



# FRACTURE PREVENTION CENTRAL

## *Fracture Liaison Service Return on Investment Calculator*

*User Guide*

*Version 1.0 – January 2017*

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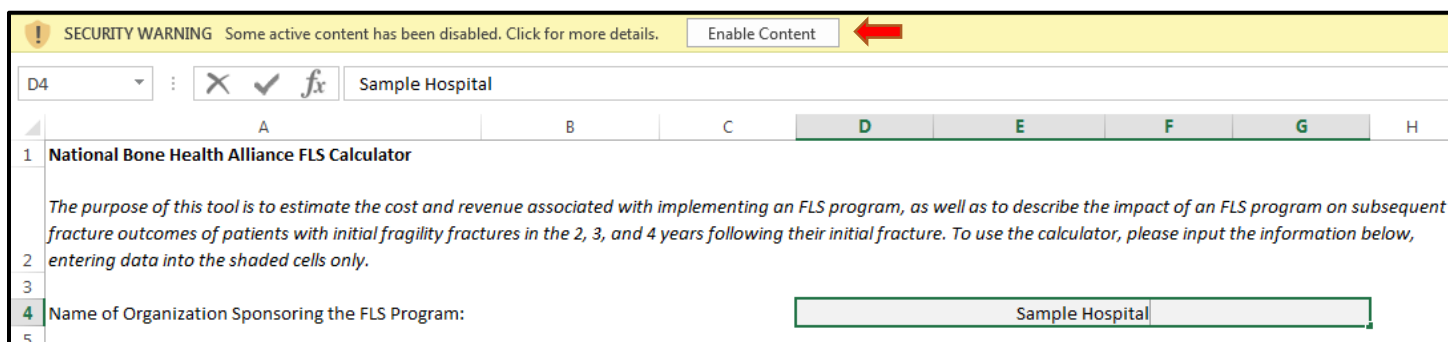
## Overview

NBHA, in collaboration with the Research Triangle Institute and University of Alabama-Birmingham, has developed an interactive calculator, the Fracture Liaison Service Return on Investment Calculator, to help FLS champions make the business case for adoption to providers, payers and practitioners. The Calculator provides estimates for the potential costs and revenues as well as the potential impact on fracture outcomes of Medicare patients age 65 and up associated with implementing an FLS in a facility or medical practice. Estimates from the calculator are based on results from statistical models of a large sample of Medicare patients. The calculator is prepopulated with a number of default input parameters from peer-reviewed literature, other public sources, and developer assumptions. However, the user can—and should—modify these default values with local parameter estimates, updated literature estimates and expert opinion when they are available.

The calculator is a Microsoft Excel macro-enabled workbook and is available on the [Fracture Prevention CENTRAL website](#). The purpose of this guide is to illustrate how to use the calculator: inputting data into the calculator, understanding how statistical interact with user inputs to generate output, interpreting the output generated by the calculator, and discussing the limitations of the calculator in the current form.

## Inputs to the Calculator

Upon downloading and opening the calculator workbook, Microsoft Excel will ask you to confirm that the active content in the workbook is safe. Please click the “**Enable Content**” button at the very top of the excel window, indicated by a red arrow in the image below. The security warning bar will disappear when the button is clicked. Next, make sure you are on the “Inputs” tab, and enter a name to represent the facility or practice for which you are analyzing a potential FLS. In the image below, we have entered “Sample Hospital.”



## FLS Caseload

The first data entry section asks you to describe the *potential caseload* faced by your FLS, which is a function of fragility fractures treated in your facility or practice. The purpose of this exercise is to project fragility fractures you will treat over the next year by a mix of fracture site and demographic characteristics (age and sex). In the calculator, we suggest that conducting a retrospective chart review for the past year is the best way to project fractures over the next year; however, you may use any method that you feel provides a reasonable estimate of patients who will present with fragility fractures over the next year.

The calculator allows you to select from two methods for entering initial fracture estimates. The first, a simplified option, allows you to describe demographic characteristics and fracture frequencies separately. The next two images describe the data entry fields for the simplified option.

**Initial Fracture Data Entry:**

Select your data entry preference and characterize patient population and fragility fractures. Choose simplified to enter demographics and fracture counts separately, or detailed to provide fracture counts by demographic group.

Data Entry Type:  Simplified  Detailed

**Patient Characteristics:**

Describe the demographic characteristics of your fragility fracture patients (age 65+)

Sex	Male	45%
	Female	55%
Age	65-74	33%
	75-84	30%
	85+	37%

**Fragility Fractures:**

Use the checkboxes below to select the fracture types that would lead to a referral to the FLS. Then, enter the number of cases of those fractures you've treated over the past year for patients age 65+. If an incident involved fractures at multiple sites, count it toward the primary (most severe) fracture site.

Fracture sites to include:  Ankle  Clavicle  Femur  Hip  Humerus  Pelvis  Radius/Ulna  Spine  Tibia/Fibula

Ankle	10
Clavicle	12
Femur	13
Hip	<input type="text"/>
Humerus	
Pelvis	
Radius/Ulna	
Spine	
Tibia/Fibula	

The calculator allows you to exclude fracture sites from consideration for FLS referral. For example, if your facility or practice chooses not to refer patients with tibia or fibula fractures to the FLS, simply uncheck the corresponding box. When the box is unchecked, the fracture site will disappear from the table as shown in the image below.

**Fragility Fractures:**

Use the checkboxes below to select the fracture types that would lead to a referral to the FLS. Then, enter the number of cases of those fractures you've treated over the past year for patients age 65+. If an incident involved fractures at multiple sites, count it toward the primary (most severe) fracture site.

Fracture sites to include:  Ankle  Clavicle  Femur  Hip  Humerus  Pelvis  Radius/Ulna  Spine  Tibia/Fibula

Ankle	10
Clavicle	12
Femur	13
Hip	<input type="text"/>
Humerus	
Pelvis	
Radius/Ulna	
Spine	

The second data entry method, termed the detailed option, requires you to enter the number of fractures by demographic group. This method does not require the calculator to make an assumption about how fractures are distributed among demographic groups as is required when the simplified option is used, but it does require data that are more detailed. The next image presents the data entry fields for the detailed option. As with the simplified option, you may exclude fracture sites using the checkboxes above the table. Finally, regardless of which data entry method is used, it is important that patients are not double-counted if you use a retrospective approach to estimate fragility fractures. If a patient presents with a multi-site fracture, be sure to count that patient only once under the primary fracture site.

**Initial Fracture Data Entry:**

Select your data entry preference and characterize patient population and fragility fractures. Choose simplified to enter demographics and fracture counts separately, or detailed to provide fracture counts by demographic group.

Data Entry Type:  Simplified  Detailed

**Fragility Fractures by Demographic Group:**

Use the checkboxes below to select the fracture types that would lead to a referral to the FLS. Then, enter the number of fragility fractures cases you've treated over the past year for patients in each demographic group. If an incident involved fractures at multiple sites, count it toward the primary (most severe) fracture site.

Fracture sites to include:  Ankle  Clavicle  Femur  Hip  Humerus  Pelvis  Radius/Ulna  Spine  Tibia/Fibula

Fracture Site	Male		Female		
	65-74	75-84	65-74	75-84	85+
Ankle	5	7	3	5	8
Clavicle	2	6	8	4	1
Femur	3	4	7	9	5
Hip	3	7			
Humerus					
Pelvis					
Radius/Ulna					
Spine					
Tibia/Fibula					

The last parameter required in the FLS caseload section is an estimate of the number of fragility fracture patients that you will recruited to the FLS. The calculator comes prepopulated with a default value of 85%, but you should modify this parameter to reflect your FLS. In other words, are you able to provide FLS to *all* patients eligible patients? Or is there limited capacity, some patients refuse or are lost to follow-up? The next image presents this field.

**FLS Recruitment Rate:**

What percentage of patients with initial fractures will be recruited into the FLS protocol.

FLS Recruitment Rate:

**FLS Costs**

The second section collects information about the costs associated with your FLS program. The first part deals with the FLS coordinator’s salary. Based on the caseload estimated in the previous section, the calculator suggests a level of effort for the FLS coordinator needed to support the program. In the image below, the suggested level of effort is 0.5 full time equivalents (FTE).

**FLS Coordinator:**

Based on the number of fragility fractures you've treated over the past year, you will need an estimated 0.5 full time equivalents (FTEs) of FLS coordinator support. You may use this value by default or modify it below. To revert to the estimated level of effort, check the box to the right of the FTE input. Note that the estimated level of effort will change as the input number of fractures change.

Choose the type of staff that will serve as an FLS coordinator, and the salary box will be populated with a default value. Please adjust this value with local salary data, if available, using FTE salaries. If you choose the 'other staff' option, the salary box will remain empty, so be sure to provide a salary value. Please also adjust the fringe benefit rate if your facility's rate differs from the default of 30%. The fringe benefit rate includes benefits such as paid time off and employer-paid health insurance as well as payroll taxes for Social Security and Medicare.

Estimated level of effort for FLS Coordinator:	0.5 FTEs	
FLS Coordinator level of effort for calculation (FTEs):	<input type="text" value="0.50"/>	<input checked="" type="checkbox"/> Use Estimated Level of Effort?
FLS Coordinator Type:	<input type="text"/>	
FLS Coordinator FTE Salary <sup>1</sup> :	<input type="text"/>	
Fringe Benefit Rate:	<input type="text"/>	

You may choose to use the suggested level of effort, as in the image above, or modify it to your liking. In the image below, we have changed the level of effort from 0.5 FTEs to 1 FTE. To revert to the suggested level of effort, click the checkbox to the right.

**FLS Coordinator:**

Based on the number of fragility fractures you've treated over the past year, you will need an estimated 0.5 full time equivalents (FTEs) of FLS coordinator support. You may use this value by default or modify it below. To revert to the estimated level of effort, check the box to the right of the FTE input. Note that the estimated level of effort will change as the input number of fractures change.

Choose the type of staff that will serve as an FLS coordinator, and the salary box will be populated with a default value. Please adjust this value with local salary data, if available, using FTE salaries. If you choose the 'other staff' option, the salary box will remain empty, so be sure to provide a salary value. Please also adjust the fringe benefit rate if your facility's rate differs from the default of 30%. The fringe benefit rate includes benefits such as paid time off and employer-paid health insurance as well as payroll taxes for Social Security and Medicare.

Estimated level of effort for FLS Coordinator:	0.5 FTEs	
FLS Coordinator level of effort for calculation (FTEs):	<input type="text" value="1.00"/>	<input type="checkbox"/> Use Estimated Level of Effort?
FLS Coordinator Type:	<input type="text"/>	
FLS Coordinator FTE Salary <sup>1</sup> :	<input type="text"/>	
Fringe Benefit Rate:	<input type="text"/>	

The calculator is prepopulated with three staff types that commonly serve as FLS coordinators: nurse practitioner, physician assistant, and registered nurse. Use the dropdown to select the staff that will serve as FLS coordinator in your program.

**FLS Coordinator:**

Based on the number of fragility fractures you've treated over the past year, you will need an estimated 0.5 full time equivalents (FTEs) of FLS coordinator support. You may use this value by default or modify it below. To revert to the estimated level of effort, check the box to the right of the FTE input. Note that the estimated level of effort will change as the input number of fractures change.

Choose the type of staff that will serve as an FLS coordinator, and the salary box will be populated with a default value. Please adjust this value with local salary data, if available, using FTE salaries. If you choose the 'other staff' option, the salary box will remain empty, so be sure to provide a salary value. Please also adjust the fringe benefit rate if your facility's rate differs from the default of 30%. The fringe benefit rate includes benefits such as paid time off and employer-paid health insurance as well as payroll taxes for Social Security and Medicare.

Estimated level of effort for FLS Coordinator:	0.5 FTEs	
FLS Coordinator level of effort for calculation (FTEs):	<input type="text" value="0.50"/>	<input checked="" type="checkbox"/> Use Estimated Level of Effort?
FLS Coordinator Type:	<input type="text" value=""/>	
FLS Coordinator FTE Salary <sup>1</sup> :	<input type="text" value=""/>	
Fringe Benefit Rate:	<input type="text" value=""/>	

Nurse Practitioner  
Physician Assistant  
Registered Nurse  
Other Staff

If you choose one of the aforementioned staff types, the calculator will fill in the salary and fringe benefit rate fields with default values. Default salaries are national averages from the Bureau of Labor Statistics (2016). The default fringe benefit rate of 30% is assumed. You can—and should—replace these parameters with values that more closely represent your facility or practice, if applicable.

**FLS Coordinator:**

Based on the number of fragility fractures you've treated over the past year, you will need an estimated 0.5 full time equivalents (FTEs) of FLS coordinator support. You may use this value by default or modify it below. To revert to the estimated level of effort, check the box to the right of the FTE input. Note that the estimated level of effort will change as the input number of fractures change.

Choose the type of staff that will serve as an FLS coordinator, and the salary box will be populated with a default value. Please adjust this value with local salary data, if available, using FTE salaries. If you choose the 'other staff' option, the salary box will remain empty, so be sure to provide a salary value. Please also adjust the fringe benefit rate if your facility's rate differs from the default of 30%. The fringe benefit rate includes benefits such as paid time off and employer-paid health insurance as well as payroll taxes for Social Security and Medicare.

Estimated level of effort for FLS Coordinator:	0.5 FTEs	
FLS Coordinator level of effort for calculation (FTEs):	<input type="text" value="0.50"/>	<input checked="" type="checkbox"/> Use Estimated Level of Effort?
FLS Coordinator Type:	<input type="text" value="Nurse Practitioner"/>	
FLS Coordinator FTE Salary <sup>1</sup> :	<input type="text" value="\$101,260"/>	
Fringe Benefit Rate:	<input type="text" value="30.0%"/>	

Finally, the calculator allows you to describe other labor and non-labor costs borne by your FLS in a given year. For labor costs, provide a brief description and specify the level of effort (in FTEs), the full time salary for the staff, and the fringe benefit rate. It is important to enter the full, 1 FTE salary for the staff, as the calculator will pro-rate the salary based on the number of FTEs entered. For non-labor costs, briefly describe and provide the dollar amount for the cost. The calculator also allows to you specify an overhead rate to be applied to labor costs only, or to all costs. In the image below, we have specified administrative assistant support as an additional labor cost, supplies and materials as a non-labor cost, and a 10 percent overhead rate applied to all costs.

**Other Costs:**

Describe other labor and non-labor costs incurred by the FLS program. For labor costs, briefly describe the staff and their level of effort with the FLS program. Enter a full-time salary for an individual in this position, and a fringe benefit rate, if applicable. For non-labor costs, briefly describe and provide the annual cost for each resource. If the FLS program incurs an overhead cost, specify the rate and whether it is applied to labor costs or all costs.

Labor:

Staff Type (max 25 chars)	FTE	Full FTE Salary	Fringe Benefit Rate
Administrative Assistant	0.25	\$35,000	30.0%

Non-labor:

Description (max 25 chars)	Cost
Supplies and Materials	\$1,000

Overhead Rate:

10.0%

Apply to:

- Labor Only
  All Costs

### FLS Revenue

The third section requires you to describe the FLS protocol at your facility or practice so that the calculator can estimate the amount of revenue generated by the program. The protocol section is broken up into two parts. The first part asks you to specify a “base” protocol, which captures patient visits with the FLS coordinator. The calculator is pre-populated with four default base protocols, one for each of the four reimbursement schedules displayed in the image below. To import a base protocol, enter the zip code where your facility or practice is located, select one of the four reimbursement schedules, and click “Import Protocol.”

**Characterize FLS Protocol:**

In this section, we'll describe how services provided to FLS patients differ from those provided to non-FLS patients. We'll call this the FLS protocol. First, we'll describe the base protocol, which comprises a typical set of FLS office visits. The tool contains default base protocols for convenience. To import a base protocol, enter your ZIP code, select the protocol that best fits your facility type and reimbursement schedule from the drop-down menu, and click "Import Protocol." Freely adjust the base protocol by adding, modifying, or deleting information in the shaded cells. To revert to a default protocol, select the appropriate protocol and click "Import Protocol." To erase the contents of the base protocol field, click the "Clear All" button.

Zip Code:

Item	Reimbursement Revenue <sup>2</sup>	Probability of Receipt	
		FLS	Non-FLS
Hospital (facility), 100% Reimbursement Schedule			
Hospital (facility), 85% Reimbursement Schedule			
Group/Private Practice (non-facility), 100% Reimbursement Schedule			
Group/Private Practice (non-facility), 85% Reimbursement Schedule			

As shown in the image below, the calculator will populate the table with office visits. Each office visit is characterized by when they occur relative to when the patient was first referred to the FLS, their CPT code, the revenue associated with the visit, and the probability that patients participating in the FLS—and those *not* participating in the FLS—will have the office visit. All revenues in the calculator are from fee schedules published by the Center for Medicare and Medicaid Services (Center for Medicare & Medicaid Services, 2016a, 2016b). The calculator requires estimates of the probability of receipt by FLS and non-FLS patients in order to calculate incremental revenue (i.e., revenue relative to

usual care). It is likely that 0 percent of non-FLS patients will receive any of the office visits in the base protocol section, but this is unlikely to hold for procedures in the second part of the protocol section.

As with all fields in the calculator, you can edit all base protocol fields to match your FLS. In fact, it is not required to import any of the default protocols; information can be entered manually into the table instead, if desired. The defaults are present for your convenience to be tweaked or simply ignored as you see fit.

**Characterize FLS Protocol:**

*In this section, we'll describe how services provided to FLS patients differ from those provided to non-FLS patients. We'll call this the FLS protocol. First, we'll describe the base protocol, which comprises a typical set of FLS office visits. The tool contains default base protocols for convenience. To import a base protocol, enter your ZIP code, select the protocol that best fits your facility type and reimbursement schedule from the drop-down menu, and click "Import Protocol." Freely adjust the base protocol by adding, modifying, or deleting information in the shaded cells. To revert to a default protocol, select the appropriate protocol and click "Import Protocol." To erase the contents of the base protocol field, click the "Clear All" button.*

Zip Code:

Item	Elapsed Months (from FLS initiation)	Anticipated CPT Code (optional)	Reimbursement Revenue <sup>2</sup>	Probability of Receipt	
				FLS	Non-FLS
Initial visit	0	99204	\$145.53	100.0%	0.0%
Three month follow-up visit	3	99214	\$87.35	100.0%	0.0%
Six month follow-up	6	99213	\$56.97	90.0%	0.0%
12 month follow-up	12	99213	\$56.97	85.0%	0.0%
18 month follow-up	18	99213	\$56.97	85.0%	0.0%
24 month follow-up	24	99213	\$56.97	85.0%	0.0%
36 month follow-up	36	99213	\$56.97	85.0%	0.0%
48 month follow-up	48	99213	\$56.97	85.0%	0.0%

The second part of the protocol section asks you to identify procedures that are delivered to FLS patients at a different frequency than to non-FLS patients. Once again, data can be entered into this section manually if desired, but the calculator is pre-populated with a broad array of procedures ranging from diagnostic imaging to physical therapy to laboratory services. The drop-down menu is shown in the table below. To use the pre-populated procedures, enter the zip code where your facility or practice is located, select the procedure and a reimbursement schedule, and click "Import Procedure."



Next, we'll identify procedures in addition to typical FLS office visits listed above. To maximize accuracy, all revenue-generating appointments, labs, etc. that an FLS patient is more or less likely to receive than a non-FLS patient should be included here. The tool is preloaded with services commonly delivered to FLS patients. If a procedure is not included in the list below you may enter it in manually in the shaded cells. If a procedure occurs multiple times, enter it once for each instance. The procedures below do not need to be in chronological order. For each row in which you enter data, either manually or by using the preloaded services, **be sure to indicate when the procedure is expected to be delivered and the probability that an FLS patient and non-FLS patient will receive a given service**. **If you do not enter this information, the calculations will be incorrect**. If you wish to consider total revenue rather than incremental revenue (vs.usual care), simply enter 0% for Non-FLS probability of receipt for all procedures.

Zip Code:

- OP visit existing patient, level 4
- OP visit existing patient, level 3
- DXA bone density axial
- DXA bone density/peripheral
- DXA, Axial w/ VFA**
- Quantitative CT Scan
- Physical Therapy Evaluation
- Physical Therapy Re-Evaluation

Item	Elapsed Months (from FLS initiation)	Anticipated CPT Code (optional)	Reimbursement Revenue <sup>2</sup>	Probability of Receipt	
				FLS	Non-FLS

As shown in the first image below, the calculator will insert the chosen procedure into the table. Please specify when the procedure is to be conducted relative to when the patient was first referred to the FLS and the probability of receipt for FLS and non-FLS patients as demonstrated in the second image below.

Next, we'll identify procedures in addition to typical FLS office visits listed above. To maximize accuracy, all revenue-generating appointments, labs, etc. that an FLS patient is more or less likely to receive than a non-FLS patient should be included here. The tool is preloaded with services commonly delivered to FLS patients. If a procedure is not included in the list below you may enter it in manually in the shaded cells. If a procedure occurs multiple times, enter it once for each instance. The procedures below do not need to be in chronological order. For each row in which you enter data, either manually or by using the preloaded services, **be sure to indicate when the procedure is expected to be delivered and the probability that an FLS patient and non-FLS patient will receive a given service**. **If you do not enter this information, the calculations will be incorrect**. If you wish to consider total revenue rather than incremental revenue (vs.usual care), simply enter 0% for Non-FLS probability of receipt for all procedures.

Zip Code:

Item	Elapsed Months (from FLS initiation)	Anticipated CPT Code (optional)	Reimbursement Revenue <sup>2</sup>	Probability of Receipt	
				FLS	Non-FLS
DXA, Axial w/ VFA		77085	\$67.03		

Next, we'll identify procedures in addition to typical FLS office visits listed above. To maximize accuracy, all revenue-generating appointments, labs, etc. that an FLS patient is more or less likely to receive than a non-FLS patient should be included here. The tool is preloaded with services commonly delivered to FLS patients. If a procedure is not included in the list below you may enter it manually in the shaded cells. If a procedure occurs multiple times, enter it once for each instance. The procedures below do not need to be in chronological order. For each row in which you enter data, either manually or by using the preloaded services, **be sure to indicate when the procedure is expected to be delivered and the probability that an FLS patient and non-FLS patient will receive a given service**. If you do not enter this information, the calculations will be incorrect. If you wish to consider total revenue rather than incremental revenue (vs. usual care), simply enter 0% for Non-FLS probability of receipt for all procedures.

Zip Code:

Item	Elapsed Months (from FLS initiation)	Anticipated CPT Code (optional)	Reimbursement Revenue <sup>2</sup>	Probability of Receipt	
				FLS	Non-FLS
DXA, Axial w/ VFA	1	77085	\$67.03	100.0%	15%

The calculator accepts up to 100 separate procedures. If you need more space to enter procedures, click the "Show More Rows" button. Finally, it is important to remember that the revenue estimate represents revenue, but not net financial gain, from a particular procedure. To be thorough, be sure that the costs you specified in the previous section represent the costs borne by the FLS program to provide the services listed here.

**FLS Impact**

The final input section requires you to estimate the impact that the FLS will have on preventing subsequent fractures that would otherwise occur. The calculator allows you to select from two methods to represent the impact of the FLS. The first, and most straightforward, requires you to provide direct estimates of the percentage reduction in fractures, by site, for each of the fracture sites supported by the calculator. This option is presented in the image below. For example, if the calculator estimated that 100 clavicle fractures would occur without the FLS, the entry of 3% in the table in the image below means that the FLS would prevent three clavicle fractures. We recognize that this method requires you to make assumptions about the impact of the FLS with perhaps little supporting information. However, the lack of FLS effectiveness studies precludes the current calculator from having prepopulated default values.

**Characterize FLS Impact:**

Choose how you would like the calculator to estimate the impact of FLS and enter the relevant information.

- FLS Impact:  Direct Estimates of Fractures Prevented  
 Percentage of Patients Receiving Treatment

**Direct Estimates of Fractures Prevented**

Enter the percentage of fractures at each site that the FLS is expected to prevent.

Fracture Site	% Reduction
Ankle	2.50%
Clavicle	3.00%
Femur	2.80%
Hip	
Humerus	
Pelvis	
Radius/Ulna	
Spine	
Tibia/Fibula	

The second option relies on existing studies of effectiveness of various treatment options to reduce fracture rates and requires you to specify the percentage of FLS and non-FLS patients that are expected to receive each of four treatments. When using this option, it is important not to double-count patients. For example, if some patients are expected to receive instructions for optimal supplementation and a pharmacological treatment, they should contribute to the percentages next to the pharmacological treatment, only. The fracture reduction rates in the table in the image below are based on randomized controlled studies (Black et al., 1996; Cummings et al., 1998; Hodsmen et al., 2005; Larsen, Mosekilde, & Foldspang, 2004; National Osteoporosis Foundation, 2014; Neer et al., 2001; Palacios et al., 2015; Sim & Ebeling, 2013; Tang, Eslick, Nowson, Smith, & Bensoussan, 2007). However, the studies were often conducted on a specific group (e.g., women of a certain age group), so the fracture reduction rates specified in the calculator may not be applicable to other groups. In addition, this method ignores the potential contribution of other treatment options or services such as physical therapy. The studies used to support this option are outlined in the appendix.

**Characterize FLS Impact:**

Choose how you would like the calculator to estimate the impact of FLS and enter the relevant information.

- FLS Impact:  Direct Estimates of Fractures Prevented  
 Percentage of Patients Receiving Treatment

**Percentage of FLS Patients Receiving Treatment**

Enter the percentage of patients, both FLS and non-FLS, expected to receive each treatment after an initial fragility fracture. Note, treatment options are mutually exclusive. **If a patient receives supplements and a pharmacological treatment, enter the patient into the pharmacological treatment field only.** The columns do not need to add to 100%, but they cannot exceed it. Estimates for non-FLS patients are necessary because the estimated impact of FLS must be relative to the status quo, not relative to no treatment at all.

Treatment	%FLS Patients Treated	% Non-FLS Patients Treated
Optimal Calcium and Vitamin D Supplementation (16% fracture reduction rate) <sup>3</sup>	25.00%	20.00%
Bisphosphonates (e.g., Alendronate) (50% fracture reduction rate) <sup>4</sup>	12.00%	7.00%
Denosumab (Prolia) (39% fracture reduction rate) <sup>5</sup>		
Parathyroid Hormone: Teriparatide (Forteo) (59% fracture reduction rate) <sup>6</sup>		

The calculator does not account for the cost of acquiring and delivering these medications in this section. To be thorough, be sure to account for costs borne by the FLS to provide these medications in the cost section.

## Statistical Models in the Calculator

The calculator relies on two statistical models to translate user inputs to output. The models were estimated on a dataset containing Medicare claims from 100% of female beneficiaries and a 5% random sample of male beneficiaries between 2006 and 2012. Inclusion in the initial analytic dataset required an initial fragility fracture event and at least 12 months of Medicare part A, B, C, and D coverage before the fracture event, and 12 months of coverage, or death within 12 months, following the fracture event. We excluded patients with Paget’s disease or cancer diagnoses, and those receiving hospice services.

These criteria led to an analytic dataset containing 418,381 beneficiaries. To address the common problem inherent in analyzing claims data—right-censoring at the end of the time period represented by the dataset—we created three cohorts to ensure comparable follow-up periods. The cohorts required 24, 36, and 48 months of coverage following the initial fracture (or death within those time periods), respectively. In a dataset containing records from 2006-2012, the 24-month cohort is the least restrictive because it can include individuals who had their initial fracture as late as 2010, as long as they maintained Medicare part A, B, C, and D coverage. However, the 48-month cohort is the most restrictive because it requires that the initial fracture event happened no later than 2008. The sizes of the cohorts were 220,102, 37,716, and 25,999 respectively.

We estimated a multinomial logit model of re-fracture rates as a function of age, sex, and initial fracture site. The dependent variable was a ten level indicator representing nine re-fracture sites (ankle, clavicle, femur, hip, humerus, pelvis, radius, spine, and tibia/fibula) and a tenth level representing no re-fracture. The covariates are listed in the table below. We estimated this model for each of the three cohorts and from the output, we estimated probabilities of re-fracture, by fracture site, for each group defined by age, sex, and initial fracture site.

<b>Re-fracture Rate Model Covariates</b>
Age – 65-74, 75-84, 85+
Sex
Initial fracture site – nine levels
Age*sex
Age*initial fracture site
Sex*initial fracture site

Using a second model, we estimated costs associated with re-fractures using a generalized gamma linear model with a log link function, an approach commonly used to estimate models of healthcare costs (Manning & Mullahy, 2001). The dependent variable represented total health care costs, and the covariates are listed below. From the output of these models, we estimated incremental cost associated with re-fracture by subtracting the predicted total costs of individuals with a re-fracture at a certain site from predicted total costs of individuals without a re-fracture, holding other covariates equal.

<b>Cost Model Covariates</b>
Age – 65-74, 75-84, 85+
Sex
Initial fracture site – nine levels
Age*sex
Age*initial fracture site
Sex*initial fracture site
Re-fracture site – ten levels (includes no re-fracture level)
Age*re-fracture site
Sex*re-fracture site
Initial fracture site*re-fracture site
Total costs in 12 months prior to initial fracture

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## Binary indicator for multi-site fracture

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The intention is to estimate these models within the cohorts described earlier; however, in the current version of the calculator, the model is estimated three times on the full analytic sample with a dependent variable representing costs in the two, three, and four years following the initial fracture, respectively. This approach does not account for the right-censoring problem discussed earlier, and future versions of the calculator will incorporate the cohort structure into these models. Due to small sizes of cells defined by the interacted covariates in the table above, some modifications will be required to the model specification to support estimation of the models within the cohort.

Within the calculator, the caseload input is combined with the re-fracture probabilities derived from the first model to estimate the expected number of re-fractures at a certain site. These frequencies are multiplied by the estimated incremental costs derived from the second model to generate costs associated with re-fractures for the caseload specified by the user over two, three, and four years. The information on the impact of the FLS to reduce re-fractures input by the user is then combined with the expected number of re-fractures to estimate the number of fractures expected with an FLS. These frequencies are subtracted from the frequencies estimated assuming no FLS, and the difference describes the estimated number of fractures avoided when an FLS is implemented. These totals are multiplied by the incremental cost estimates to determine expected savings in terms of costs associated with re-fractures from implementing the FLS.

## Calculator Output

The calculator updates automatically you complete input sections. When all input fields have been filled, you can review the report by selecting the “Report” tab at the bottom of the Excel window. You can either review the report in Excel or save it to a PDF file by clicking the button indicated by the arrow in the image below.



The report is broken up into five sections. The first, shown below, summarizes the input information provided by the user and represents the caseload with a chart of initial fractures, by site.

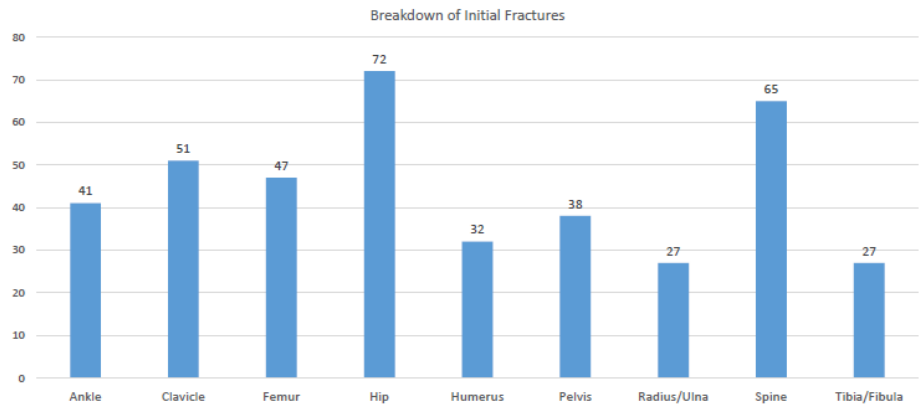
Fracture Liaison Service (FLS) Impact Analysis Report

Generated for Sample Hospital



Input Summary

Initial Fracture Data Input	Detailed
Initial Fragility Fracture Patients	400
FLS Recruitment Rate	80.00%
FLS Coordinator Staffing	0.5 FTEs of Nurse Practitioner
Other Staff	Administrative Assistant
Non-labor Costs	Space, Supplies and Materials
Expected Patients Recruited into FLS	320
FLS Base Protocol Selected:	Hospital (facility), 85% Reimbursement Schedule
FLS Impact Data Input:	Direct Estimates



The second section calculates the costs incurred by the FLS based on the input information provided and the revenue generated by the program. The chart on the right side describes the revenue accumulating over time. At the bottom of this section, the calculator estimates a return on investment in terms of costs and revenues. In this example case, the program costs \$93,948 and generates revenues of \$187,966 in the first year for a return on investment of 1.00. This means that for every \$1 spent on the FLS, the host facility or practice can expect \$2 in revenue, for a net of \$1.

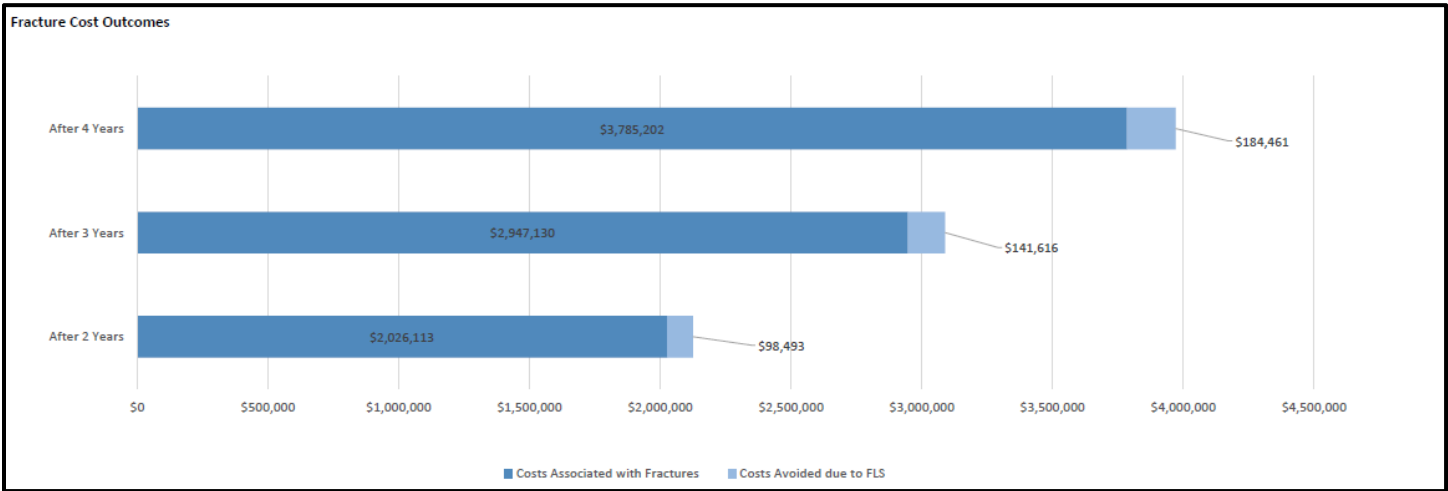
FLS Cost & Revenue	
Labor Cost for FLS Coordinator	\$65,819.00
Other Labor Costs	\$11,375.00
Non-Labor & Overhead Costs	\$16,754.10
Incremental Revenue per Patient Generated by FLS over 4 years	\$752.02
Total Revenue Generated by FLS Program in one year	\$187,966.40

Given a total cost of \$93,948 and revenue of \$187,966, the return on the investment in the FLS program is 1.00 after 1 year.

The third section is a table of fracture outcomes by site. The table presents the expected percentage of fractures avoided based on input information and describes the number of fractures expected with and without the FLS, by fracture site and overall, and by each of the three time periods considered in the calculator. The table also lists the expected number of fractures prevented by the FLS, calculated by subtracting expected fractures without the FLS by expected fractures with the FLS.

Fracture Site	Expected Percentage of Fractures Avoided	Over 2 Years		Over 3 Years		Over 4 Years				
		Fx w/o FLS	Fx w/FLS	Fx Prevented	Fx w/o FLS	Fx w/FLS	Fx Prevented			
Ankle	3.00%	1.62	1.59	0.04	2.69	2.63	0.06	3.28	3.21	0.08
Clavicle	4.00%	0.84	0.81	0.03	0.88	0.85	0.03	0.97	0.94	0.03
Femur	2.50%	2.32	2.28	0.05	2.91	2.85	0.06	3.03	2.97	0.06
Hip	6.80%	12.14	11.48	0.66	16.84	15.92	0.92	21.11	19.97	1.15
Humerus	5.00%	3.84	3.69	0.15	5.22	5.01	0.21	5.90	5.67	0.24
Pelvis	4.20%	3.07	2.96	0.10	3.81	3.69	0.13	4.53	4.38	0.15
Radius/Ulna	3.60%	4.78	4.64	0.14	6.64	6.45	0.19	7.40	7.18	0.21
Spine	7.20%	19.56	18.43	1.13	23.30	21.96	1.34	28.72	27.06	1.65
Tibia/Fibula	3.00%	1.86	1.81	0.04	2.67	2.60	0.06	3.04	2.97	0.07
All Sites	-	50.04	47.70	2.34	64.96	61.96	3.00	77.99	74.34	3.65

The fourth section describes the costs associated with re-fractures. For each of the three time periods, the length of the bar represents costs associated with re-fractures occurring without the FLS. The dark blue bar represents costs associated with re-fractures occurring with the FLS. The pale section of the bar represents the savings in terms of costs associated with re-fractures brought about by implementation of an FLS.



The final section lists the protocol information exactly as the user entered it on the input tab. This section is included solely for reference and context around the revenue estimates.

FLS Protocol						
Revenue estimates on the previous page were made based on the following FLS protocol information entered by the user.						
Base Protocol						
Item	Elapsed Months (from FLS initiation)	Anticipated CPT Code (optional)	Reimbursement Revenue	FLS	Probability of Receipt	
					FLS	Non-FLS
Initial visit	0	99204	\$123.70	100%	0%	0%
Three month follow-up visit	3	99214	\$74.25	100%	0%	0%
Six month follow-up	6	99213	\$48.42	90%	0%	0%
12 month follow-up	12	99213	\$48.42	85%	0%	0%
18 month follow-up	18	99213	\$48.42	85%	0%	0%
24 month follow-up	24	99213	\$48.42	85%	0%	0%
36 month follow-up	36	99213	\$48.42	85%	0%	0%
48 month follow-up	48	99213	\$48.42	85%	0%	0%
Additional Procedures						
Item	Elapsed Months (from FLS initiation)	Anticipated CPT Code (optional)	Reimbursement Revenue	FLS	Probability of Receipt	
					FLS	Non-FLS
Lab, CBC	3	85025	\$9.00	100%	0%	0%
Lab, 25-OH vitamin D level	3	82306	\$34.28	100%	0%	0%
Lab, serum calcium	3	82310	\$5.98	100%	0%	0%
Lab, PTH, Intact	3	83970	\$47.80	100%	0%	0%
Lab, Serum Protein Electrophoresis	3	84165	\$12.44	100%	0%	0%
Physical Therapy Evaluation	6	97001	\$72.23	100%	0%	0%
Physical Therapy Gait Training	6	97116	\$27.49	100%	0%	0%
Physical Therapy Gait Training	6	97116	\$27.49	100%	0%	0%
Physical Therapy Gait Training	6	97116	\$27.49	100%	0%	0%
Physical Therapy Re-Evaluation	6	97002	\$40.51	100%	0%	0%

## Limitations and Conclusions

There are limitations associated with the calculator to be aware of. First, we acknowledge that the suggested method for entering caseload data—a retrospective review—is time-consuming and can be impractical. Furthermore, there is no guarantee that the experience of the previous year is a good indicator for the current year. While we assume that a retrospective review will provide the best estimate of caseload, we encourage you to use alternative methods if a retrospective review is not an option. Even using a range of inputs and comparing output is useful, as it allows you to estimate a range of potential outcomes.

Second, we remind the user that adding procedures to the protocol does not automatically update the costs associated with the program, so the user must ensure that what they have entered in the cost section accounts for all of the services delivered to FLS patients. We note that, for office visits, the largest component of cost is the FLS coordinator salary, which is included in the cost section, but other procedures such as labs or pharmacological treatments might carry additional costs that should be identified in the other cost section.

Third, we acknowledge that the calculator requires the user to make a strong assumption about the impact of the FLS or to rely on effectiveness estimates of specific treatments and exclude the potential impact of other treatments or procedures. FLS protocols vary considerably, and FLSs in general have not been sufficiently studied to produce estimates of their effectiveness at reducing fractures. While output on fracture outcomes is sensitive to FLS impact inputs, it is worth noting that FLS costs and revenues are calculated independent of these parameters.

Finally, there are a number of shortcomings of the calculator that we will remedy in future releases. First and most obvious, the calculator only supports analysis of patients age 65 and up. Currently, we are working to identify a data source to allow us to expand to calculator for patients as young as 50. Second, the current version of the calculator is programmed for an exclusively fee-for-service environment. In that context, “savings” associated with reductions in re-fractures actually represent lost revenue to the facility or practice. We are currently working to integrate a shared savings model into the calculator that will account for incentives paid to facilities or practices that limit re-fractures.

Despite these limitations, the calculator provides a useful framework for interested parties to evaluate the implementation of an FLS in their facility or practice. It allows the user to describe their projected caseload, expected costs, proposed FLS protocol, and potential FLS impact and review output based on those inputs. It combines user inputs with estimates of re-fracture probabilities and costs associated with refractures derived from statistical models of claims data. Please share your questions and feedback, as they will help us to improve the calculator in future releases. Please send your comments and questions to [info@nbha.org](mailto:info@nbha.org).



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## Appendix

### Studies used for FLS Impact

<b>Treatment</b>	<b>Rate of Fracture Reduction</b>	<b>Source(s)</b>	<b>Notes</b>
Optimal Calcium and Vitamin D Supplementation	16%	Larsen et al., 2004 Tang et al., 2007	Not based on prior-fracture population. Rates may differ in these populations.
Bisphosphonates (e.g., Alendronate)	50%	NOF Clinician's Guide Black et al., 1996 Cummings et al., 1998	Most studies have been conducted on women, although there is some evidence for effectiveness for men (Sim & Ebeling, 2013).
Denosumab (Prolia)	39%	Palacios et al., 2015	
Parathyroid Hormone: Teriparatide (Forteo)	59%	NOF Clinician's Guide Neer et al., 2001	Study based on women, although there is some evidence for effectiveness for men (Hodsman et al., 2005). Fracture reduction rate is the average of stated rates of reduction for vertebral and non-vertebral