oncol Biol Phys* 2016;95:1391–8.

11. van den Hout WB, Kramer GWPM, Noordijk EM, Leer JWH. Cost–utility analysis of short- versus long-course palliative radiotherapy in patients with non-small-cell lung cancer. *J Natl Cancer Inst* 2006;98:1786–94.
12. Carrera PM, Kantarjian HM, Blinder VS. The financial burden and distress of patients with cancer: understanding and stepping-up action on the financial toxicity of cancer treatment. *CA Cancer J Clin* 2018;68:153–65.
13. Szumacher E, Llewellyn-Thomas H, Franssen E, *et al.* Treatment of bone metastases with palliative radiotherapy: patients' treatment preferences. *Int J Radiat Oncol Biol Phys* 2005;61:1473–81.
14. Konski A, James J, Hartsell W, *et al.* Economic analysis of Radiation Therapy Oncology Group 97-14: multiple versus single fraction radiation treatment of patients with bone metastases. *Am J Clin Oncol* 2009;32:423–8.
15. Pollicino CA, Turner SL, Roos DE, O'Brien PC. Costing the components of pain management: analysis of Trans-Tasman Radiation Oncology Group trial (TROG 96.05): one versus five fractions for neuropathic bone pain. *Radiother Oncol* 2005;76:264–9.
16. Wu JSY, Wong RKS, Lloyd NS, Johnston M, Bezjak A, Whelan T on behalf of the Supportive Care Guidelines Group of Cancer Care Ontario. Radiotherapy fractionation for the palliation of uncomplicated painful bone metastases—an evidence-based practice guideline. *BMC Cancer* 2004;4:71.
17. Lutz S, Berk L, Chang E, *et al.* on behalf of the American Society for Radiation Oncology (ASTRO). Palliative radiotherapy for bone metastases: an ASTRO evidence-based guideline. *Int J Radiat Oncol Biol Phys* 2011;79:965–76.
18. Lutz S, Balboni T, Jones J, *et al.* Palliative radiation therapy for bone metastases: update of an ASTRO evidence-based guideline. *Pract Radiat Oncol* 2017;7:4–12.
19. Fairchild A, Barnes E, Ghosh S, *et al.* International patterns of practice in palliative radiotherapy for painful bone metastases: evidence-based practice? *Int J Radiat Oncol Biol Phys* 2009;75:1501–10.
20. Hartsell WF, Konski AA, Lo SS, Hayman JA. Single fraction radiotherapy for bone metastases: clinically effective, time efficient, cost conscious and still underutilized in the United States? *Clin Oncol (R Coll Radiol)* 2009;21:652–4.
21. Tran K, Rahal R, Brundage M, *et al.* Use of low-value radiotherapy practices in Canada: an analysis of provincial cancer registry data. *Curr Oncol* 2016;23:351–5.
22. Levinson W, Huynh T. Engaging physicians and patients in conversations about unnecessary tests and procedures: Choosing Wisely Canada. *CMAJ* 2014;186:325–6.
23. Mitera G, Earle C, Latosinsky S, *et al.* Choosing Wisely Canada cancer list: ten low-value or harmful practices that should be avoided in cancer care. *J Oncol Pract* 2015;11:e296–303.
24. Chung YT, Ong A, Bashir B, *et al.* Utilization rates of palliative single fraction radiotherapy (SFRT) versus multiple fraction radiotherapy (MFRT) for bone metastases in Manitoba and identification of risk factors associated with receipt of MFRT: a retrospective, population-based, cohort study [abstract 310]. *Radiother Oncol* 2018;129(suppl 1):S105.
25. Cheon PM, Wong E, Thavarajah N, *et al.* A definition of "uncomplicated bone metastases" based on previous bone metastases radiation trials comparing single-fraction and multi-fraction radiation therapy. *J Bone Oncol* 2015;4:13–17.
26. Curran JA, Grimshaw JM, Hayden JA, Campbell B. Knowledge translation research: the science of moving research into policy and practice. *J Contin Educ Health Prof* 2011;31:174–80.
27. Corbelli J, Borrero S, Bonnema R, *et al.* Physician adherence to U.S. Preventive Services Task Force mammography guidelines. *Womens Health Issues* 2014;24:e313–19.
28. Yu CH, Lillie E, Mascarenhas-Johnson A, Gall Casey C, Straus SE. Impact of the Canadian Diabetes Association guideline dissemination strategy on clinician knowledge and behaviour change outcomes. *Diabetes Res Clin Pract* 2018;140:314–23.
29. Bhattacharyya N, Kepnes LJ. Initial impact of the acute otitis externa clinical practice guideline on clinical care. *Otolaryngol Head Neck Surg* 2011;145:414–17.
30. Tunis SR, Hayward RS, Wilson MC, *et al.* Internists' attitudes about clinical practice guidelines. *Ann Intern Med* 1994;120:956–63.
31. Browman GP, Levine MN, Mohide EA, *et al.* The practice guidelines development cycle: a conceptual tool for practice guidelines development and implementation. *J Clin Oncol* 1995;13:502–12.
32. Carlsen B, Glenton C, Pope C. Thou shalt versus thou shalt not: a meta-synthesis of GPs' attitudes to clinical practice guidelines. *Br J Gen Pract* 2007;57:971–8.
33. Scheel JR, Hippe DS, Chen LE, *et al.* Are physicians influenced by their own specialty society's guidelines regarding mammography screening? An analysis of nationally representative data. *AJR Am J Roentgenol* 2016;207:959–64.
34. Francke AL, Smit MC, de Veer AJ, Mistiaen P. Factors influencing the implementation of clinical guidelines for health care professionals: a systematic meta-review. *BMC Med Inform Decis Mak* 2008;8:38.
35. Welch WC, Mathew MS, Welch RL, McShane BJ. Email as an encumbrance to physician-patient communication. *Cureus* 2019;11:e3816.
36. O'Brien MA, Rogers S, Jamtvedt G, *et al.* Educational outreach visits: effects on professional practice and health care outcomes. *Cochrane Database Syst Rev* 2007;2007:CD000409.
37. Grimshaw JM, Thomas RE, MacLennan G, *et al.* Effectiveness and efficiency of guideline dissemination and implementation strategies. *Health Technol Assess* 2004;8:1–72.
38. Olson RA, Tiwana M, Barnes M, *et al.* Impact of using audit data to improve the evidence-based use of single-fraction radiation therapy for bone metastases in British Columbia. *Int J Radiat Oncol Biol Phys* 2016;94:40–7.
39. Medves J, Godfrey C, Turner C, *et al.* Systematic review of practice guideline dissemination and implementation strategies for healthcare teams and team-based practice. *Int J Evid Based Healthc* 2010;8:79–89.
40. Gifford WA, Davies B, Edwards N, Graham ID. Leadership strategies to influence the use of clinical practice guidelines. *Nurs Leadersh (Tor Ont)* 2006;19:72–88.
41. Hoskin P, Misra V, Hopkins K, *et al.* SCORAD III: randomized noninferiority phase III trial of single-dose radiotherapy (RT) compared to multifraction RT in patients (pts) with metastatic spinal canal compression (SCC) [abstract LBA10004]. *J Clin Oncol* 2017;35:. [Available online at: https://ascopubs.org/doi/abs/10.1200/JCO.2017.35.18_suppl.LBA10004; cited 7 January 2019]
42. Guadagnolo BA, Huo J, Liao KP, Buchholz TA, Das P. Changing trends in radiation therapy technologies in the last year of life for patients diagnosed with metastatic cancer in the United States. *Cancer* 2013;119:1089–97.
43. Fairchild A, Pituskin E, Rose B, *et al.* The rapid access palliative radiotherapy program: blueprint for initiation of a one-stop multidisciplinary bone metastases clinic. *Support Care Cancer* 2009;17:163–70.
44. Casson C, Johnson J. Implementation and evaluation of a rapid access palliative clinic in a New Zealand cancer centre. *J Med Radiat Sci* 2014;61:217–24.