**Supplementary Materials and Methods: Approaches to handling symptoms and test indication in calculations of proportion of time covered by screening**

***Approach 1***ignores symptoms and indication, and thus the person-time following a diagnostic test is included in both the numerator and denominator of the proportion of time covered (PTC).

***Approach 2*** censors patients when they develop symptoms (during uncovered time). Symptomatic person-time is excluded from the PTC numerator and denominator. By definition, person-time following a diagnostic colonoscopy (i.e., one triggered by symptoms) is excluded from the PTC numerator. This is the preferred approach.

***Approach 3*** censors patients at the time of a diagnostic exam. Subsequent person-time is excluded from both the PTC numerator and denominator. Symptoms are not otherwise factored into analyses.

We apply each of these approaches to 9 scenarios that include, in different proportions, individuals with four different patterns of symptoms and testing shown below. We assume patients are not covered at the start of follow-up. Covered-time and follow-up would accrue for each type of person in the three different approaches as follows:

|  |  |  |  |  |  |  |  |
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|  |   |   |   |   | 1. Ignore symptoms and indication
 | 1. Censor at symptoms
 | 1. Censor at diagnostic test
 |
|  | Start of follow-up | Start of symptoms | Colonoscopy | End of follow-up | Covered time | Follow-up time | PTC | Covered time | Follow-up time | PTC | Covered time | Follow-up time | PTC |
| Symptoms, diagnostic colonoscopy | 1/1/2005 | 7/1/2005 | 1/1/2006 | 12/31/2014 | 9.0 | 10 | 90% | 0.0 | 0.5 | 0% | 0.0 | 1 | 0% |
| No symptoms, screening colonoscopy | 1/1/2005 | - | 1/1/2006 | 12/31/2014 | 9.0 | 10 | 90% | 9.0 | 10 | 90% | 9.0 | 10 | 90% |
| Symptoms, no diagnostic colonoscopy | 1/1/2005 | 7/1/2005 | - | 12/31/2014 | 0.0 | 10 | 0% | 0.0 | 0.5 | 0% | 0.0 | 10 | 0% |
| No symptoms, no screening colonoscopy | 1/1/2005 | - | - | 12/31/2014 | 0.0 | 10 | 0% | 0.0 | 10 | 0% | 0.0 | 10 | 0% |

The 9 scenarios based on different combinations of the patterns shown above are:

1. Medium symptom prevalence (20%); half of symptomatic patients get diagnostic test
2. Medium symptom prevalence (20%); all symptomatic patients get diagnostic test
3. Medium symptom prevalence (20%); no symptomatic patients get diagnostic test
4. Low symptom prevalence (4%); half of symptomatic patients get diagnostic test
5. Low symptom prevalence (4%); all symptomatic patients get diagnostic test
6. Low symptom prevalence (4%); no symptomatic patients get diagnostic test
7. High symptom prevalence (60%); half of symptomatic patients get diagnostic test
8. High symptom prevalence (60%); all symptomatic patients get diagnostic test
9. High symptom prevalence (60%); no symptomatic patients get diagnostic test

The proportion of patients without symptoms who screen is fairly consistent (60-63%) across scenarios.

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|  |  |  |  |  |  | **(1) Ignore symptoms and indication** | **(2) Censor at symptoms** | **(3) Censor at diagnostic test** |
| **A) Medium symptom prevalence (20%); half of symptomatic patients get diagnostic test** |
| **Patient type** | **N** | **Start of follow-up** | **Start of symptoms** | **Colonoscopy** | **End of follow-up** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** |
| Symptoms, diagnostic colonoscopy | 10 | 1/1/2005 | 7/1/2005 | 1/1/2006 | 12/31/2014 | 90 | 100 | 0 | 5 | 0 | 10 |
| No symptoms, screening colonoscopy | 50 | 1/1/2005 | - | 1/1/2006 | 12/31/2014 | 450 | 500 | 450 | 500 | 450 | 500 |
| Symptoms, no diagnostic colonoscopy | 10 | 1/1/2005 | 7/1/2005 | - | 12/31/2014 | 0 | 100 | 0 | 5 | 0 | 100 |
| No symptoms, no screening colonoscopy | 30 | 1/1/2005 | - | - | 12/31/2014 | 0 | 300 | 0 | 300 | 0 | 300 |
| Overall | 100 |   |   |   |   | 540 | 1000 | 450 | 810 | 450 | 910 |
|  Standard PTC overall |   |   |   |   |   | 54% | 56% | 49% |

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| --- | --- | --- | --- | --- | --- | --- |
| **B) Medium symptom prevalence (20%); all symptomatic patients get diagnostic test** |  |  |  |  |  |  |
| **Patient type** | **N** | **Start of follow-up** | **Start of symptoms** | **Colonoscopy** | **End of follow-up** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** |
| Symptoms, diagnostic colonoscopy | 20 | 1/1/2005 | 7/1/2005 | 1/1/2006 | 12/31/2014 | 180 | 200 | 0 | 10 | 0 | 20 |
| No symptoms, screening colonoscopy | 50 | 1/1/2005 | - | 1/1/2006 | 12/31/2014 | 450 | 500 | 450 | 500 | 450 | 500 |
| Symptoms, no diagnostic colonoscopy | 0 | 1/1/2005 | 7/1/2005 | - | 12/31/2014 | 0 | 0 | 0 | 0 | 0 | 0 |
| No symptoms, no screening colonoscopy | 30 | 1/1/2005 | - | - | 12/31/2014 | 0 | 300 | 0 | 300 | 0 | 300 |
| Overall | 100 |   |   |   |   | 630 | 1000 | 450 | 810 | 450 | 820 |
|  Standard PTC overall |   |   |   |   |   | 63% | 56% | 55% |
| **C) Medium symptom prevalence (20%); no symptomatic patients get diagnostic test** |
| **Patient type** | **N** | **Start of follow-up** | **Start of symptoms** | **Colonoscopy** | **End of follow-up** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** |
| Symptoms, diagnostic colonoscopy | 0 | 1/1/2005 | 7/1/2005 | 1/1/2006 | 12/31/2014 | 0 | 0 | 0 | 0 | 0 | 0 |
| No symptoms, screening colonoscopy | 50 | 1/1/2005 | - | 1/1/2006 | 12/31/2014 | 450 | 500 | 450 | 500 | 450 | 500 |
| Symptoms, no diagnostic colonoscopy | 20 | 1/1/2005 | 7/1/2005 | - | 12/31/2014 | 0 | 200 | 0 | 10 | 0 | 200 |
| No symptoms, no screening colonoscopy | 30 | 1/1/2005 | - | - | 12/31/2014 | 0 | 300 | 0 | 300 | 0 | 300 |
| Overall | 100 |   |   |   |   | 450 | 1000 | 450 | 810 | 450 | 1000 |
|  Standard PTC overall |   |   |   |   |   | 45% | 56% | 45% |

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| **D) Low symptom prevalence (4%); half of symptomatic patients get diagnostic test** |
| **Patient type** | **N** | **Start of follow-up** | **Start of symptoms** | **Colonoscopy** | **End of follow-up** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** |
| Symptoms, diagnostic colonoscopy | 2 | 1/1/2005 | 7/1/2005 | 1/1/2006 | 12/31/2014 | 18 | 20 | 0 | 1 | 0 | 2 |
| No symptoms, screening colonoscopy | 60 | 1/1/2005 | - | 1/1/2006 | 12/31/2014 | 540 | 600 | 540 | 600 | 540 | 600 |
| Symptoms, no diagnostic colonoscopy | 2 | 1/1/2005 | 7/1/2005 | - | 12/31/2014 | 0 | 20 | 0 | 1 | 0 | 20 |
| No symptoms, no screening colonoscopy | 36 | 1/1/2005 | - | - | 12/31/2014 | 0 | 360 | 0 | 360 | 0 | 360 |
| Overall | 100 |   |   |   |   | 558 | 1000 | 540 | 962 | 540 | 982 |
|  Standard PTC overall |   |   |   |   |   | 56% | 56% | 55% |
| **E) Low symptom prevalence (4%); all symptomatic patients get diagnostic test** |
| **Patient type** | **N** | **Start of follow-up** | **Start of symptoms** | **Colonoscopy** | **End of follow-up** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** |
| Symptoms, diagnostic colonoscopy | 4 | 1/1/2005 | 7/1/2005 | 1/1/2006 | 12/31/2014 | 36 | 40 | 0 | 2 | 0 | 4 |
| No symptoms, screening colonoscopy | 60 | 1/1/2005 | - | 1/1/2006 | 12/31/2014 | 540 | 600 | 540 | 600 | 540 | 600 |
| Symptoms, no diagnostic colonoscopy | 0 | 1/1/2005 | 7/1/2005 | - | 12/31/2014 | 0 | 0 | 0 | 0 | 0 | 0 |
| No symptoms, no screening colonoscopy | 36 | 1/1/2005 | - | - | 12/31/2014 | 0 | 360 | 0 | 360 | 0 | 360 |
| Overall | 100 |   |   |   |   | 576 | 1000 | 540 | 962 | 540 | 964 |
|  Standard PTC overall |   |   |   |   |   | 58% | 56% | 56% |

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| **F) Low symptom prevalence (4%); no symptomatic patients get diagnostic test** |
| **Patient type** | **N** | **Start of follow-up** | **Start of symptoms** | **Colonoscopy** | **End of follow-up** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** |
| Symptoms, diagnostic colonoscopy | 0 | 1/1/2005 | 7/1/2005 | 1/1/2006 | 12/31/2014 | 0 | 0 | 0 | 0 | 0 | 0 |
| No symptoms, screening colonoscopy | 60 | 1/1/2005 | - | 1/1/2006 | 12/31/2014 | 540 | 600 | 540 | 600 | 540 | 600 |
| Symptoms, no diagnostic colonoscopy | 4 | 1/1/2005 | 7/1/2005 | - | 12/31/2014 | 0 | 40 | 0 | 2 | 0 | 40 |
| No symptoms, no screening colonoscopy | 36 | 1/1/2005 | - | - | 12/31/2014 | 0 | 360 | 0 | 360 | 0 | 360 |
| Overall | 100 |   |   |   |   | 540 | 1000 | 540 | 962 | 540 | 1000 |
|  Standard PTC overall |   |   |   |   |   | 54% | 56% | 54% |
| **G) High symptom prevalence (60%); half of symptomatic patients get diagnostic test** |
| **Patient type** | **N** | **Start of follow-up** | **Start of symptoms** | **Colonoscopy** | **End of follow-up** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** |
| Symptoms, diagnostic colonoscopy | 30 | 1/1/2005 | 7/1/2005 | 1/1/2006 | 12/31/2014 | 270 | 300 | 0 | 15 | 0 | 30 |
| No symptoms, screening colonoscopy | 25 | 1/1/2005 | - | 1/1/2006 | 12/31/2014 | 225 | 250 | 225 | 250 | 225 | 250 |
| Symptoms, no diagnostic colonoscopy | 30 | 1/1/2005 | 7/1/2005 | - | 12/31/2014 | 0 | 300 | 0 | 15 | 0 | 300 |
| No symptoms, no screening colonoscopy | 15 | 1/1/2005 | - | - | 12/31/2014 | 0 | 150 | 0 | 150 | 0 | 150 |
| Overall | 100 |   |   |   |   | 495 | 1000 | 225 | 430 | 225 | 730 |
|  Standard PTC overall |   |   |   |   |   | 50% | 52% | 31% |

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| **H) High symptom prevalence (60%); all symptomatic patients get diagnostic test** |
| **Patient type** | **N** | **Start of follow-up** | **Start of symptoms** | **Colonoscopy** | **End of follow-up** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** |
| Symptoms, diagnostic colonoscopy | 60 | 1/1/2005 | 7/1/2005 | 1/1/2006 | 12/31/2014 | 540 | 600 | 0 | 30 | 0 | 60 |
| No symptoms, screening colonoscopy | 25 | 1/1/2005 | - | 1/1/2006 | 12/31/2014 | 225 | 250 | 225 | 250 | 225 | 250 |
| Symptoms, no diagnostic colonoscopy | 0 | 1/1/2005 | 7/1/2005 | - | 12/31/2014 | 0 | 0 | 0 | 0 | 0 | 0 |
| No symptoms, no screening colonoscopy | 15 | 1/1/2005 | - | - | 12/31/2014 | 0 | 150 | 0 | 150 | 0 | 150 |
| Overall | 100 |   |   |   |   | 765 | 1000 | 225 | 430 | 225 | 460 |
|  Standard PTC overall |   |   |   |   |   | 77% | 52% | 49% |
| **I) High symptom prevalence (60%); no symptomatic patients get diagnostic test** |
| **Patient type** | **N** | **Start of follow-up** | **Start of symptoms** | **Colonoscopy** | **End of follow-up** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** | **Covered time (years)** | **Follow-up time (years)** |
| Symptoms, diagnostic colonoscopy | 0 | 1/1/2005 | 7/1/2005 | 1/1/2006 | 12/31/2014 | 0 | 0 | 0 | 0 | 0 | 0 |
| No symptoms, screening colonoscopy | 25 | 1/1/2005 | - | 1/1/2006 | 12/31/2014 | 225 | 250 | 225 | 250 | 225 | 250 |
| Symptoms, no diagnostic colonoscopy | 60 | 1/1/2005 | 7/1/2005 | - | 12/31/2014 | 0 | 600 | 0 | 30 | 0 | 600 |
| No symptoms, no screening colonoscopy | 15 | 1/1/2005 | - | - | 12/31/2014 | 0 | 150 | 0 | 150 | 0 | 150 |
| Overall | 100 |   |   |   |   | 225 | 1000 | 225 | 430 | 225 | 1000 |
|  Standard PTC overall |   |   |   |   |   | 23% | 52% | 23% |

***Relationship among approaches***

If no patients experience symptoms (and thus no patient receives diagnostic testing), the three approaches will yield equal measures of PTC. In other circumstances, the approaches are expected to differ as follows:

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| --- | --- | --- |
| **Comparison** | **Observation** | **Explanation** |
| Approach 1 vs. Approach 2 | Varies by diagnostic testing among patients with symptoms.  | Denominator for Approach 1 is always ≥ denominator for Approach 2 since symptomatic person-time is included in Approach 1 but not Approach 2. The numerator of Approach 1 may or may not be larger by a proportionate amount compared to the numerator in Approach 2. |
| PTC by Approach 1 > PTC by Approach 2 when all symptomatic patients get diagnostic testE.g., scenarios B and H | If diagnostic testing in symptomatic patients is high, the numerator is relatively large in Approach 1. |
| PTC by Approach 2 > PTC by Approach 1 when no symptomatic patients get diagnostic testE.g., scenarios C and I | If there is no diagnostic testing in symptomatic patients, the numerators will be the same in Approach 1 and Approach 2, and thus, Approach 1, with its larger denominator will be smaller than Approach 2. |
| Approach 2 vs. Approach 3 | PTC by Approach 2 ≥ PTC by Approach 3 in all scenarios  | Numerators are the same in Approach 2 and Approach 3. Both exclude person-time after a diagnostic test. The denominator for Approach 3 includes person-time during which there are symptoms but there has not been a diagnostic test. The denominator for Approach 2 does not include this person-time. So, PTC by Approach 2, with its equal or smaller denominator, will be equal to or larger than PTC by Approach 3. |
| Approach 1 vs. Approach 3 | PTC by Approach 1 = PTC by Approach 3 when no symptomatic patients get diagnostic tests E.g., scenarios C, F, and I | There is no person-time accrued by diagnostic tests so ignoring diagnostic testing makes no difference. The numerators and denominators are the same in Approach 1 and Approach 3. |
| PTC by Approach 1 > PTC by Approach 3 when there is some diagnostic testing among symptomatic patientsE.g., scenarios A, B, D, E, G, H | Excluding person-time after a diagnostic test (Approach 3) reduces the numerator and denominator by the same absolute amount (compared to Approach 1). The reduction in the numerator is *relatively* bigger than in the denominator.  |

***General observations:***

* When symptoms are uncommon (e.g., scenarios D, E, and F), the approaches yield similar results.
* The more common symptoms are, the greater the difference in approaches. With Approach 2 as the preferred approach:
	+ When diagnostic testing among patients with symptoms is high (e.g., scenarios B and H), Approach 3 is a better approximation of Approach 2 compared to Approach 1
	+ When diagnostic testing among patients with symptoms is moderate (e.g., scenarios A and G), Approach 1 is a better approximation of Approach 2 compared to Approach 3
	+ When diagnostic testing among patients with symptoms is low (e.g., scenarios C and I), neither Approach 1 nor Approach 3 is a good approximation of Approach 2