

## Supplemental Online Content

1

2

3 Rotenstein L, Melnick ER, Iannaccone C, et al. Virtual scribes and physician time spent on  
4 electronic health records. *JAMA Netw Open*. 2024;7(5):e2413140.  
5 doi:10.1001/jamanetworkopen.2024.13140

6

7 **eFigure 1.** Equation for Interrupted Time Series Methodology

8 **eTable 1.** Characteristics of Physicians in EHR Metrics 6-Month Analytic Sample

9 **eTable 2.** EHR Use and Time Expenditure Patterns for 3 Months Pre- vs. Postscribe Use

10 **eFigure 2.** 3-Month Change in EHR Metrics With Scribe Use, Scribe Service Type

11 **eFigure 3.** 6-Month Change in EHR Metrics with Scribe Use for Overall Cohort

12 **eFigure 4.** 6-Month Change in EHR Metrics with Scribe Use, Stratified by Specialty

13 **eFigure 5.** 6-Month Change in EHR Metrics with Scribe Use, Stratified by Scribe Service Type

14 **eTable 3.** Factors Associated with 6-Month Change

15 **eTable 4.** Factors Associated with 6-Month Change in Proportion of the Note by the Physician

16 **eFigure 5.** Pajama Time per Appointment by Scribe Type

17

18

19 This supplemental material has been provided by the authors to give readers additional  
20 information about their work.

1 **eFigure 1. Equation for Interrupted Time Series Methodology (segmented linear regression**  
2 **model for change in level and slope from pre to post period)**

3  $Y_t = \beta_0 + \beta_1 t + \beta_2 D_t + \beta_3 (t - T_1) D_t + \varepsilon_t.$

- 4 •  $Y_t$  is the outcome measured at time  $t$ , with the “interruption” or intervention occurring at  
5 time  $T_1$
- 6 •  $D_t$  represents the post-intervention interval. It has a value of 0 in the pre-intervention period  
7 and a value of 1 in the post-intervention period.
- 8 •  $\beta_0$  is the intercept
- 9 •  $\beta_1$  is the pre-intervention slope
- 10 •  $\beta_2$  is the change in the level from the pre-intervention to the post-intervention period
- 11 •  $\beta_3$  is the change in the slope from the pre-interruption slope to the post-interruption slope

1 **eTable 1. Characteristics of Physicians in EHR Metrics 6-Month Analytic Sample**

| <b><u>Characteristic</u></b>   | <b><u>N</u></b> | <b><u>%</u></b> |
|--|-----------------|-----------------|
| <b>Gender</b><br><i>(N=121 unique physicians)</i>                            |                 |                 |
| Male   | 48              | 39.7            |
| Female   | 73              | 60.3            |
| <b>Specialty Category</b><br><i>(N=121 unique physicians)</i>                |                 |                 |
| Medical Specialty  | 36              | 29.8            |
| Primary Care   | 75              | 62.0            |
| Surgical Specialty   | 10              | 8.2             |
| <b>Hospital</b><br><i>(N=121 unique physicians)</i>                          |                 |                 |
| BWH  | 16              | 13.2            |
| MGH  | 105             | 86.8            |
| <b>Years Since Residency</b><br><i>(N=121 unique physicians)</i>             |                 |                 |
| < 5 years  | 9               | 7.4             |
| 5 -10 years  | 34              | 28.1            |
| 11-15 years  | 20              | 16.6            |
| 16-20 years  | 16              | 13.2            |
| 21-25 years  | 14              | 11.6            |
| 26-29 years  | 9               | 7.4             |
| 30+ years  | 19              | 15.7            |
| <b>Scribe Service</b><br><i>(N=122 unique scribe participation episodes)</i> |                 |                 |
| Asynchronous   | 108             | 88.5            |
| Real-Time  | 14              | 11.5            |

2

1 eTable 2. EHR Use and Time Expenditure Patterns for 3 Months Pre- vs Post-Scribe Use a)  
 2 Overall Cohort, b) by Specialty, c) by Scribe Service Type  
 3  
 4

a) Overall Cohort

|   | 3 Months Pre-Scribe Use | 3 Months Post-Scribe Use | P-Value for Difference | Corrected P-Value | N   |
|---|-------------------------|--------------------------|------------------------|-------------------|-----|
|   | Median (Q1, Q3)         | Median (Q1, Q3)          |                        |                   |     |
| Total EHR Time Per Appointment (minutes)    | 29.0 (17.02, 45.0)      | 23.2 (14.9, 36.8)        | <0.001                 | <0.001            | 129 |
| Note Time Per Appointment (minutes)         | 7.9 (4.6, 12.6)         | 7.1 (3.9, 10.6)          | < 0.001                | <0.001            | 127 |
| Pajama Time Per Appointment (minutes)       | 5.6 (2.3, 13.2)         | 5.1 (2.2, 11.0)          | 0.003                  | 0.004             | 126 |
| Proportion of Note Contributed by Provider  | 1.00 (0.84, 1.00)       | 0.54 (0.34, 0.78)        | <0.001                 | <0.001            | 152 |
| Proportion of Orders with Team Contribution | 0.07 (0.02, 0.16)       | 0.07 (0.02, 0.17)        | 0.72                   | 0.72              | 152 |

5

6 b) by Specialty

|   | 3 Months Pre-Scribe Use | 3 Months Post-Scribe Use | P-Value for Difference | Corrected <sup>a</sup> P-Value | N  |
|---|-------------------------|--------------------------|------------------------|--------------------------------|----|
|   | Median (Q1, Q3)         | Median (Q1, Q3)          |                        |                                |    |
| <i>Medical Specialty</i>                    |                         |                          |                        |                                |    |
| Total EHR Time Per Appointment (minutes)    | 21.2 (14.6, 38.1)       | 17.5 (11.2, 24.5)        | <0.001                 | <0.001                         | 41 |
| Note Time Per Appointment (minutes)         | 8.20 (5.90, 12.40)      | 7.10 (3.70, 10.30)       | 0.0006                 | 0.001                          | 40 |
| Pajama Time Per Appointment (minutes)       | 4.20 (1.90, 11.00)      | 3.60 (2.00, 8.00)        | 0.005                  | 0.006                          | 40 |
| Proportion of Note Contributed by Provider  | 0.98 (0.89, 1.0)        | 0.67 (0.40, 0.92)        | <0.001                 | <0.001                         | 51 |
| Proportion of Orders with Team Contribution | 0.02 (0.00, 0.23)       | 0.02 (0.00, 0.36)        | 0.20                   | 0.20                           | 51 |
| <i>Surgical Specialty</i>                   |                         |                          |                        |                                |    |
| Total EHR Time Per Appointment (minutes)    | 12.3 (8.5, 15.1)        | 10.8 (9.6, 13.0)         | 0.38                   | 0.65                           | 76 |
| Note Time Per Appointment (minutes)         | 4.50 (2.20, 7.60)       | 4.40 (2.30, 7.50)        | 0.42                   | 0.65                           | 75 |
| Pajama Time Per Appointment (minutes)       | 4.30 (2.40, 6.00)       | 4.00 (2.70, 5.00)        | 0.68                   | 0.68                           | 74 |
| Proportion of Note Contributed by Provider  | 0.51 (0.40, 0.85)       | 0.43 (0.25, 0.55)        | 0.05                   | 0.25                           | 88 |
| Proportion of Orders with Team Contribution | 0.54 (0.27, 0.72)       | 0.43 (0.22, 0.79)        | 0.52                   | 0.65                           | 88 |
| <i>Primary Care Specialty</i>               |                         |                          |                        |                                |    |
| Total EHR Time Per Appointment (minutes)    | 33.3 (20.6, 49.3)       | 30.2 (19.8, 45.9)        | 0.0003                 | 0.0005                         | 12 |
| Note Time Per Appointment (minutes)         | 8.60 (5.70, 14.00)      | 8.00 (4.60, 12.00)       | 0.0002                 | 0.0005                         | 12 |
| Pajama Time Per Appointment (minutes)       | 6.50 (2.40, 16.70)      | 6.40 (2.40, 13.70)       | 0.14                   | 0.18                           | 12 |
| Proportion of Note Contributed by Provider  | 1.00 (0.91, 1.00)       | 0.54 (0.29, 0.77)        | <0.001                 | 0.0005                         | 13 |
| Proportion of Orders with Team Contribution | 0.07 (0.04, 0.12)       | 0.07 (0.04, 0.1)         | 0.34                   | 0.34                           | 13 |

7

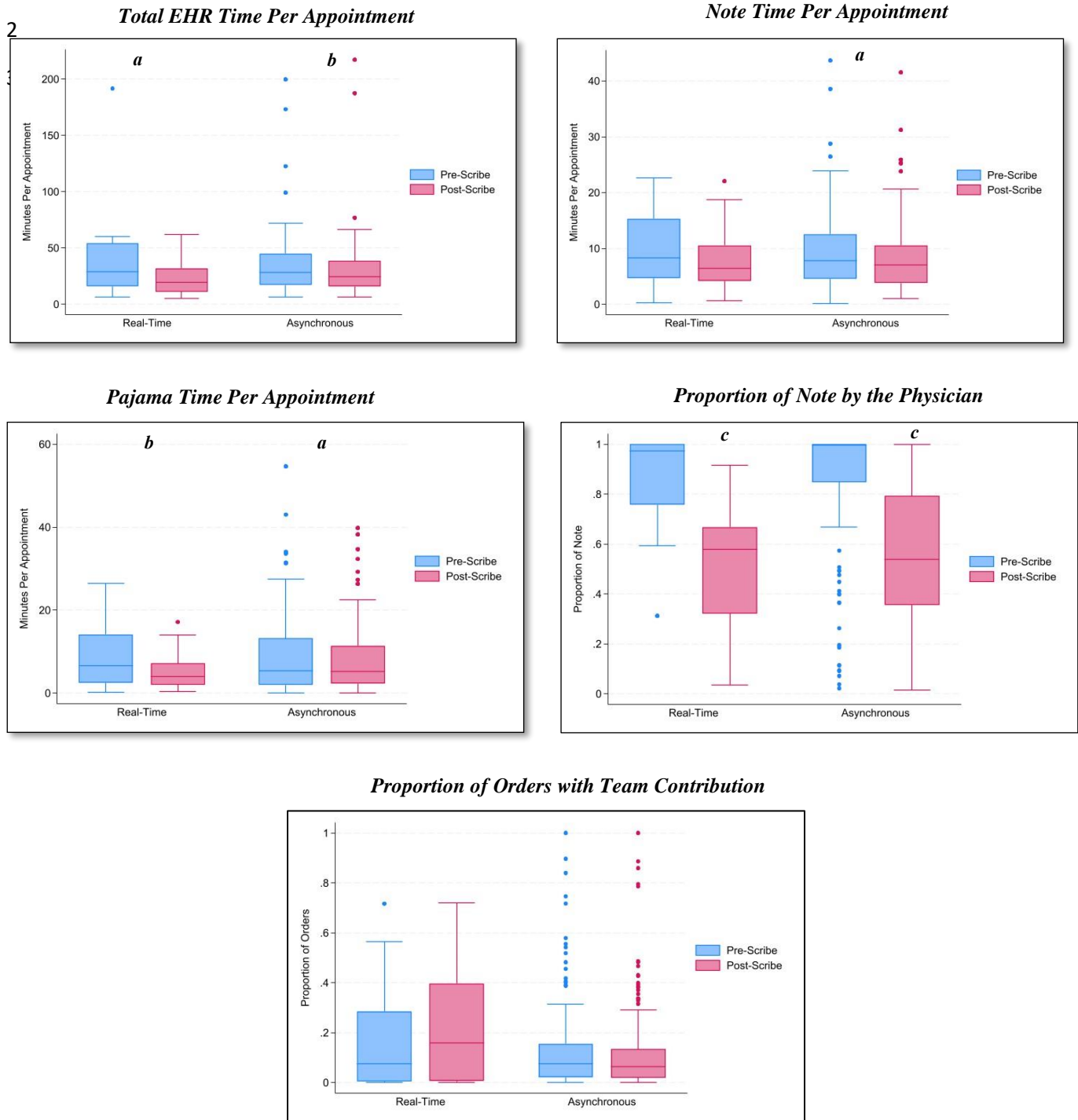
1 **c) by Scribe Service Type**

|  | 3 Months Pre-Scribe Use | 3 Months Post-Scribe Use | P-Value for Difference | Corrected <sup>a</sup> P-Value | N   |
|--|-------------------------|--------------------------|------------------------|--------------------------------|-----|
|  | Median (Q1, Q3)         | Median (Q1, Q3)          |                        |                                |     |
| <i>Asynchronous</i>                                |                         |                          |                        |                                |     |
| <b>Total EHR Time Per Appointment (minutes)</b>    | 28.5 (17.2, 45.0)       | 24.4 (15.7, 37.1)        | <0.001                 | 0.002                          | 15  |
| <b>Note Time Per Appointment (minutes)</b>         | 7.8 (4.6, 12.6)         | 7.1 (3.9, 10.5)          | < 0.001                | 0.002                          | 15  |
| <b>Pajama Time Per Appointment (minutes)</b>       | 5.5 (2.0, 13.2)         | 5.0 (2.2, 11.4)          | 0.04                   | 0.05                           | 15  |
| <b>Proportion of Note Contributed by Provider</b>  | 1.00 (0.85, 1.00)       | 0.54 (0.36, 0.79)        | < 0.001                | 0.002                          | 18  |
| <b>Proportion of Orders with Team Contribution</b> | 0.07 (0.02, 0.16)       | 0.06 (0.02, 0.13)        | 0.31                   | 0.31                           | 18  |
| <i>Real-Time</i>                                   |                         |                          |                        |                                |     |
| <b>Total EHR Time Per Appointment (minutes)</b>    | 29.2 (24.4, 54.1)       | 18.9 (10.7, 32.0)        | 0.0006                 | 0.003                          | 114 |
| <b>Note Time Per Appointment (minutes)</b>         | 8.3 (4.7, 15.3)         | 9.5 (2.3, 13.5)          | 0.07                   | 0.09                           | 112 |
| <b>Pajama Time Per Appointment (minutes)</b>       | 6.6 (2.5, 14.1)         | 5.5 (2.2, 8.8)           | 0.004                  | 0.02                           | 111 |
| <b>Proportion of Note Contributed by Provider</b>  | 0.97 (0.76, 1.0)        | 0.58 (0.32, 0.67)        | < 0.001                | 0.03                           | 134 |
| <b>Proportion of Orders with Team Contribution</b> | 0.17 (0.22)             | 0.22 (0.24)              | 0.13                   | 0.13                           | 134 |

2  
3  
4

a. P-values corrected for multiple comparisons using the Benjamini-Hochberg method.

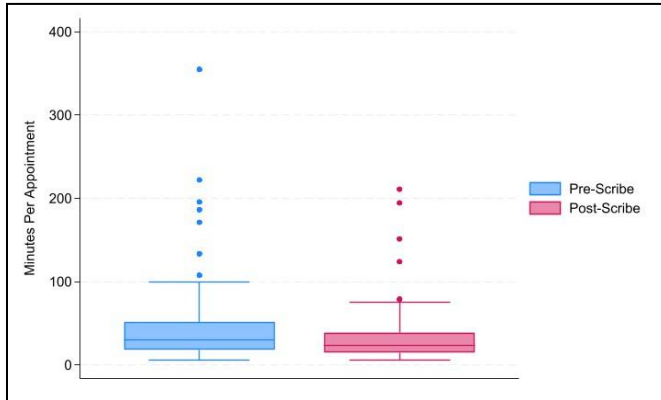
1 **eFigure 2. Three-Month Change in EHR Metrics With Scribe Use, Scribe Service Type**



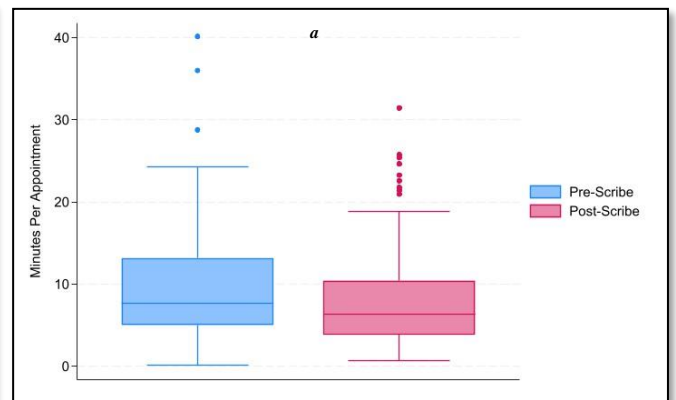
*a* $p < 0.05$ ; *b* $p < 0.01$ ; *c* $p < 0.001$

1 **eFigure 3. Six-Month Change in EHR Metrics With Scribe Use for Overall Cohort**

*a) Total EHR Time Per Appointment*



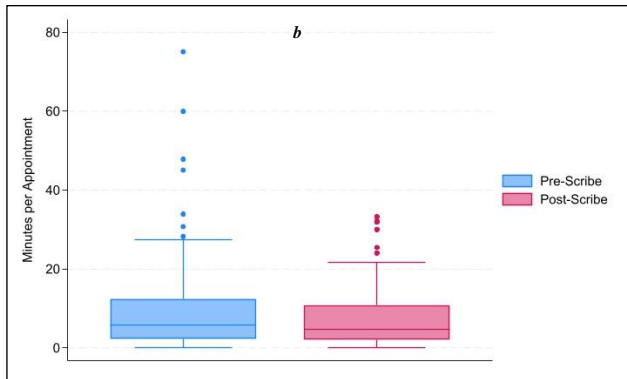
*b) Note Time Per Appointment*



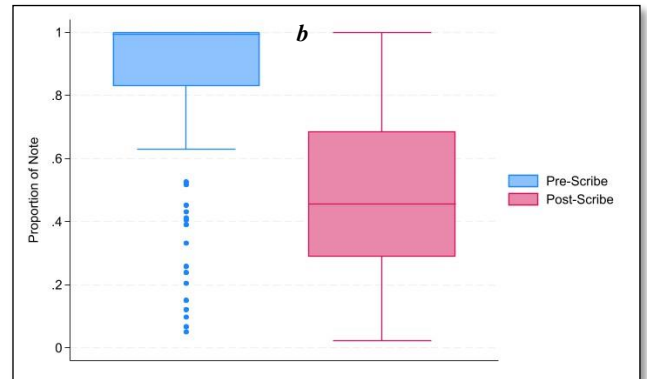
2

3

*c) Pajama Time Per Appointment*

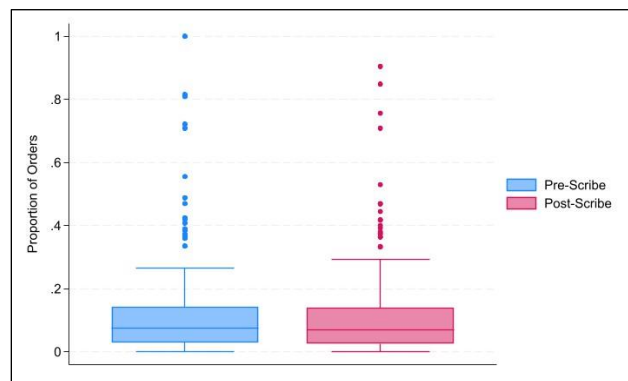


*d) Percent of the Note by the Physician*



4

*e) Proportion of Orders with Team Contribution*



5

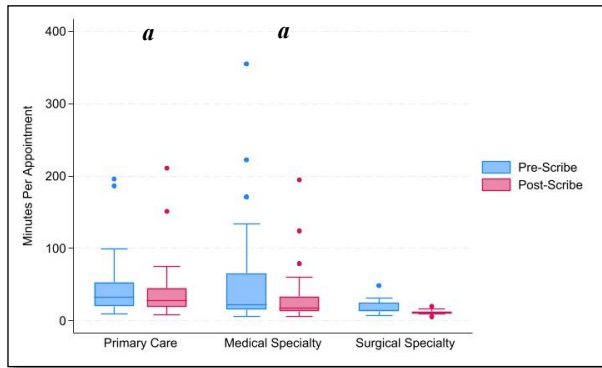
*<sup>a</sup> p<0.001, <sup>b</sup> p<0.01*

*All p-values corrected for multiple comparisons using the Benjamini-Hochberg method*

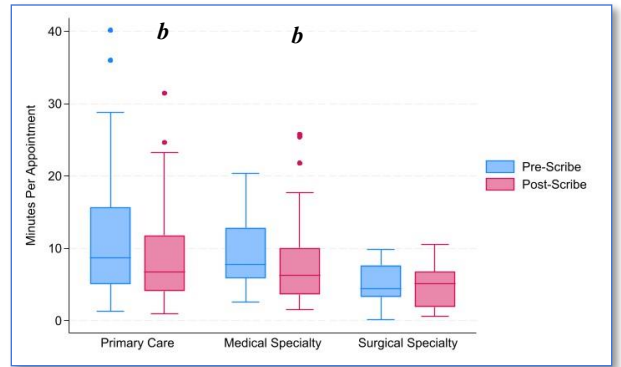
1 **eFigure 4. Six-Month Change in EHR Metrics With Scribe Use, Stratified by Specialty**

2

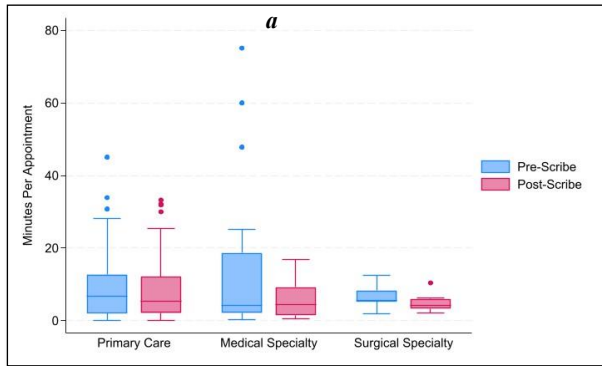
a) *Total EHR Time Per Appointment*



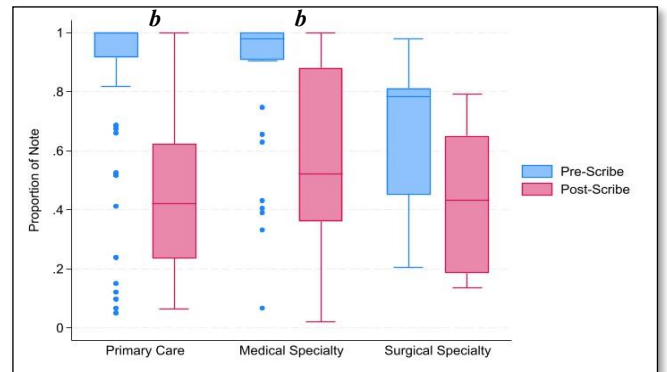
b) *Note Time Per Appointment*



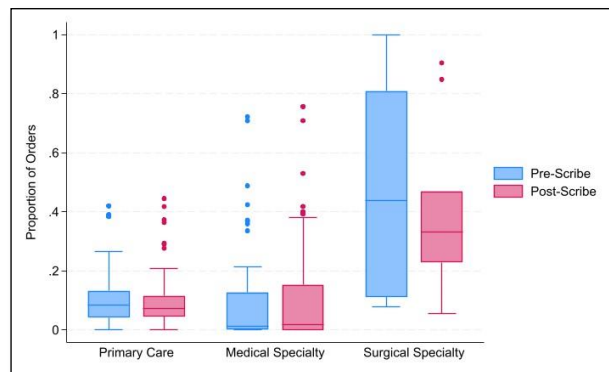
c) *Pajama Time Per Appointment*



d) *Percent of the Note by the Physician*



e) *Proportion of Orders with Team Contribution*



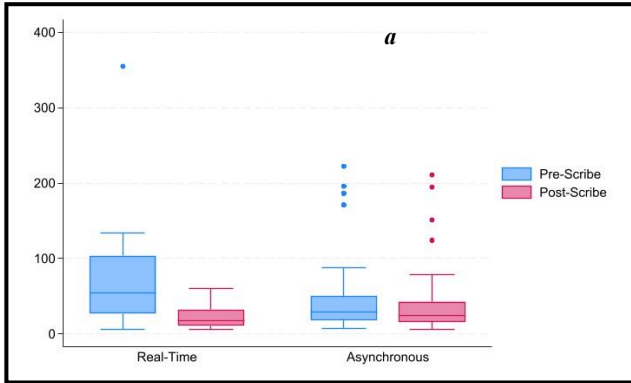
*<sup>a</sup> p<0.05; <sup>b</sup> p<0.001*

*All p-values corrected for multiple comparisons using the Benjamini-Hochberg method*

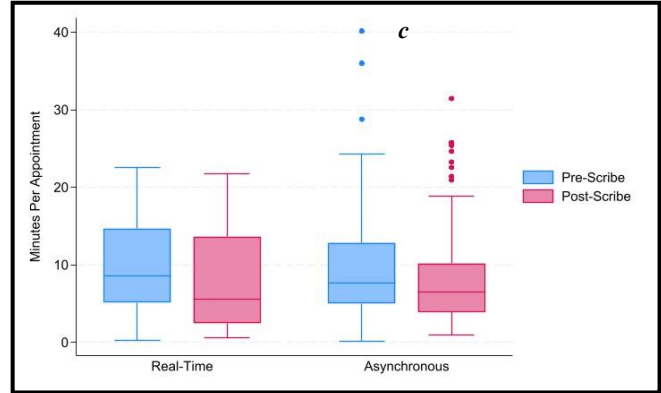


1 **eFigure 5. Six-Month Change in EHR Metrics With Scribe Use, Stratified by Scribe**  
 2 **Service Type**  
 3

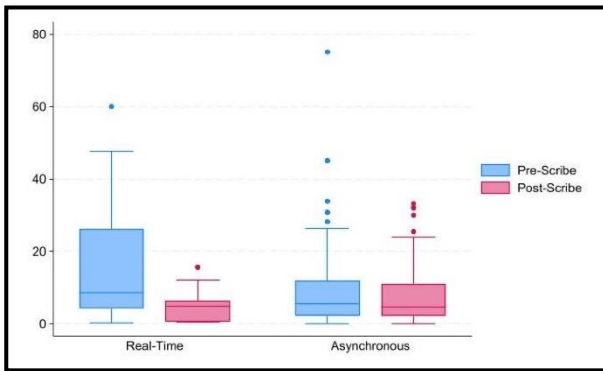
*a) Total EHR Time Per Appointment*



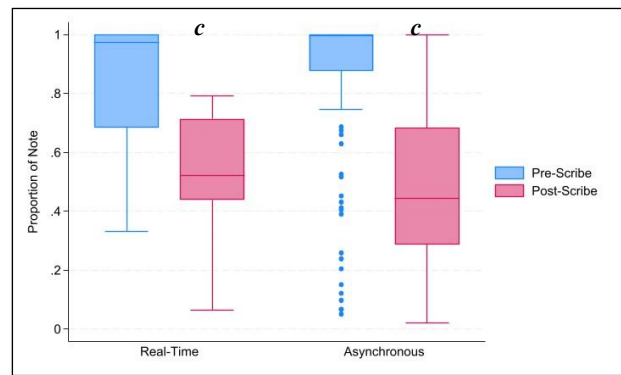
*b) Note Time Per Appointment*



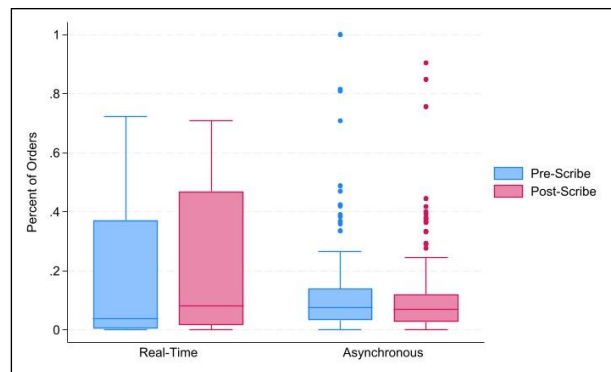
*c) Pajama Time Per Appointment*



*d) Percent of the Note by the Physician*



*e) Proportion of Orders with Team Contribution*



<sup>a</sup>  $p < 0.05$ ; <sup>b</sup>  $p < 0.01$ ; <sup>c</sup>  $p < 0.001$

All  $p$ -values corrected for multiple comparisons using the Benjamini-Hochberg method

1 **eTable 3. Factors Associated With 6-Month Change in a) Total EHR Time; b) Notes Time;**  
 2 **c) Pajama Time, all Per Appointment, After Scribe Use**

| Parameter   | Total EHR Time Per Appointment       |         | Notes Time Per Appointment           |         | Pajama Time Per Appointment          |         |
|---|--------------------------------------|---------|--------------------------------------|---------|--------------------------------------|---------|
|   | Estimate (95% CI), Minutes Per Visit | P-Value | Estimate (95% CI), Minutes Per Visit | P-Value | Estimate (95% CI), Minutes Per Visit | P-Value |
| <i>Baseline EHR Time Per Appointment (Minutes)</i>            | -0.7 (-0.8, -0.6)                    | <0.0001 | -0.3 (-0.4, -0.2)                    | <0.0001 | -0.6 (-0.7, -0.5)                    | <0.0001 |
| <i>Change in Percent of Note Contribution by the Provider</i> | 8.5 (-5.0, 22.1)                     | 0.22    | 4.9 (3.0, 6.8)                       | <0.0001 | 2.3 (-1.2, 5.9)                      | 0.20    |
| <b>Specialty</b>  |                                      |         |                                      |         |                                      |         |
| Medical Specialty   | -17.9 (-27.9, -7.9)                  | 0.0005  | -1.2 (-2.6, 0.3)                     | 0.11    | -4.4 (-7.0, -1.8)                    | 0.0001  |
| Surgical Specialty  | -17.8 (-34.1, -1.6)                  | 0.03    | -0.6 (-2.9, 1.7)                     | 0.59    | -1.9 (-6.0, 2.2)                     | 0.36    |
| Primary Care  | -                                    | -       |                                      |         | -                                    | -       |
| <b>Scribe Service Type</b>                                    |                                      |         |                                      |         |                                      |         |
| Asynchronous  | 7.1 (-7.7, 21.8)                     | 0.35    | -1.2 (-3.2, 0.8)                     | 0.26    | 2.3 (-1.4, 6.0)                      | 0.22    |
| Real-Time Scribe  | -                                    | -       |                                      |         | -                                    | -       |
| <b>Institution</b>  |                                      |         |                                      |         |                                      |         |
| BWH   | -0.9 (-13.4, 11.5)                   | 0.88    | 0.1 (-1.6, 1.8)                      | 0.92    | 1.4 (-1.7, 4.6)                      | 0.38    |
| MGH   | -                                    | -       |                                      |         | -                                    | -       |
| <b>PCP Gender</b>   |                                      |         |                                      |         |                                      |         |
| Female PCP  | 1.5 (-7.1, 10.1)                     | 0.74    | -0.2 (-1.4, 1.1)                     | 0.78    | 0.9 (-1.3, 3.2)                      | 0.42    |
| Male PCP  | -                                    | -       |                                      |         | -                                    | -       |
| <b>Years Since Residency</b>                                  |                                      |         |                                      |         |                                      |         |
| 0 to 10 years since residency                                 | -2.1 (-11.4, 7.2)                    | 0.66    | -0.3 (-1.6, 1.0)                     | 0.68    | 0.1 (-2.3, 2.5)                      | 0.92    |
| 11 to 20 years since residency                                | -5.0 (-15.7, 5.7)                    | 0.36    | -0.1 (-1.6, 1.4)                     | 0.88    | 0.4 (-2.4, 3.2)                      | 0.77    |
| > 20 years since residency                                    | -                                    | -       |                                      |         | -                                    | -       |
| <b>Change in the Percent of Orders with Team Contribution</b> | -17.9 (-72.7, 26.8)                  | 0.43    | 0.4 (-5.9, 6.7)                      | 0.89    | -1.0 (-12.4, 10.5)                   | 0.87    |

3

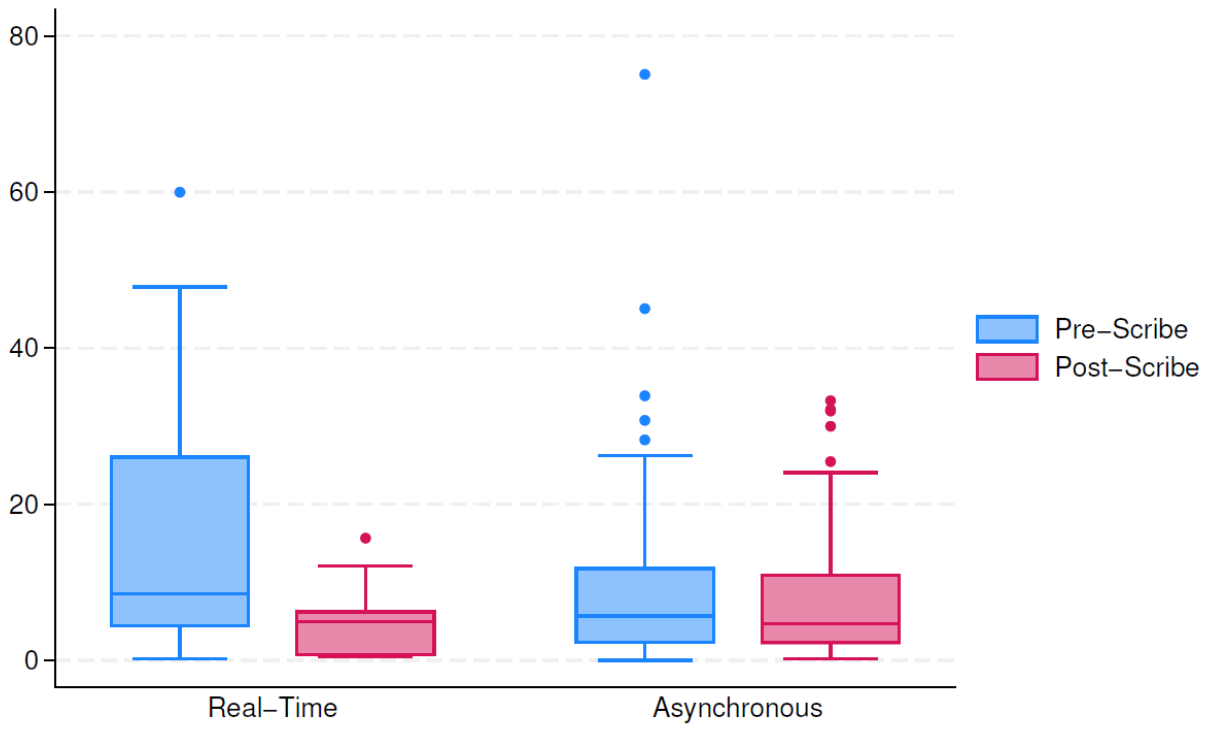
1 **eTable 4. Factors Associated With 6-Month Change in Proportion of the Note by the**  
 2 **Physician**

| Parameter  | Estimate (95% CI), Minutes Per Visit | Pr >  t |
|--|--------------------------------------|---------|
| <b>Baseline Percent of Note by the Physician</b> | -0.74 (-0.94, -0.55)                 | <0.0001 |
| Baseline Note Time Per Appointment               | 0.01 (0.00, 0.01)                    | 0.13    |
| <b>Specialty</b>                                 |                                      |         |
| Medical Specialty                                | 0.04 (-0.08, 0.16)                   | 0.48    |
| Surgical Specialty                               | 0.08 (-0.11, 0.27)                   | 0.40    |
| Primary Care                                     | -                                    | -       |
| <b>Scribe Service Type</b>                       |                                      |         |
| Asynchronous                                     | 0.01 (-0.16, 0.17)                   | 0.13    |
| Real-Time Scribe                                 | -                                    | -       |
| <b>Institution</b>                               | 0.01 (-0.13, 0.16)                   | 0.87    |
| BWH  |                                      |         |
| MGH  | -                                    | -       |
| <b>PCP Gender</b>                                |                                      |         |
| Female PCP                                       | 0.02 (-0.08, 0.13)                   | 0.70    |
| Male PCP   | -                                    | -       |
| <b>Years Since Residency</b>                     |                                      |         |
| 0 to 10 years since residency                    | 0.03 (-0.08, 0.14)                   | 0.63    |
| 11 to 20 years since residency                   | 0.01 (-0.12, 0.13)                   | 0.90    |
| > 20 years since residency                       | -                                    | -       |

3

4

1 eFigure 5. Pajama Time per Appointment by Scribe Type



2