

Supplementary Online Content

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

eTable 1. Cohort Creation (Denominator) and Outcome Definitions (Numerator) per Recommendation

Recommendation	Denominator	Numerator
Don't repeat DXA scans more often than every two years in the absence of high-risk or new risk factors ^{23,24}	<i>Inclusion criteria:</i> Prior baseline, low-risk, or high-risk DXA scan ⁷ . <i>Exclusion criteria:</i> Age <40 or >105 yr on date of scan ⁷ .	Patients meet inclusion and exclusion criteria with claim for subsequent DXA scan within 2 years of prior scan ⁷ .
Don't ordering screening electrocardiograms (ECGs) for asymptomatic or low-risk outpatients ^{21,22}	<i>Inclusion criteria:</i> Periodic health visit with a primary care physician ¹⁴ . <i>Exclusion criteria:</i> Prior diagnosis or recent symptoms suggestive of cardiovascular disease; prior cardiac procedures; high-risk comorbidities; age <18 or >105 yr ¹⁴ .	Patients meet inclusion and exclusion criteria with receipt of an ECG within 30 days of periodic health visit ¹⁴ . Exclude any ECGs that occur during an emergency department visit from the numerator only ^b .
Don't order routine chest X-rays (CXRs) for asymptomatic or low-risk outpatients ²²	<i>Inclusion criteria:</i> Periodic health visit with a primary care physician ¹⁵ . <i>Exclusion criteria:</i> Prior diagnosis or recent symptoms suggestive of cardiopulmonary disease; prior cardiac procedures; consultations with cardiopulmonary specialists; high-risk comorbidities; age <18 or >105 yr ¹⁵ .	Patients meet inclusion and exclusion criteria with claim for CXR within 7 days of periodic health visit ¹⁵ . Exclude any CXRs done during inpatient stay or emergency department visit from numerator only ¹⁵ .
Don't screen women with Pap smears if under 21 years of age or over 69 years of age ²²	<i>Inclusion criteria:</i> Periodic health visit with a primary care physician ^b . <i>Exclusion criteria:</i> Previous gynecologic cancer diagnosis; previous hysterectomy; recent pregnancy; HIV infection age <13 or >105 yr; age ≥21 or ≤69; male sex ⁷ .	Patient meets inclusion and exclusion criteria with claim for cervical cancer screening with Pap smear within 7 days of periodic health visit ⁷ .

Notes: DXA = dual-energy X-ray absorptiometry; ECG = electrocardiogram; Pap = Papanicolaou; CXR = chest X-ray; HIV = human immunodeficiency virus.

^a Both components of the same CW recommendation; however, split to reflect independent measurement, which is consistent with preceding studies.

^b Represent methodological deviations from referenced studies.

eTable 2. Baseline Characteristics by Number of Tests With 50+ Opportunities (n = 11,448)

Characteristic	Number of tests with 50+ opportunities			P value ^a
	0	1-3	4	
	N=2,763	N=6,291	N=2,394	
Age, median (IQR)	46 (34-60)	49 (38-58)	51 (44-58)	<.001 ^b
Missing (n, %)	310 (11.2)	282 (4.5%)	0 (0.0%)	
Years since graduation, median (IQR)	16 (4-32)	22 (9-31)	25 (17-32)	<.001 ^b
Missing (n, %)	43 (1.6)	16 (0.2)	0 (0.0)	
Sex, n (%)				<.001
Male	1,500 (54.3)	3,412 (54.2)	1,193 (49.8)	
Female	1,225 (44.3)	2,864 (45.5)	1,201 (50.2)	
Missing	38 (1.4)	15 (0.2)	0 (0.0)	
IMG, n (%)				<.001
Non-IMG	1,734 (62.8)	4,596 (73.1)	1,701 (71.1)	
IMG	338 (12.2)	1,329 (21.1)	693 (28.9)	
Missing	691 (25.0)	366 (5.8)	0 (0.0)	
Primary care model				<.001
Primarily fee-for-service	1,961 (71.0)	2,722 (43.3)	1,130 (47.2)	
Primarily capitation	754 (27.3)	3,502 (55.7)	1,258 (52.5)	
Other	48 (1.7)	67 (1.0)	6 (0.3)	
Patients per physician, median (IQR)	24 (3-84)	70 (28-152)	85 (36-178)	<.001 ^b
Missing (n, %)	1,762 (63.8)	1,659 (26.4)	54 (2.3)	

Notes: *Significant at P<.05.

^a Calculated from three-way tests.

^b Missing values were excluded from the statistical test to which the P-value corresponds.

eTable 3. Observed and Expected Frequency Distribution of Physicians Based on Cross-Test Score and Frequently Used Test(s)

Cross-test score ^b	No. physicians			Frequently used test(s) ^a			
	Observed	Expected ^c	Relative deviation ^d	DEXA	ECG	CXR	Pap
0	1023 (42.73)	981 (40.96)	0.043	O	O	O	O
1	276 (11.53)	245 (10.24)	0.126	X	O	O	O
1	180 (7.52)	245 (10.24)	-0.266	O	X	O	O
1	203 (8.48)	245 (10.24)	-0.172	O	O	X	O
1	271 (11.32)	245 (10.24)	0.105	O	O	O	X
2	46 (1.92)	61 (2.56)	-0.249	X	X	O	O
2	40 (1.67)	61 (2.56)	-0.347	X	O	X	O
2	53 (2.21)	61 (2.56)	-0.135	X	O	O	X
2	121 (5.05)	61 (2.56)	0.974	O	X	X	O
2	51 (2.13)	61 (2.56)	-0.168	O	X	O	X
2	38 (1.59)	61 (2.56)	-0.380	O	O	X	X
3	27 (1.13)	15 (0.64)	0.762	X	X	X	O
3	15 (0.63)	15 (0.64)	0.021	X	X	O	X
3	12 (0.50)	15 (0.64)	-0.217	X	O	X	X
3	28 (1.17)	15 (0.64)	0.827	O	X	X	X
4	10 (0.42)	4 (0.16)	1.611	X	X	X	X

Notes: ^a X and O respectively indicate whether a physician in that row belongs to or does not belong to the top ordering quintile for that test.

^b Represents number of tests in the top ordering rate quintile.

^c Minor discrepancy in observed and expected column totals due to rounding to closest integer per cell.

^d Calculated as $(\% \text{ observed} - \% \text{ expected}) / (\% \text{ expected})$.

eTable 4. Results of Mixed-Effects Multinomial Logistic Regression (n = 2,340)

Fixed Effects	Cross-test score	OR ^a (95% CI)	IOR-80 ^{a,b}
<i>Physician-level</i>			
Sex, male v female	1 v 0	1.08 (0.89-1.31)	-
	≥2 v 0	1.33 (1.03-1.73)*	-
IMG v non-IMG	1 v 0	1.04 (0.84-1.28)	-
	≥2 v 0	0.65 (0.49-0.87)*	-
Years since graduation	1 v 0	1.00 (1.01-1.02)	-
	≥2 v 0	1.04 (1.03-1.05)*	-
<i>Group-level</i>			
Primary care model ^{c, d}	FHO v FHG		
	1 v 0	0.87 (0.68-1.11)	(0.45, 1.65)
	≥2 v 0	0.83 (0.60-1.17)	(0.39, 1.76)
	FHT v FHG		
1 v 0	0.81 (0.63-1.04)	(0.42, 1.55)	
≥2 v 0	0.44 (0.30-0.65)*	(0.20, 0.99)	
No. patients per physician	30-59 v <30		
	1 v 0	1.14 (0.82-1.59)	(0.54, 2.40)
	≥2 v 0	0.71 (0.45-1.13)	(0.29, 1.71)
	60-109 v <30		
	1 v 0	1.03 (0.75-1.42)	(0.50, 2.15)
	≥2 v 0	0.91 (0.59-1.42)	(0.39, 2.16)
	110-209 v <30		
	1 v 0	0.95 (0.69-1.32)	(0.45, 2.00)
≥2 v 0	0.67 (0.42-1.06)	(0.27, 1.61)	
>210 vs <30			
1 v 0	1.08 (0.78-1.50)	(0.51, 2.26)	
≥2 v 0	0.84 (0.53-1.33)	(0.35, 2.01)	
<i>Random Effects^a</i>			
<i>Group-level</i>			
Variance (SE)	1 v 0	0.04 (0.05)	
	≥2 v 0	0.25 (0.12)	
MOR ^b	1 v 0	1.21 (1.11-1.30)*	
	≥2 v 0	1.62 (1.38-1.85)*	
ICC, % ^{b,e}	1 v 0	1.16	
	≥2 v 0	7.15	
<p>Notes: Significant at $P \leq .05^*$. OR = odds ratio; CI = confidence interval; IOR-80 = 80% interval odds ratio; IMG = international medical graduate; FHO = family health organization; FHG = family health group; FHT = family health team; MOR = median odds ratio. All reported values based on SAS PROC GLIMMIX output; model estimation method = Laplace; denominator degrees of freedom estimation method = between and within (bw); covariance structure = standard variance (vc).</p> <p>^a Adjusted for all other factors present in the model/table, as well as the quarter and season in which visit occurred.</p> <p>^b Estimated using group-level variance estimate.</p> <p>^c Represents the primary care patient enrollment model which informs group organization and remuneration.</p> <p>^d Suppressed comparison of 'Other v FHG' due to low observed frequency of 'Other' category.</p> <p>^e Calculated using the latent response formulation (i.e. let residual variance = 3.29).</p>			

eFigure. Frequency Distributions for Unadjusted Physician-Level Ordering Rates for Repeat DXA Scans, ECGs, Pap Tests, and CXRs Notes: DXA = dual-energy X-ray absorptiometry; ECG = electrocardiogram; Pap = Papanicolaou; CXR = chest X-ray.

