SUPPLEMENTAL MATERIAL

‘Physicians’ clinical experience and its association with health care quality: A systematised review’

Soffien Ajmi[1,2] MD; Karina Aase[2,3] Prof.

1. Department of Neurology, Stavanger University Hospital, Stavanger, Norway
2. Faculty of Health Sciences, University of Stavanger, Stavanger, Norway
3. SHARE - Centre for Resilience in Healthcare, Faculty of Health Sciences, University of Stavanger, Stavanger, Norway

Supplemental table 1: Included studies on the association between physicians' clinical experience and healthcare quality

Reference	Study design	Field	Sample size	Key results	Association
Dimension of quality: Safety					
Atkinson et al., 2018[1]	Cross-sectional study	Hospitalist and general pediatricians	95 physicians, 1423 patient encounters	Device related adverse event higher among physicians with less years of experience.	Positive
Berk et al., 2008[2]	Cross-sectional study	Emergency physicians	829 cases	Physicians with more years of experience less likely to make a cognitive error.	Positive
McMahon et al., 2012[3]	Prospective cohort study	Neurosurgeons	3000 cases	Years of experience was not a risk factor for incidental durotomies.	Neutral
Theodoro et al., 2010[4]	Prospective cohort study	Physicians performing cannulation of the internal jugular vein	289 attempted cannulations in 282 patients, 77 physicians	Non-linear, U-shaped correlation with better outcomes for low and high-volume physicians.	Neutral
Campbell et al. 2019[5]	Retrospective cohort study	Ophthalmologists	499 650 operations	For composite measure of adverse events, lower risk with more cases, no change with age.	Partially positive
Epstein et al., 2013[6]	Retrospective cohort study	Obstetricians	6 704 311 deliveries performed by 5 175 obstetricians	Significant reduction in complication rates for physicians with more years of training.	Positive
Satkunasivam, R et al., 2020[7]	Retrospective cohort study	Surgeons	1 159 676 patients, 3 314 surgeons	Older surgeons had a significantly reduced risk for of complications.	Positive
Skolka, M. et al., 2020[8]	Retrospective cohort study	Internal medicine physicians	31 physicians, 15 933 hospital discharges	Higher readmission rates for physicians with a low volume of discharges but no difference with years of experience.	Partially positive
Southern, W. N. et al., 2011[9]	Quasi-experimental study	Mixed, all inpatients	6572 patients, 59 physicians	No difference in readmission rates for physicians with different years of experience.	Neutral
Curtze S. et al., 2012[10]	Prospective cohort study	Neurologists	1 581 patients	No difference in rate of intracerebral hemorrhage after thrombolysis for physicians with different volume of treatments.	Neutral

Stevens, H. et al., 2018[11]	Retrospective cohort study	Surgeons	60 430 patients, 71 physicians	No statistically significant difference in complication rates across different surgeon age groups. .	Neutral
Dimension of quality: Clinical effectiveness					
Abe et al., 2012[12]	Cross-sectional study	Psychiatrists	1036 patients	Change in global assessment of function score from admission to discharge had no significant association with years in practice.	Neutral
Anderson et al., 2017[13]	Retrospective cohort study	Thoracic surgeons	206 surgeons, 62 851 operations	Negative association with major morbidity/mortality only for surgeons with >35 years of experience. Neutral for other outcomes and age groups.	Partially negative
Ashy et al., 2017[14]	Pooled analysis of data from six observational studies	General practitioners	15 282 patients, 2 834 physicians	Poorer blood pressure control for older physicians, but volume of hypertensive patients associated with better outcomes.	Neutral
Bjornsson et al. 2011[15]	Prospective cohort study	Physicians responding to cardiac arrests	232 resuscitations and 39 physicians	Physician experience with real cases does not add to experience from resuscitation training	Neutral
Chai et al., 2010[16]	Retrospective cohort study	Thoracic surgeons	3766 patients	Lower mortality for older surgeons.	Positive
Conway et al., 2015[17]	Retrospective cohort study	Emergency physicians	36 271 patients with 66 933 admissions	Lower mortality in physicians with more years of experience.	Positive
Funkhouser et al. 2011[18]	Retrospective cohort study	General practitioners	1901 patients and 133 physicians	No association between physician age and correct beta blocker prescription after myocardial infarction.	Neutral
Glassman et al., 2020[19]	Retrospective cohort study	General practitioners	5053 primary care physicians	Older physicians associated with lower composite measure of performance	Negative
Goodwin et al., 2018[20]	Cross-sectional study and retrospective cohort study	Early career hospitalists	21 612 hospitalists	Mortality lower for second versus first year hospitalist with no change for subsequent years.	Positive
Haubitz-Eschelbach Andrea et al., 2019[21]	Retrospective cohort study	Emergency room- and ward-physicians	18 259 patients, 494 physicians	Grey-haired physicians compared to those with black or blond hair had lower risk of in-hospital mortality.	Positive

Hsu J.C et al. 2012[22]	Retrospective cohort study	Cardiologists performing biventricular device implantation	272 patients	Fewer procedural difficulties for more experienced physicians. No difference for failed implantation.	Partially positive
Huntington et al. 2019[23]	Retrospective cohort study	Oncologists administering Rituximab treatments	15 110 patients and 2 684 physicians	Physicians with higher volume of prior treatments had lower rates of treatment discontinuation (associated with higher mortality)	Positive
Jasuja G. K. et al. 2017[24]	Cross-sectional	Physicians - Several specialties	38 648 providers	Younger physicians adhered more to guidelines with appropriate testing before medication prescription.	Negative
Kerlin et al., 2018[25]	Retrospective cohort study	Intensivists	345 physicians, 11 268 patients	No association between years of experience, volume, and mortality.	Neutral
Khatana S. A M. et al.2018[26]	Retrospective cohort study	Interventional cardiologists	356 interventional cardiologists and 145 247 patients	Physician caseload significantly associated with mortality but not years of experience.	Partially positive
Lee, H.C. et al., 2009[27]	Case-control study	Psychiatrists	87 cases compared to 348 controls	Suicide hazard among patients treated by older physicians higher.	Negative
Levie M. et al., 2011[28]	Multicenter prospective cohort study	Physicians performing hysteroscopic sterilization	578 patients, 37 newly trained and 39 senior physicians	No association with either successful placement or procedural time between newly trained and senior physicians.	Neutral
Lindenauer P. K. et al., 2006[29]	Retrospective cohort study	Internal medicine physicians	13 480 patients, 9 741 physicians	Higher physician volumes resulted in lower adherence to guidelines but no difference in mortality.	Partially negative
McAllister F.A. et al., 2015[30]	Retrospective cohort study	Internal medicine physicians	10 046 patients, 149 physicians	No association in any of the included outcome measures with years of experience.	Neutral
Miller E.S. et al., 2018[31]	Retrospective cohort study	Obstetricians	134 obstetricians and 1 852 patients	Lower risk of failed deliveries with more years of experience. No difference in rates of severe perineal lacerations.	Partially positive
Satkunasivam R et al., 2020[7]	Retrospective cohort study	Surgeons	1 159 676 patients, 3 314 surgeons	Older physicians and physicians with a higher volume associated with lower mortality.	Positive
Slinin Y. et al., 2014[32]	Retrospective cohort study	Mixed	91 276 patients, 72 734 physicians	No association between mortality for hemodialysis patients and physician years of experience or volume.	Neutral
Harvey M., et al., 2008[33]	Prospective cohort study	Emergency physicians	1 291 patients	No association between mortality and senior or resident physicians.	Neutral

Li C. J. et al., 2016[34]	Retrospective cohort study	Emergency physicians	44 383 non-trauma patients,	Reduced mortality for physicians with more years of experience.	Positive
Curtze S. et al., 2012[10]	Prospective cohort study	Neurologists	1 581 patients	No difference in disability or death for physicians with a higher volume of prior treatments.	Neutral
Southern, W. N. et al., 2011[9]	Quasi-experimental study	Mixed, all inpatients	6572 patients, 59 physicians	Higher mortality for physicians with more years of experience.	Negative
Dimension of quality: Patient-centeredness					
Haubitz-Eschelbach Andrea et al., 2019[21]	Retrospective cohort study	Emergency room- and ward-physicians	18 259 patients, 494 physicians	Grey-haired physicians had higher patient-perceived quality of care compared to those with blonde or black hair.	Neutral
Nuyen Brian A. et al., 2020[35]	Cross-sectional study	Surgeons	36 840 surveys	No association between physician age and likelihood to recommend scores.	Neutral
Obele C.C. et al., 2017[36]	Cross-sectional study	Interventional radiologists	2 774 surveys	No association between physician age or years of experience and likelihood to recommend scores.	Neutral
Seely J.M. et al., 2017[37]	Retrospective cohort study	Physicians performing ultrasound guided and vacuum-assisted stereotactic biopsy.	351 patient interviews	More years of training for physician associated with less pain and bruising after one of two studied procedures.	Partially positive
Fathy et al., 2018[38]	Retrospective cohort study	Ophthalmologists and neuro-ophthalmologists	1342 ophthalmologists	Older physician had a lower rate of unsolicited complaints.	Positive
Dimension of quality: Timeliness					
Li C. J. et al., 2016[34]	Retrospective cohort study	Emergency physicians	44 383 non-trauma patients	Older physicians had higher time to order and door to dispositions times than their younger peers.	Negative
Curtze S. et al., 2012[10]	Prospective cohort study	Neurologists	1 581 patients	Physicians with a higher volume of prior treatments had reduced door-to-needle time in stroke thrombolysis.	Positive
Mehrotra, A. et al., 2018[39]	Retrospective cohort study	Physicians performing colonoscopies	201 physicians, 104 618 patients	The mean adenoma detection rates were higher in physicians with less years of experience.	Negative
Harvey, M., et al., 2008[33]	Prospective cohort study	Emergency physicians	1 291 patients	Physicians with more years of experience had lower waiting times.	Positive

Lindenauer, P. K., 2006[29]	Retrospective cohort study	Physicians treating pneumonia	13 480 patients, 9 741 physicians	Physician volume not associated with timeliness of administration of antibiotics.	Neutral
Dimension of quality: Efficiency					
Li C. J. et al., 2016[34]	Retrospective cohort study	Emergency physicians	44 383 non-trauma patients,	Physicians with more years of experience were less likely to order unnecessary tests.	Positive
Conway et al., 2015[17]	Retrospective cohort study	Emergency physicians	36 271 patients with 66 933 admissions	Physician years of experience associated with shorter length of stay in high-risk patients.	Partially positive
Davenport et al., 2020[40]	Retrospective cohort study	Radiologists assessing initial computed tomography scan	25 596 patients	Radiologist years of experience associated with lower odds of undergoing subsequent unnecessary imaging.	Positive
Howard, Hockenberry 2019[41]	Retrospective cohort study	Obstetricians	1 658 327 vaginal deliveries, 2200 physicians	Older physicians associated with higher (unnecessary) episiotomy rates	Negative
Southern W. N. et al., 2011[9]	Quasi-experimental study	Mixed	6572 patients, 59 physicians	Physicians with more years of experience had longer mean lengths of stay.	Negative
Cournane S. et al., 2015[42]	Retrospective cohort study	Emergency physicians	19 295 patients	Less costs per case for physicians with > 15 years of experience.	Positive
Ellis S. D., et al., 2015[43]	Retrospective cohort study	Urologists	12 943 patients, 2 138 urologists	Urologists years of experience was not associated with overuse of medication.	Neutral
Mehrotra A. et al., 2012[44]	Cross-sectional study	Mixed	2 861 093 claims attributed to 12 724 physicians	Lower costs with increasing years of experience and caseload.	Positive
Piovani D. et al., 2017[45]	Cross-sectional study	Community pediatricians	424 280 patients, 1 164 physicians	Older physicians associated with higher achievement of targets for antibiotic prescription.	Positive
Rose-Felker, K. et al., 2016[46]	Retrospective cohort study	Pediatricians	1701 patients, 526 physicians	Higher years of experience associated with less appropriate ordering of echocardiography.	Negative
Schwartz, A. et al., 2019[47]	Retrospective cohort study	Generalist physicians	3 159 834 patients and 41 773 physicians	Increase in rate of low-value services with increasing physician age.	Negative
Tan, A. et al., 2016[48]	Retrospective cohort study	Primary care providers	145 320 patients, 3 297 physicians	Inappropriate ordering of imaging increased with increasing physician age and caseload.	Negative
Tang, V. et al., 2016[49]	Cross-sectional study	Mixed	203 717 patients, 61 874 physicians	Increasing physician age associated with unnecessary prostate-specific antigen screening.	Negative
Abe et al., 2012[12]	Cross-sectional study	Psychiatrists	1036 patients	No association between length of stay and years of experience.	Neutral

Dimension of quality: Equity					
Essien U. R., et al., 2019[50]	Retrospective cohort study, propensity-matched sensitivity analysis	Resident and staff primary care physicians	143 274 patients	Residents patients included a higher proportion of typically underserved populations. Residents provided lower quality of care after adjusting for patient factors.	Positive
Dimension of quality: Other					
Reid, R.O. et al., 2010[51]	Retrospective cohort study	Mixed	1.13 million patients, 10 408 physicians	Physician age was not associated with higher performance on composite performance score.	Neutral

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