# Electronic consultation system demonstrates educational benefit for primary care providers

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## Abstract

**Background:** Electronic consultation systems allow primary care providers to receive timely speciality expertise via iterative electronic communication. The use of such systems is expanding across the USA with well-documented high levels of user satisfaction. We characterise the educational impact for primary care providers of a long-standing integrated electronic consultation and referral system.

**Methods:** Primary care providers' perceptions of the educational value inherent to electronic consultation system communication and the impact on their ability to manage common speciality clinical conditions and questions were examined by electronic survey using five-point Likert scales. Differences in primary care providers' perceptions were examined overall and by primary care providers' speciality, provider type and years of experience.

**Results:** Among 221 primary care provider participants (35% response rate), 83.9% agreed or strongly agreed that the integrated electronic consultation and referral system provided educational value. There were no significant differences in educational value reported by provider type (attending physician, mid-level provider, or trainee physician), primary care providers' speciality, or years of experience. Perceived benefit of the electronic consultation and referral system in clinical management appeared stronger for laboratory-based conditions (i.e. subclinical hypothyroidism) than more diffuse conditions (i.e. abdominal pain). Nurse practitioners/physician assistants and trainee physicians were more likely to report improved abilities to manage specific clinical conditions when using the electronic consultation and/or referral system than were attending physicians, as were primary care providers with $\leqslant 10$ years experience, versus those with $>20$ years of experience.

**Conclusions:** Primary care providers report overwhelmingly positive perceptions of the educational value of an integrated electronic consultation and referral system. Nurse practitioners, physician assistants, trainee physicians and less-experienced primary care providers report the greatest clinical educational benefit, particularly for conditions involving lab-based diagnosis and management.

## Keywords

Primary care provider education, eConsult, electronic consultation

## Introduction

Electronic consultation and/or referral (eCR) systems are novel tools for speciality care delivery that have been expanding across the USA and abroad.[1–3] Primary care providers (PCPs) can use eCR systems to electronically submit consultation requests for speciality expertise. These consults are reviewed by specialists who recommend further diagnostic work-up of the condition, provide management advice, and/or recommend that the patient be seen for a face-to-face speciality care visit. Through streamlined and iterative communication, eCR systems can enhance coordination of care between PCPs and

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subspecialists and increase timely patient access to speciality expertise.[4] This has been of particular interest for healthcare safety-net delivery systems, where scarce speciality care resources negatively impact the care for high-needs populations.[5]

eCR systems have enhanced patient experience with speciality care delivery through decreased wait times for in-person speciality visits, avoided travel for unnecessary specialist visits, and improved care coordination among primary and speciality care providers.[3,4,6,7] Studies of early eCR system implementation illustrated high specialist satisfaction with eCR system communication with PCPs, an improved ability to determine the clinical question for in-person referrals, and a decrease in unnecessary face-to-face speciality care visits.[8,9] PCPs have reported high satisfaction with eCR systems, citing beliefs that eCR systems improve clinical care, provide guidance for pre-subspeciality visit workup, and offer educational benefits through iterative communication with specialists.[5,6]

Long suspected but under-studied in the USA is the perception that eCR systems may also provide real-time education for PCPs, thus enhancing PCP skill at managing more straightforward speciality problems. Suggestively, two studies examining provider experiences using a Norwegian telehealth platform found that 75–95% of referring providers reported an educational benefit from specialists' replies.[10,11] With this study, we assessed PCPs' perception of one eCR system's educational value and its impact on their ability to manage common, low-complexity, speciality conditions. Our results contribute to a growing evidence base of the impact of eCR system implementation and may help identify for healthcare institutions that are developing similar systems, subsets of providers that may disproportionately benefit from an eCR system.

## Methods

### Setting and participants

The San Francisco Health Network (SFHN) is an integrated public healthcare delivery system that provides comprehensive ambulatory care services to the uninsured and under-insured residents of San Francisco. Referrals to speciality care come from two networks of primary care providers that either work in one of 14 SFHN primary care clinics or one of 10 independent federally qualified health centres loosely affiliated to form the San Francisco Consortium Clinics. All referrals to speciality care, located at the Zuckerberg San Francisco General Hospital and Trauma Center (ZSFG), are made through an integrated electronic referral and consultation system, known as eReferral.[12]

All requests for speciality expertise within the SFHN are submitted via the eReferral platform. A trained specialist reviewer (physician or nurse practitioner) reviews each request and can schedule the patient for an in-person speciality visit, request further clarification or workup, or provide education and management strategies for the purpose of co-management with the referring provider. Iterative communication between the specialist reviewer and referring provider is automatically recorded in the patient's electronic health record. eReferral was first implemented in 2005 with gastroenterology and, by 2016, expanded to include over 80 medical, surgical and women's health specialities.

### Study design and survey methodology

In October 2015, we developed and administered an electronic survey designed to evaluate PCP perceptions of eReferral, including questions targeting the educational value of using eReferral, and its impact on PCP management of clinical conditions/problems that specialists described as common and low-complexity, and for which they typically provided virtual co-management rather than in-clinic consultation. These conditions/problems were cited by the specialists during prior one-on-one interviews with the eReferral administrative team during which best practices for consultative communication were reviewed.[13] All of the conditions/problems described by seven different eConsult specialists as common, low-complexity, and most often resolved without an in-person speciality appointment were included in the survey. We administered the survey to all SFHN PCPs who use eReferral to refer patients to ZSFG specialists. The first 150 PCPs to complete the survey were given a US$10 gift card. The study was approved by the University of California, San Francisco Committee on Human Research.

### Survey measures

We examined PCP perception of the educational value of eReferral by soliciting agreement with the statement 'eReferral has educational value for me as a PCP'. Possible answer choices included 'strongly agree', 'agree', 'neutral', 'disagree', 'strongly disagree', and 'can't evaluate'. We assessed the impact of eReferral on PCPs' perception of their abilities to manage 10 common clinical conditions/ questions leading to speciality care consultations with the question:

> Please indicate how eReferral has affected your ability to manage each of the following findings: (a) subclinical hypothyroidism, (b) hyperthyroidism, (c) abnormal liver function tests, (d) abdominal pain, (e) benign prostatic hypertrophy (BPH), (f) history of lung nodules, (g) positive anti-nuclear antibody (ANA), (h) anaemia, (i) thrombocytopaenia, (j) headaches.

PCPs were asked to choose among 'reduced ability', 'made no difference', 'improved ability', and 'never referred'.

### Statistical analyses

We examined overall PCP perception of eReferral educational value and eReferral impact on the ability of PCPs

to manage 10 speciality clinical conditions/questions. We collapsed responses into two-level categorical variables for ease of interpretation. To describe educational value, we combined 'Strongly agree' and 'agree' and 'neutral', 'strongly disagree', and 'disagree'. To describe impact on clinical management we retained 'improved ability', combined 'reduced ability' with 'made no difference', and recoded 'never referred' to a missing response. We used chi-squared tests to explore differences in PCP perception of eReferral's educational value and impact on clinical management by PCP provider type (attending physician, nurse practitioner (NP)/physician assistant (PA), trainee) and PCP years of experience (1–10 years, 11–20 years, 20+ years). We also examined differences in perception by family medicine and Internal medicine PCPs, excluding paediatric/adolescent specialists and 'other' specialists due to small sample sizes ($n = 20$ and $n = 8$, respectively). The Bonferroni correction was used for chi-squared analyses to account for multiple pairwise comparisons. Logistic regression models further examined eReferral impact on clinical management for each condition adjusting for PCP provider type, PCP speciality, number of years in practice, and number of half-day outpatient clinic sessions worked per week. Trainees were excluded from regression analyses because of collinearity with number of years in practice ($r = -0.61$). STATA 13 was used to conduct the analysis.[14]

## Results

### Participant demographics

Of 636 SFHN PCPs who received the survey, 221 PCPs responded for a 35% response rate. Nearly one-quarter (23.3%, $n = 51$) of respondents were NP/PAs, 45.2% ($n = 99$) were attending physicians, and 31.5% ($n = 69$) were trainee physicians (fellows or residents). Among non-trainees, 40.7% ($n = 61$) had practised 1–10 years, 34.7% ($n = 52$) had practised 11–20 years, and 24.7% ($n = 37$) had practised more than 20 years (Table 1). Nearly one-half (46.6%, $n = 103$) of respondents specialised in family medicine, 40.7% ($n = 90$) specialised in internal medicine or HIV, and 9.0% ($n = 20$) specialised in paediatrics or adolescent medicine. One-quarter (24.8%, $n = 51$) of respondents worked 0–1 clinic sessions in clinic per week and 8.7% ($n = 18$) were full-time clinicians who worked eight or more clinic sessions per week. The remainder worked 2–7 clinic sessions per week.

### eReferral perceived educational value

Overall, 83.9% of PCPs agreed (42.4% 'agree'; 41.5% 'strongly agree') that eReferral had educational value, while 8.8% were neutral and 7.4% disagreed (5.5% 'disagree'; 1.8% 'strongly disagree'). We found no significant differences for perceived educational value by provider type, speciality or years of experience. Multivariate logistic regression verified no significant differences for

**Table 1.** Primary care provider (PCP) survey demographics.

| Primary clinic/practice setting | n (%) |
| --- | --- |
| San Francisco Health Network Clinic (SFHN) | 191 (86.4) |
| SF Community Consortium Clinic (SFCC) | 30 (13.5) |
| Provider type | |
| Nurse practitioner or physician assistant | 51 (23.3) |
| Attending physician | 99 (45.2) |
| Trainee physician | 69 (31.5) |
| Primary speciality | |
| Family medicine/HIV | 103 (46.6) |
| Internal medicine | 90 (40.7) |
| Paediatrics/adolescent medicine | 20 (9.0) |
| Other[a] | 8 (3.8) |
| Years in practice[b] | |
| 1–10 years | 66 (42.0) |
| 11–20 years | 52 (33.1) |
| 20+ years | 39 (24.8) |
| Outpatient clinic sessions per week[c] | |
| 0–1 | 51 (24.8) |
| 2–4 | 85 (41.3) |
| 5–7 | 52 (25.2) |
| 8+ | 12 (8.7) |

[a]'Other' included women's health, emergency medicine, urgent care, podiatry, and physical medicine and rehabilitation.
[b]'Currently in training' ($n = 64$) not reported or included in n (%).
[c]Clinic sessions constituted one half-day each.

perceived educational value by provider type when controlling for PCP speciality, years of experience and number of outpatient sessions per week.

### eReferral impact on clinical management

PCPs reported mostly positive opinions when asked if eReferral improved their ability to manage the majority of common speciality conditions assessed. The percentage of PCPs who responded with 'agree'/'strongly agree' ranged from 46.2% (abdominal pain) to 81.6% (hyperthyroidism), with percentages over 60% for seven of the 10 conditions (Figure 1). The least percentage of PCPs indicated improvement in clinical management of abdominal pain and benign prostatic hypertrophy, with roughly equal percentages indicating that eReferral 'made no difference' in their ability to clinically manage compared to 'agree'/'strongly agree'. A small minority of PCPs (1–2%) reported that eReferral reduced their ability to manage any one of the specified conditions or questions. Notably, two individual PCPs reported negative responses for every speciality condition/question, accounting for half to all of the negative responses for every speciality condition/question.

Significant differences were found in perception of eReferral's impact on managing common conditions by PCP provider type. NP/PAs were more likely than attending physicians to report improved ability to manage four of the 10 clinical conditions (subclinical hypothyroidism,
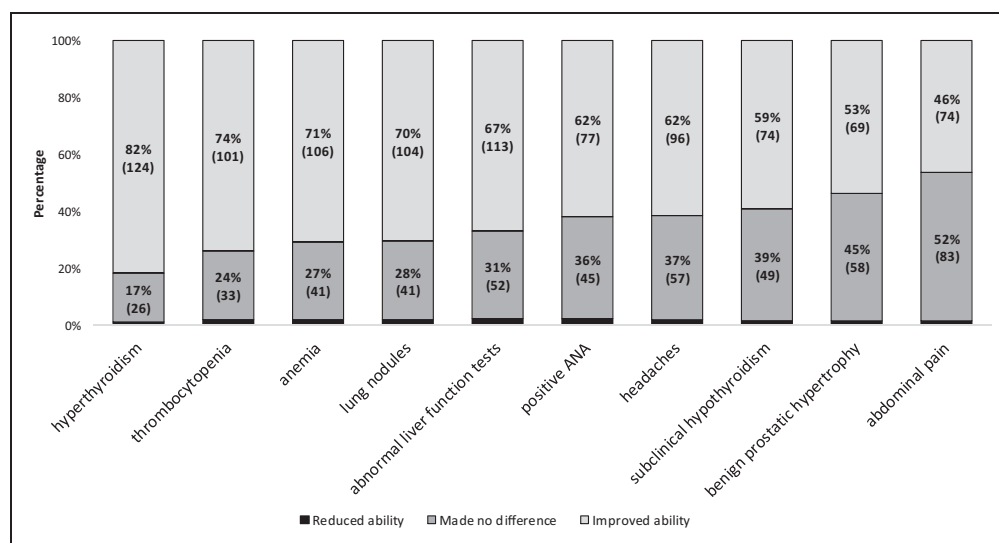
**Figure 1.** Primary care provider (PCP) perception of eReferral's impact on their ability to manage common clinical conditions/problems. ANA: anti-nuclear antibody.

**Table 2.** Percentage of primary care providers (PCPs) that agreed that eReferral improves their ability to manage common clinical findings, by provider type and years of experience.

|  | Subclinical hypothyroidism | Hyper-thyroidism | Abnormal LFTs | Abdominal pain | Benign prostatic hypertrophy | History of lung nodules | Positive ANA | Anaemia | Thrombo-cytopaenia | Headaches |
|---|---|---|---|---|---|---|---|---|---|---|
| PCP provider type (%) |  |  |  |  |  |  |  |  |  |  |
| Attending physician | 44 | 75 | 57 | 34 | 47 | 65 | 56 | 54 | 62 | 47 |
| NP/PA | 77[a] | 90 | 72 | 54 | 63 | 78 | 62 | 84[a] | 88[a] | 72[a] |
| Trainee physician | 68 | 85 | 78[a] | 60[a] | 57 | 71 | 73 | 85[a] | 79 | 79[a] |
| Years of experience (%) |  |  |  |  |  |  |  |  |  |  |
| 1–10 | 61 | 81 | 75 | 48 | 60 | 67 | 57 | 78 | 82 | 59 |
| 11–20 | 59 | 85 | 64 | 37 | 51 | 78 | 69 | 69 | 77 | 58 |
| 20+ | 50 | 74 | 43[a] | 41 | 47 | 65 | 53 | 47[a] | 55[a] | 53 |

ANA: anti-nuclear antibody; LFT: liver function test; NP: nurse practitioner; PA: physician assistant.
[a]Denotes significant pairwise differences in responses between PCP provider type subsets when compared to 'attending physician' or between Years of experience subsets when compared to '1–10', respectively ($p < 0.017$).

anaemia, thrombocytopaenia, headaches) as a direct impact of eReferral ($p < 0.017$ for each; Table 2). Trainee physicians (residents/fellows) were also more likely than attending physicians to report improved ability from eReferral to manage four of the 10 clinical conditions (abnormal liver function, abdominal pain, anaemia, headaches; $p < 0.017$ for each; Table 2). Similarly, PCP experience impacted the perceived educational benefit of eReferral. Clinicians with 10 years of experience or less reported greater impact from eReferral compared to their more experienced counterparts, though statistically significant differences were only noted for the management of abnormal liver function tests, anaemia and thrombocytopaenia ($p < 0.017$ for each; Table 2).

Multivariate logistic models controlling for provider type, PCP speciality, PCP experience and number of outpatient sessions per week yielded similar results (Appendix 1). These models confirmed that NPs/PAs had greater odds of reporting improved ability to manage several clinical conditions compared to attending providers: subclinical hypothyroidism (adjusted odds ratio (aOR) = 4.8, $p = 0.008$); abdominal pain (aOR = 3.1; $p = 0.03$); anaemia, (aOR = 4.9, $p = 0.01$); and headaches (aOR = 2.9, $p = 0.04$). In the multivariate model, internal medicine and family medicine providers had similar odds of reporting improved ability to manage common clinical conditions, with the exception of managing a positive ANA (aOR for internal medicine vs family medicine = 0.22, $p = 0.003$). Compared to PCPs with 20 years of experience or more, those with 1–10 years of experience had higher odds of reporting greater impact from eReferral in managing most conditions, with statistically significant differences in managing abnormal liver function tests (aOR = 3.25, $p = 0.04$ and anaemia (aOR = 4.17,

$p = 0.02$). No differences in perceived impact of eReferral on the management of common, low-complexity speciality conditions were seen by clinical load.

## Discussion

We demonstrate that PCPs uniformly perceive strong educational benefit from one eCR system, including increased capacity to manage a diverse array of common, low-complexity speciality referral conditions. These results expand upon findings from other studies that show PCPs appreciate the educational opportunities inherent to iterative communication with specialists via eCR systems.[6,10,11,15] Our results demonstrate that these educational benefits are enjoyed by PCPs regardless of provider type, speciality or years of experience, though we did show that mid-level providers and PCPs with less experience were more likely to report an improved ability to manage certain clinical conditions as a direct result of the eCR system. This is consistent with work from a free-standing electronic consultation system in Canada, in which NPs demonstrated increased use of an eCR system compared to family practice physicians and perceived greater value both for themselves and for their patients, including educational benefit.[16] Nevertheless, our results suggest that making eCR services and their educational benefits available to all PCPs in a network is most desirable to maximally increase the number of conditions that can be managed in primary care.

Providers attributed greater positive educational benefits to the eCR system for conditions involving laboratory-based diagnosis and management (i.e. subclinical hypothyroidism, hyperthyroidism, abnormal liver function tests, a positive anti-nuclear antibody test result, anaemia, thrombocytopaenia), compared to more symptom and history focused clinical entities such as abdominal pain, benign prostatic hypertrophy, history of lung nodules and headaches. We attribute these benefits, in part, to the consistent advice given by experienced specialists to PCPs. Of the seven specialities represented in our survey, several have had longstanding specialist reviewers, including: endocrinology, haematology, neurology, hepatology, and general surgery. Pulmonology, rheumatology and urology, on the other hand, experienced a greater turnover of specialist reviewers in our system. Differences in consistency among speciality reviewers may have contributed to differences in perceived benefit of the eCR system in managing speciality conditions. Additionally, we note that the clinical conditions for which there was greatest perceived educational value from the eCR system are largely managed by 'cognitive specialists', such as endocrinologists or haematologists who rely heavily on laboratory testing for diagnosis and management with minimal need for medical procedures. PCPs may have an easier time learning with laboratory-based data compared to qualitative information within the context of an eCR system. Other factors that could influence our results include quality of PCP-specialist correspondences, frequency of eCR system use by PCPs, prior PCP content knowledge, and existing relationships with specialist providers. It is also probable that unmeasured specialist reviewer characteristics such as type of training, years of experience and teaching ability, influenced the educational value conferred to PCPs. Indeed, prior studies have demonstrated that PCP satisfaction with eCR systems is largely influenced by quality of specialist communication and response time.[6,17]

In a healthcare delivery system with low PCP turnover, the educational benefits of an eConsult system are likely to materialise after several years, after PCPs have had time to apply their knowledge to new patients. Through eCR systems, specialist providers can thus play significant roles in developing and maintaining a medical neighbourhood, benefiting both patients and healthcare providers.[18,19] This has healthcare policy implications, since a consensus for specialist compensation for electronic consultation effort has not yet been achieved. Existing compensation strategies vary by healthcare delivery systems, with most relying on pro-rated, fee-for-service models that do not take into account the potential educational benefit conferred by consistent, high-quality specialist responses.[20–23] Adopting a value-based model for remuneration could further encourage specialist reviewers to communicate consistently and effectively, aligning compensation with the tenets of a patient-centred medical neighbourhood, including increasing primary care capacity.

Study limitations include a low overall response rate of 35%. While nonresponse bias may influence the overall positive perception reported for eConsult's educational value, a review of physician survey response behaviours found that nonresponse bias may not be an important factor contributing to the validity of physician surveys.[24] We also obtained our list of common clinical conditions from an informal survey of some of our speciality reviewers. Our analyses would benefit from expanding our pool of clinical conditions. Other results may emerge when including a wider variety of specialities or more conditions managed by the same speciality. Additionally, our results may not be generalisable to other healthcare delivery systems due to site or system-specific factors. However, our distribution of our PCPs' clinical responsibilities suggests that our participants included both academics and non-academics, which should make our results reasonably generalisable.

There exist other initiatives that also provide PCP education and improve PCP capacity but eCR systems have several unique characteristics which make them particularly attractive for provider continuing medical education. For example, eCR systems offer longitudinal learning experiences, which may be more effective at facilitating continuous growth for physicians than discrete learning opportunities conferred by lectures or conferences. eConsult educational opportunities are inherently case-based and provide interactivity through iterative communications between providers on a specific patient, both of which facilitate learning among adult medical

professionals.[25–28] While other educational initiatives such as mini-speciality residencies or interactive seminars have also been shown to provide educational benefit, those forms of training unfortunately take providers out of their practice, thereby increasing the workload for their covering colleagues.[29] eCR systems, on the other hand, are seamlessly integrated into the healthcare delivery process, allowing PCPs to continually receive educational benefit from multiple specialities at point of care. This study demonstrates a clear educational benefit of eCR systems for PCPs, expanding their ability to manage common low-complexity medical problems and thus providing additional evidence to encourage eCR system implementation among diverse healthcare delivery systems.

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## Appendix

**Appendix 1.** Adjusted odds ratios and 95% confidence intervals of perceptions of primary care providers (PCPs) that eReferral improves their ability to manage common clinical conditions. The model for each condition is adjusted for PCP provider type, PCP speciality, number of years in practice and number of outpatient half-day clinic sessions worked per week. Bold values are associated with a *p*-value of <0.05.

| | Subclinical hypothyroidism | Hyper-thyroidism | Abnormal LFTs | Abdominal pain | Benign prostatic hypertrophy | History of lung nodules | Positive ANA | Anaemia | Thrombo cytopaenia | Headaches |
|---|---|---|---|---|---|---|---|---|---|---|
| **PCP provider type** | | | | | | | | | | |
| NP/PA vs attending physician (ref) | **4.77 (1.51–15.07)**\*\* | 3.57 (0.96–13.30) | 2.12 (0.75–5.95) | **3.09 (1.11–8.56)** | 2.61 (0.94–7.24) | 1.66 (0.59–4.69) | 0.71 (0.23–2.19) | **4.86 (1.46–16.18)** | 3.12 (0.85–11.43) | **2.92 (1.04–8.21)** |
| **PCP speciality** | | | | | | | | | | |
| Internal medicine vs family medicine (ref) | 1.91 (0.73–4.99) | 1.46 (0.54–3.96) | 0.95 (0.41–2.19) | 0.85 (0.37–1.98) | 0.84 (0.35–2.05) | 1.47 (0.61–3.51) | **0.22 (0.08–0.60)** | 0.52 (0.21–1.31) | 0.50 (0.18–1.38) | 0.91 (0.39–2.09) |
| **Years of experience** | | | | | | | | | | |
| 1–10 vs 20+ (ref) | 1.28 (0.38–4.32) | 1.28 (0.38–4.30) | **3.25 (1.07–9.88)** | 1.26 (0.44–3.65) | 1.90 (0.61–5.87) | 0.95 (0.32–2.82) | 1.60 (0.49–5.18) | 4.16 (1.28–13.54) | 2.52 (0.78–8.14) | 1.19 (0.42–3.39) |
| 11–20 vs 20+ (ref) | 0.89 (0.26–3.06) | 1.34 (0.37–4.79) | 1.67 (0.59–4.73) | 0.71 (0.24–2.15) | 1.18 (0.40–3.46) | 1.00 (0.57–5.33) | 3.47 (0.98–12.29) | **2.77 (0.90–8.55)** | 3.06 (0.87–10.73) | 1.23 (0.42–3.64) |
| **Number of half-day ambulatory clinic sessions worked per week** | | | | | | | | | | |
| 2–4 vs 0–1 (ref) | 2.80 (0.67–11.80) | 0.75 (0.19–2.92) | 0.85 (0.26–2.75) | 0.92 (0.29–2.87) | 0.64 (0.19–2.12) | 0.60 (0.17–2.08) | 1.20 (0.33–4.39) | 0.61 (0.20–2.08) | 1.23 (0.35–4.31) | 1.33 (0.44–4.03) |
| 5–7 vs 0–1 (ref) | 1.68 (0.36–7.92) | 0.53 (0.12–2.34) | 0.80 (0.22–2.95) | 0.92 (0.26–3.25) | 0.67 (0.18–2.41) | 1.26 (0.30–5.19) | 0.93 (0.23–3.81) | 0.66 (0.16–2.74) | 1.67 (0.41–6.74) | 1.06 (0.31–3.68) |
| 8+ vs 0–1 (ref) | 0.79 (0.11–5.72) | 0.61 (0.10–3.92) | 0.43 (0.09–2.15) | 0.44 (0.086–2.29) | 0.20 (0.35–1.13) | 0.93 (0.17–5.07) | 0.73 (0.13–4.12) | 0.27 (0.04–1.81) | 2.11 (0.30–14.83) | 0.98 (0.19–5.13) |

ANA: anti-nuclear antibody; LFT: liver function test; NP: nurse practitioner; PA: physician assistant.