

OSTEOPOROSIS



Report from Osteoporosis Canada's second national FLS audit (2020): helping Canadian FLSs reach their full potential



September 2020

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Executive summary

After a first fragility fracture, the risk of a subsequent fracture approximately doubles and any new fractures are most likely to occur within the next 2 years.¹⁻⁴ Despite availability of inexpensive medications that are effective at reducing the risk of those secondary fractures, the Public Health Agency of Canada (PHAC) has recently demonstrated that fewer than 20% of Canadians who present with a new fragility fracture will be diagnosed and/or treated for their underlying osteoporosis within one year of that fracture.⁵

A model of care called Fracture Liaison Service (FLS) is, by far, the most effective secondary fracture prevention method to ensure fracture patients receive the osteoporosis care they need to prevent new fractures.⁶⁻⁸ FLS has been proven to effectively:

- improve patient care by closing the post-fracture care gap⁶⁻¹⁹
- reduce the incidence of repeat fractures (including hip fractures)^{7,9-11,19,20}
- reduce mortality in this patient population^{9,20}
- reduce healthcare utilization and associated costs^{7,10,12,17,21-25}

It is an indispensable function for all FLSs to measure and monitor the effectiveness of their processes. FLSs may frequently be hindered by various internal and/or external barriers and many patients may unknowingly be “left behind”. Osteoporosis Canada’s (OC) national FLS audits are a critical component of every FLSs’ continuous quality improvement (CQI). The OC audits are intended for all Canadian FLSs except those under the Ontario Osteoporosis Strategy as the latter perform their own internal audits.

The foundation for OC’s national FLS audits are its Key Performance Indicators (KPIs) v2.0²⁶ which outline a set of clearly defined measures based on the proportion of patients who receive optimal osteoporosis management post-fracture. The core KPIs deemed absolutely essential to all FLSs include:

- **First i:** Identification
 - Of patients presenting to the particular clinical care setting covered by the FLS (i.e. inpatient, outpatient or both), the proportion of fragility fracture patients who are successfully identified and captured by the FLS. The KPI for the first i is sub-divided into
 - First i, hips - provides greater insight into barriers specific to the inpatient settings.
 - First i, non-hip, non-spine (NHNS) - provides greater insight into the barriers in outpatient settings.



- **Second i:** Investigation
 - Proportion of FLS patients for whom a fracture risk determination is completed.
- **Third i:** Initiation of treatment
 - Of the high-risk patients in the FLS, proportion on effective osteoporosis treatment within 26 weeks of fracture.

Audit results

This report provides an overview of the results from OC’s second national FLS audit (cohort of FLS patients from April 1 to September 30, 2019). These results are compared to OC’s first national audit (cohort of FLS patients from April 1 to September 30, 2017).

Of 17 eligible Canadian FLSs, 15 participated in this second audit (88% participation rate). The aggregate results are provided below.

KPI	First audit Total of 1398 patients	Second audit Total of 1870 patients
First i, hips	73%	↑79%
First i, NHNS	56%	↑73%
Second i	90%	↑95%
Third i	49%	↑57%

The results of this second national FLS audit once again demonstrate the effectiveness of Canadian FLSs in closing the post-fracture care gap. There is also an encouraging trend over time denoting improvement from the first national FLS audit. This is especially notable for KPIs demonstrating the poorest results in the first audit. It is very obvious that our Canadian FLSs have implemented changes that have led to improved patient outcomes.

“The national FLS audits have been so very helpful in helping us identify areas for improvement. By removing barriers, we were able to improve our FLS’s results on key performance indicators. The patients are the real winners as they will have improved clinical outcomes.”

Carla Purcell
FLS Coordinator, Dartmouth, NS

The results of this second national FLS audit highlight the ongoing and unwavering commitment of Canadian FLSs to CQI and to improving osteoporosis care for Canadians presenting with fragility fractures.

Let’s make their FIRST break their LAST!

Glossary of terms and acronyms used in this document

Fracture Liaison Service:	
A Fracture Liaison Service (FLS) is a specific systems-based model of care for secondary fracture prevention where a dedicated coordinator:	
IDENTIFICATION	<ul style="list-style-type: none"> systematically and proactively identifies patients aged 50 years and older presenting to a hospital with a new fragility fracture and/or with a newly reported vertebral fracture;
INVESTIGATION	<ul style="list-style-type: none"> organizes appropriate investigations to determine the patient's fracture risk;
INITIATION	<ul style="list-style-type: none"> facilitates the initiation of appropriate osteoporosis medications.
FLS has outperformed all other post-fracture osteoporosis interventions in terms of significant patient outcomes and reduction in healthcare costs. ⁶⁻⁸	

The “3i’s”

Identification, **Investigation** and **Initiation** of treatment are often referred to as the “3i’s” of FLS, with identification being the first i, investigation the second i and initiation the third i.

Fragility fracture

A fragility fracture is a fracture occurring spontaneously or following minor trauma such as a fall from standing height or less. In this document, we focus on the non-spine fragility fractures recommended for surveillance by the Public Health Agency of Canada (PHAC): hip (proximal femur), wrist (distal radius), shoulder (proximal humerus) and pelvis. The latter 3 fracture types are referred to as non hip, non spine (NHNS) fractures.

Types of FLSs

- **Inpatient-only FLS:** FLS that enrolls only fragility fracture patients admitted to hospital. Most inpatient-only FLSs are also hip-only FLSs.
- **Outpatient-only FLS:** FLS that enrolls only fragility fracture patients from orthopaedic outpatient clinics.
- **Combined inpatient/outpatient FLS:** FLS that enrolls patients from both the inpatient wards and from the orthopaedic outpatient clinics.

Acronyms

CIHI: Canadian Institute for Health Information

CQI: Continuous Quality Improvement

FLS: Fracture Liaison Service

KPI: Key Performance Indicator

NHNS: Non-hip, non-spine fracture patients

OC: Osteoporosis Canada

PHAC: Public Health Agency of Canada

Natural history of fragility fractures without an FLS

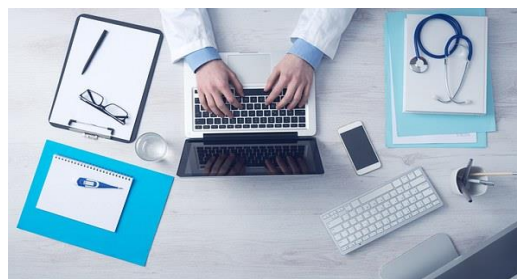
After the first fragility fracture, the risk of a subsequent fracture approximately doubles and any new fractures are most likely to occur within the next 2 years.¹⁻⁴ The risk of another fracture is both elevated and imminent. The clock is ticking from the minute the initial fracture occurs, thus appropriate osteoporosis management must be initiated promptly to reduce the patient's imminent risk of another fracture.

Unfortunately, without access to FLS, less than 20% of Canadians who suffer a fragility fracture ever receive the osteoporosis care they need to prevent their next fracture.^{5,27-29}

Many interventions have been tried but only FLS has been able to show a very meaningful reduction in the post-fracture care gap,⁶⁻¹⁹ the incidence of repeat fractures,^{7,9-11,19,20} mortality,^{9,20} and utilization/costs of healthcare resources.^{7,10,12,17,21-25} Shockingly, there are very few FLSs in Canada and most Canadians who fracture still do not have access to an FLS at this time.

Re-calculation of results from the first national FLS audit

In order to allow for comparison with the results of the second national FLS audit, the results from OC's first national FLS audit were re-calculated using the current version of the OC FLS KPIs (v2.0)²⁶, which amended the method of estimating the denominator for the first i.



OC's second national FLS audit: overview

This national FLS audit is intended for all Canadian FLSs, excluding those of the Ontario Osteoporosis Strategy as the latter conducts its own audits.

As this is a voluntary audit, we are most grateful for the hard work of the many healthcare professionals and administrators who have contributed to this effort.

The second national FLS audit evaluates the FLSs' performance on the OC core FLS KPIs, as defined in *Key performance indicators (KPIs) for Canadian FLSs v2.0: setting the foundation for reflective practice and improvement for FLSs*²⁶:

- First i, hips
- First i, non-hip, non-spine (NHNS)
- Second i
- Third i

While OC’s national audits evaluate only the FLS and its processes, we recognize that the wider system in which the FLS operates is also important. For example, an inpatient-only/hip-only FLS will be evaluated for one component of the first i, (first i, hips) rather than both as would be the case for a combined inpatient/outpatient FLS. It is very possible for that hip-only FLS to score well on the KPI for first i, hips. However, it is noted in their individual FLS performance report that the lack of FLS for NHNS fracture patients is a major gap in osteoporosis care at that hospital.

OC’s second national FLS audit: participation

Seventeen FLSs were eligible to participate in this audit.

Of the 17 eligible FLSs, participation is as follows:

- 15 provided complete data (88% audit participation rate)
- 2 FLSs were unable to provide their data as their FLS was temporarily suspended due to the Covid-19 pandemic.

FLS type of participating FLSs	Number of FLSs
Combined inpatient/outpatient FLS	5
Inpatient-only FLS	9
Outpatient-only FLS	1

FLS remains a very rare entity in this country. There are hundreds of hospitals offering orthopaedic fracture care in Canada and there were only 41 FLSs at the time of the audit. Despite the compelling scientific and health economics evidence in support of FLS, the overwhelming majority of Canadians who suffer a fragility fracture still do not have access to an FLS in 2020!

OC’s second national FLS audit: data gathering and management

All but one of the FLSs provided data on the cohort of patients enrolled by the FLSs from April 1 to September 30, 2019. Each of these patients was followed for a 6-month period, ending on or before March 31, 2020.

Exceptionally, one FLS was without FLS coordinator during the entire audit cohort period. To promote audit participation, and with the consent of OC’s FLS Audit Committee, a 6-month cohort of patients from May 1 to October 31, 2018 was submitted

instead by that FLS, with the follow up period correspondingly modified. It is expected that the results are comparable.

FLSs submit aggregate rather than patient level data; therefore, OC is not able to verify the accuracy of the submitted data.

The KPIs for the first i are completely dependent on our ability to identify a valid denominator from a database independent of the FLS. Because of unusual circumstances at two hospitals (and completely unrelated to the FLSs themselves), a valid denominator cannot be estimated for one of their first i KPIs (one for first i, hips and the other for first i, NHNS). Both FLSs were excluded from those very specific KPIs (they were included in the analysis for all other KPIs).

All data was analysed in accordance with OC’s FLS KPIs v2.0.²⁶

NEW this year: levels of achievement

The FLS Audit Committee has determined color-coded levels of achievement for core FLS KPIs based on the following principles:

- First determine the near optimal level for the specific KPI. This will be considered the threshold for the GREEN zone.
- In recognition that most FLSs will start with lower performance and gradually improve over time, allow for a broad 30 percentage point spread for an AMBER zone, indicative of “Good, room for improvement”.
- Any performance below AMBER will be color-coded RED and signifies “highest priority for service improvement”.



1. Plan
2. Do
3. Study
4. Act

The FLS Audit Committee has set the following thresholds for this audit:

Levels to be reached		Color	Interpretation
First and third i's	Second i		
0-49%	0-64%	RED	Highest priority for service improvement
50-79%	65-94%	AMBER	Good, room for improvement
≥ 80%	≥ 95%	GREEN	Great, at or near optimal

The thresholds will be reviewed periodically by the FLS Audit Committee as it is anticipated that the performance of FLSs will gradually improve over time. For more information about these thresholds, please see Appendix A.

NEW this year: trend over time

For the first time, there are two data points (2018 and 2020 audits). This is the opportunity for FLSs to see the results of their CQI by monitoring their trend over time.

By consensus, the FLS Audit Committee has determined that absolute changes of 5% will be highlighted as follows:

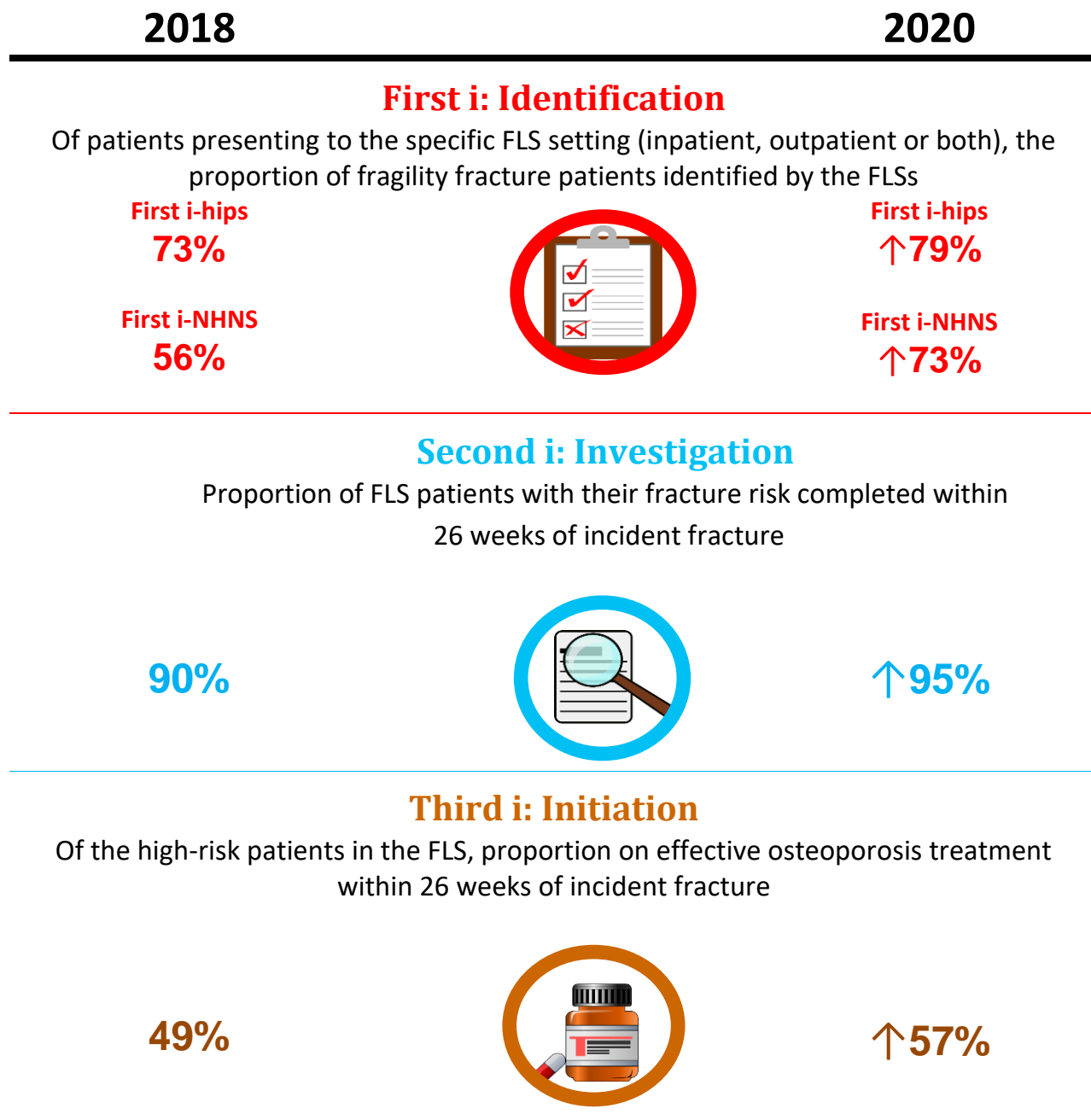
- ↑ denotes an absolute increase of 5% or more
- ↓ denotes an absolute decrease of 5% or more
- ↔ no significant change, i.e. a change that is less than 5%. Please note that any changes, no matter how great, that are fully within the GREEN zone in both 2018 and 2020 are felt to be insignificant as they are already at or near optimal on both measurements.



FLS audit results

Aggregate results

The results below should be interpreted taking the post-fracture care gap into consideration. PHAC has recently documented that less than 20% of Canadians who present with a fragility fracture receive a prescription for an osteoporosis medication within 12 months of their fracture.⁵












Medians and ranges for individual Canadian FLSs on the core KPIs

KPI (Number of FLSs in second audit)	First audit medians (range) N ≤ 12 FLSs	Second audit medians (range) N ≤ 15 FLSs
First i, hips (14 FLSs)	77% (54%-100%)	79.5% ↔ (52%-100%)
First i, NHNS (5 FLSs)	61% (54%-96%)	74% ↑ (52%-100%)
Second i (15 FLSs)	98.5% (63%-100%)	100% ↔ (68%-100%)
Third i (15 FLSs)	50% (24%-86%)	60% ↑ (38%-83%)

The results of this second national FLS audit demonstrate the effectiveness of Canadian FLSs in closing the post-fracture care gap. There is also an encouraging trend over time denoting improvement from the first national FLS audit.



FLSs' levels of achievement

	Percentage of FLSs reaching each level	
	First audit	Second audit
First i, hips	45%	50% 
	55%	50% 
	0	0
First i, NHNS	20%	40% 
	80%	60% 
	0	0
Second i	67%	87% 
	25%	13% 
	8%	0
Third i	9%	13% 
	45%	60% 
	45%	27% 

The curved arrows show where movement occurred between the first and second audits. There has been an improvement, with less RED “flags” and an overall movement from AMBER to GREEN.

No FLS is perfect!

FLSs attaining GREEN level of achievement

	Of 15 FLSs
Attained GREEN for all 4 KPIs	0
Attained GREEN for 3 of the 4 KPIs	1
Attained GREEN for 2 of the 4 KPIs	8
Attained GREEN for 1 of the 4 KPIs	5
Did not attain GREEN for any of the 4 KPIs	1

FLSs with RED “flags”

	Of 15 FLSs
Received no RED “flags” at all	11
Received one single RED “flag”	4*
Received more than one RED “flag”	0

*All 4 RED “flags” were for the third i.

National FLS audits: nurturing improvements in patient care

The first national FLS audit had already identified that initiation of treatment in high risk patients (third i) is challenging for most FLSs.

Despite a significant improvement in the third i, the second audit still clearly demonstrates that initiation of appropriate osteoporosis treatment post-fracture remains a challenge. To patients and some primary care providers, the benefit of osteoporosis medications in preventing an imminent new fracture is very often dwarfed by their disproportionate fear of extremely rare side-effects. This phenomenon is recognized as the cause for the worsening of the post-fracture care gap that has been demonstrated since 2009 in Canada.⁵

Since the first national audit, collective efforts to improve the treatment initiation in high risk patients have included:

- OC partnered with Canadian FLS coordinators to develop new educational tools for patients to address their concerns about side effects to osteoporosis medications with evidence-based data. These are already in use in many FLSs.
- A webinar discussing the importance of appropriate osteoporosis management for the elderly with fragility fractures
- At the local level:
 - FLSs advocating to provincial drug plans for more comprehensive coverage of osteoporosis therapies
 - Educational sessions have been offered to primary care providers and physicians caring for long term care residents
 - Posters providing guidance on the proper administration of oral bisphosphonates have been distributed to long term care facilities.

It is, therefore, very gratifying to see the noticeable improvement in the third i in this second audit compared to the first one (median for individual FLSs improved from 50% to 60%; national aggregate results improved from 49% to 57%). Despite that improvement, the third i remains the single biggest challenge faced by most Canadian FLSs. More intense efforts are still needed to close that gap and ensure the greatest benefit for fragility fracture patients.

Next steps

Canadian FLSs are to be congratulated for their commitment to ensuring quality osteoporosis care for fragility fracture patients. The high participation rate in this voluntary audit is a testament to that commitment as is the noticeable improvement in this second audit compared to the first one.

Local FLS teams will review the results reported in their confidential FLS KPI reports to identify areas for improvement. They will be supported as they begin to address barriers to success and to adopt solutions that will help enhance patient outcomes. The audit results will assist them in developing a quality improvement plan to improve their FLS processes, thus optimizing patient care. FLSs will gradually develop greater effectiveness and efficiency.

Given the unprecedented Covid-19 pandemic situation, Osteoporosis Canada will exceptionally extend the next audit cycle to 3 years instead of the usual 2 years. Therefore, the next national FLS audit will be on the cohort of patients enrolled in Canadian FLSs from April 1 to September 30, 2022. The extra year will allow FLSs to focus on more immediate priorities engendered by the pandemic and to adjust to the “new normal” in healthcare delivery within the various provinces.

Finally, it needs to be re-emphasized that the quality care highlighted in this report is restricted to patients being assessed and managed by an FLS. There are hundreds of Canadian hospitals offering orthopaedic services. But with only 41 FLSs on the OC FLS Registry as of June 30, 2020, the overwhelming majority of fragility fracture patients in Canada still do not have access to this proven model of care. Without FLS, it is well documented that 80% of fragility fracture patients will not receive the osteoporosis care they need to prevent their next fracture. Canada needs many more FLSs to meet the needs of Canadians!

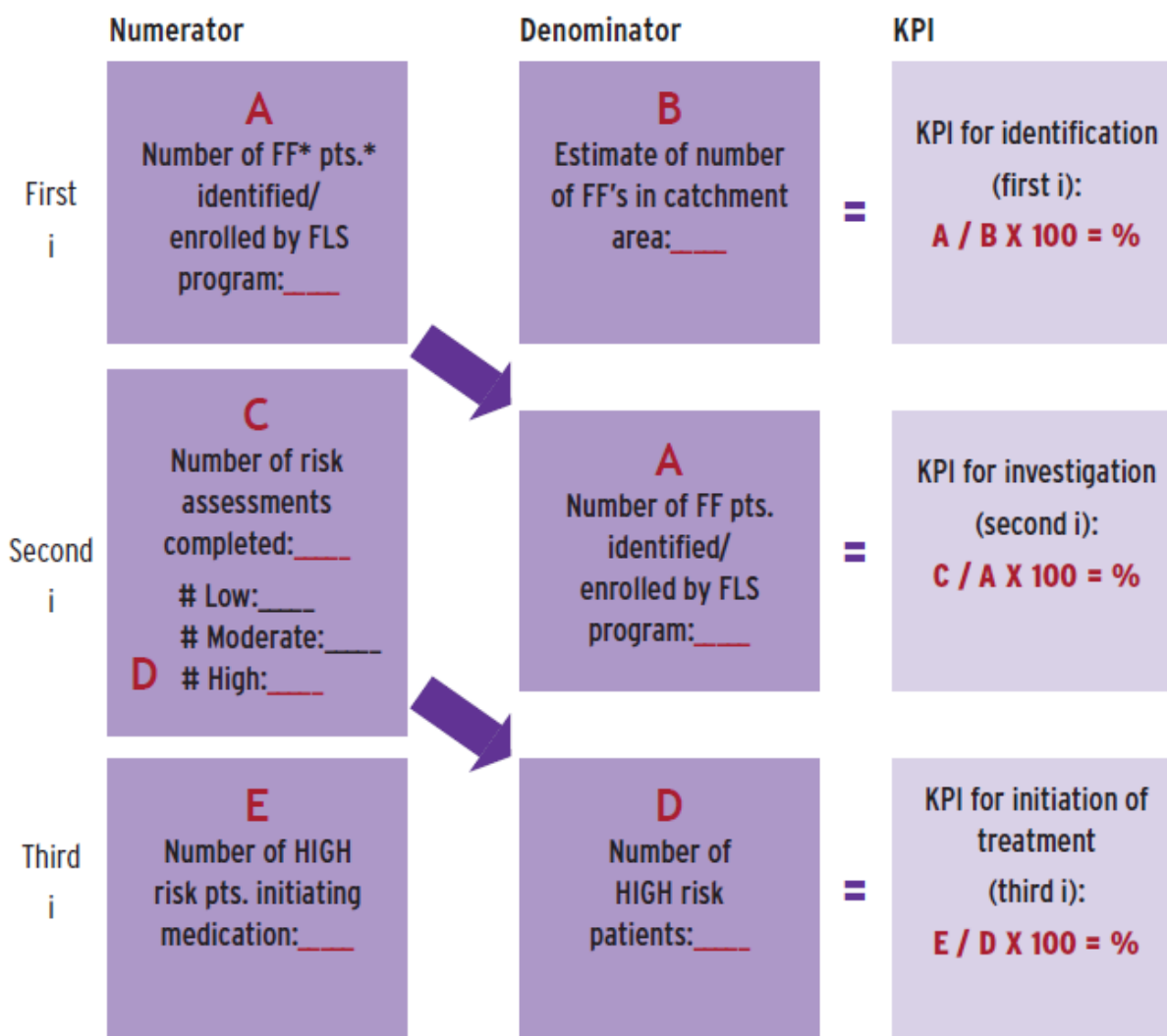
***Let's make
their FIRST
break their
LAST!***



Appendix A: Rationale for 'level of achievement' thresholds

The FLS Audit Committee acknowledges that the thresholds selected for the levels of achievement for this audit cycle are arbitrary. Nonetheless, an explanation of why different levels were selected for different KPIs may be helpful. Firstly, here's a reminder of how the numerator and denominator for each KPI are determined:

Overview of core FLS indicators



Determining optimal performance for the first i was the most challenging. The denominator for the first i is an estimate of the total fragility fractures in the area served by the FLS. This estimate is derived from the number of hip fracture patients seen by the hospital, which generally comes from the data provided by the latter to the Canadian

Institute for Health Information (CIHI). Hospitals count their hip fracture patients at the time of discharge whereas FLSs count their hip fracture patients (and all other fracture patients) at the time of admission. There is, therefore, an unavoidable “time mismatch” between the numerator and denominator for this KPI.

Additionally, the hospital's hip fracture count includes all hip fractures (traumatic and fragility) whereas FLSs only enroll fragility fracture patients. So, unlike the subsequent KPIs, for which the denominator has a great deal of precision, there is an unavoidable uncertainty in the denominator for the first i. A reasonably challenging threshold of 80% was chosen for “at or near optimal” in part because of the critical role this KPI plays in identifying how many patients are being ‘left behind’ from the outset.

One would not normally expect any FLS to reach 100% for their first i, however, this occasionally happens as a result of:

- The above “time mismatch” between numerator and denominator
- Some tertiary care hospitals receive referrals for hip fracture patients who had their original hip fracture surgery performed at another hospital (and therefore that hip fracture was counted at that other hospital in their CIHI data rather than at the hospital where the FLS is located).

In this report, any KPI for the first i exceeding 100% is considered to be an artificial aberration as per the above and therefore will be reported as 100%.

Only the second i allows for FLSs to attain 100% performance (or very close). Hip-only inpatient FLSs have a significant advantage in this KPI, since hip fractures are high risk by definition (as per current OC Clinical Practice Guidelines).³¹ With that in mind, a very high “at or near optimal” level of 95% was selected for the threshold for the GREEN zone for the second i.

For the third i, no FLS can ever be expected to reach 100% because the denominator flows from the numerator for the second i and will include patients who have died and patients for whom all osteoporosis medications are contraindicated. Although this reduces the precision of this KPI, it does allow for an even playing field when comparing FLSs. A threshold of 80% was selected for “at or near optimal” based on what is already documented to be possible when all fragility fracture patients are managed by an osteoporosis specialist (i.e. gold standard).

References

1. Kanis JA, Johnell O, De Laet C, et al. A meta-analysis of previous fracture and subsequent fracture risk. *Bone*. 2004;35(2):375-382. doi:10.1016/j.bone.2004.03.024
2. Huntjens KMB, Kosar S, Van Geel TACM, et al. Risk of subsequent fracture and mortality within 5 years after a non-vertebral fracture. *Osteoporos Int*. 2010;21(12):2075-2082. doi:10.1007/s00198-010-1178-5
3. Kanis JA, Johansson H, Odén A, et al. Characteristics of recurrent fractures. *Osteoporos Int*. 2018;29(8):1747-1757. doi:10.1007/s00198-018-4502-0
4. Johansson H, Siggeirsdóttir K, Harvey NC, et al. Imminent risk of fracture after fracture. *Osteoporos Int*. 2017;28(3):775-780. doi:10.1007/s00198-016-3868-0
5. Morin SN, O'Donnell S, Jean S, et al. Post-fracture care gap in Canada from 2000-2011: a nationwide population-based analysis. Presented at the American Society of Bone and Mineral Research annual meeting; 2018.
6. Sale JEM, Beaton D, Posen J, Elliot-Gibson V, Bogoch E. Systematic review on interventions to improve osteoporosis investigation and treatment in fragility fracture patients. *Osteoporos Int*. 2011;22(7):2067-2082. doi:10.1007/s00198-011-1544-y
7. Ganda K, Puech M, Chen JS, et al. Models of care for the secondary prevention of osteoporotic fractures: a systematic review and meta-analysis. *Osteoporos Int*. 2013; 24(2):393-406. doi:10.1007/s00198-012-2090-y
8. Wu C, Tu S, Chang Y, et al. Fracture liaison services improve outcomes of patients with osteoporosis-related fractures : a systematic literature review and meta-analysis. *Bone*. 2018;111(138):92-100. doi:10.1016/j.bone.2018.03.018
9. Huntjens KMB, Van Geel TCM, Geusens PP, et al. Impact of guideline implementation by a fracture nurse on subsequent fractures and mortality in patients presenting with non-vertebral fractures. *Injury*. 2011;42(SUPPL. 4):539-543. doi:10.1016/S0020-1383(11)70011-0
10. Sander B, Elliot-Gibson V, Beaton DE, Bogoch ER, Maetzel A. A coordinator program in post-fracture osteoporosis management improves outcomes and saves costs. *J Bone Jt Surg - Ser A*. 2008;90(6):1197-1205. doi:10.2106/JBJS.G.00980
11. Axelsson KF, Johansson H, Lundh D, Möller M, Lorentzon M. Association between recurrent fracture risk and implementation of fracture liaison services in four Swedish hospitals: a cohort study. *J Bone Miner Res*. 2020;35 (7):1216-1223. doi:10.1002/jbmr.3990

12. Beaupre LA, Lier D, Smith C, et al. A 3i hip fracture liaison service with nurse and physician co-management is cost-effective when implemented as a standard clinical program. *Arch Osteoporos*. 2020;15(1). doi:10.1007/s11657-020-00781-w
13. Majumdar SR, Beaupre LA, Harley CH, et al. Use of a case manager to improve osteoporosis treatment after hip fracture - results of a randomized controlled trial. *Arch Intern Med*. 2007;167(19):2110-2115. doi:10.1001/archinte.167.19.2110
14. Bogoch ER, Elliot-Gibson V, Beaton DE, Jamal SA, Josse RG, Murray TM. Effective initiation of osteoporosis diagnosis and treatment for patients with a fragility fracture in an orthopaedic environment. *J Bone Jt Surg - Ser A*. 2006;88(1):25-34. doi:10.2106/JBJS.E.00198
15. Majumdar SR, Johnson JA, Bellerose D, et al. Nurse case-manager vs multifaceted intervention to improve quality of osteoporosis care after wrist fracture: Randomized controlled pilot study. *Osteoporos Int*. 2011;22(1):223-230. doi:10.1007/s00198-010-1212-7
16. McLellan AR, Gallacher SJ, Fraser M MC. The fracture liaison service: success of a program for the evaluation and management of patients with osteoporotic fracture. *Osteoporos Int*. 2003;14:1028-1034.
17. Dell R, Greene D, Schelkun SR, Williams K. Osteoporosis disease management: the role of the orthopaedic surgeon. *J Bone Jt Surg Am*. 2008;90(Supplement 4):188-194. doi:10.2106/JBJS.H.00628
18. Boudou L, Gerbay B, Chopin F, Ollagnier E, Collet P, Thomas T. Management of osteoporosis in fracture liaison service associated with long-term adherence to treatment. *Osteoporos Int*. 2011;22(7):2099-2106. doi:10.1007/s00198-011-1638-6
19. Lih A, Nandapalan H, Kim M, et al. Targeted intervention reduces refracture rates in patients with incident non-vertebral osteoporotic fractures: A 4-year prospective controlled study. *Osteoporos Int*. 2011;22(3):849-858. doi:10.1007/s00198-010-1477-x
20. Wu CH, Chen CH, Chen PH, et al. Identifying characteristics of an effective fracture liaison service: systematic literature review. *Osteoporos Int*. 2018;29(5). doi:10.1007/s00198-017-4370-z
21. Majumdar SR, Lier DA, Beaupre LA, et al. Osteoporosis case manager for patients with hip fractures: results of a cost-effectiveness analysis conducted alongside a randomized trial. *Arch Intern Med*. 2009;169(1):25-31. doi:10.1001/archinte.169.1.25
22. Dell R. Fracture prevention in Kaiser Permanente Southern California. *Osteoporos Int*. 2011;22(SUPPL. 3):457-460. doi:10.1007/s00198-011-1712-0

23. McLellan AR, Wolowacz SE, Zimovetz EA, et al. Fracture liaison services for the evaluation and management of patients with osteoporotic fracture: A cost-effectiveness evaluation based on data collected over 8 years of service provision. *Osteoporos Int.* 2011;22(7):2083-2098. doi:10.1007/s00198-011-1534-0
24. United Kingdom: Department of Health. *Fracture Prevention Services: An Economic Evaluation.* HMSO. 2009
25. Cooper MS, Palmer AJ, Seibel MJ. Cost-effectiveness of the Concord Minimal Trauma Fracture Liaison service, a prospective, controlled fracture prevention study. *Osteoporos Int.* 2012;23(1):97-107. doi:10.1007/s00198-011-1802-z
26. Osteoporosis Canada. *Key Performance Indicators (KPIs) for Canadian FLS v 2.0.*; 2018. doi:<https://fls.osteoporosis.ca/wp-content/uploads/FLS-KPIs-V-2.0-English-FINAL.pdf>
27. Bessette L, Ste-Marie LG, Jean S, et al. The care gap in diagnosis and treatment of women with a fragility fracture. *Osteoporos Int.* 2008;19(1):79-86. doi:10.1007/s00198-007-0426-9
28. Leslie WD, Giangregorio LM, Yogendran M, et al. A population-based analysis of the post-fracture care gap 1996-2008: The situation is not improving. *Osteoporos Int.* 2012;23(5):1623-1629. doi:10.1007/s00198-011-1630-1
29. Jean S, Gamache P, Brown JP et al. Temporal trends analysis of post-fracture management: a population-based study, 2002-2014. *J Bone Min Res.* 2016;31 Suppl 1.
30. McLellan AR, Gallacher SJ, Fraser M, McQuillian C. The fracture liaison service: Success of a program for the evaluation and management of patients with osteoporotic fracture. *Osteoporos Int.* 2003;14(12):1028-1034. doi:10.1007/s00198-003-1507-z
31. Papaioannou, A., Morin, S, Cheung A, et al. 2010 clinical practice guidelines for the diagnosis and management of osteoporosis in Canada: summary. *Can Med Assoc J.* 2010;182(17):1864-1873.