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Quality improvement initiative to reduce URI-associated antibiotic prescriptions among adult primary care providers

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ABSTRACT

Importance Despite evidence that most upper respiratory infections (URIs) are due to viruses, antibiotics are frequently prescribed for this indication in the outpatient setting. Antibiotic stewardship strategies are needed to reduce adverse patient outcomes and staggering healthcare costs due to resistant infections that ensue from inappropriate prescriptions.

Objective To determine if individual provider scorecards detailing antibiotic prescribing rates paired with educational resources reduce inappropriate antibiotic use for URIs in the outpatient primary care setting.

Design, setting and participants This quality improvement project investigated the number of URI-coded office visits in the primary care setting over three consecutive influenza seasons, which resulted in an antibiotic prescription in Cooper University Healthcare's 14 primary care offices. We compared provider's individual prescribing patterns to their peers' average and created a scorecard that was shared with each provider over a series of intervention phases. Data were collected from a preintervention period (November 2017–February 2018), and two postintervention phases, phase I (November 2018–February 2019) and phase II (November 2019–February 2020).

Intervention A personalised, digital scorecard containing antibiotic-prescribing data for URI-coded visits from the prior influenza season was emailed to each primary care provider. Prior to the subsequent influenza season, prescribers received their updated prescribing rates as well as peer-to-peer comparisons. In both phases, the scorecard was attached to an email with antimicrobial stewardship educational materials.

Main outcomes and measures The primary outcome was a reduction in the number of inappropriate antibiotic prescriptions for URI-related diagnoses. The diagnoses were organised into five broad coding categories, including bronchitis, sinusitis, sore throat excluding strep, influenza and tonsillitis excluding strep.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Do provider scorecards paired with educational materials result in reduced inappropriate antibiotic prescribing for upper respiratory infection (URI)-related diagnoses among outpatient primary care providers?

WHAT THIS STUDY ADDS

⇒ In this QI project, which included a total of 16 100 office visits with URI-related diagnosis codes, there was a statistically significant reduction in antibiotics ordered for all diagnoses except for 'influenza' and 'tonsillitis excluding strep'.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Our intervention showed that a reproducible electronic medical record report containing provider-level prescribing data in combination with educational information can significantly reduce antibiotic prescribing for URIs in the outpatient setting.

BACKGROUND

Antimicrobial resistance (AMR) has been classified by the Centers for Disease Control and Prevention (CDC) as a public health threat.[1] Approximately 60% of antibiotic prescriptions in the USA originate in the outpatient setting, including primary care offices, urgent care clinics and the emergency department.[2] Of these, an estimated 30% of outpatient antibiotic prescriptions are deemed 'inappropriate', which the CDC defines as unnecessary use and inappropriate selection, dosing and duration of antibiotics.[3,4] Despite clear guidance stating antibiotic treatment of adults with non-specific upper respiratory infection (URI) does not enhance illness resolution and is not recommended, many providers continue to prescribe antibiotics for these illnesses.[4] A survey of general practitioners found that 84% of physicians felt pressure from patients to prescribe antibiotics, which could significantly contribute to this inappropriate prescribing.[5] Notably, antibiotics prescribed for URIs in the outpatient setting account for a staggering 44% of the approximately 266 million antibiotic prescriptions annually in the USA.[6]

Targeting this problem is of paramount importance to public health as inappropriate antibiotic use can lead to adverse drug reactions, *Clostridioides difficile* infection, AMR and increased healthcare costs.[1 7] The CDC Antibiotic Resistance Threats 2019 report found that more than 2.8 million antibiotic-resistant infections occur annually in the USA and these infections have led to more than 35 000 deaths.[7] Adverse effects from antibiotics may be unavoidable in those that truly need treatment, but thoughtful clinician discretion may prevent undesirable complications. There are many explanations for inappropriate antibiotic prescribing among clinicians. These include but are not limited to pressure to maintain high patient satisfaction scores, lack of provider education, a desire to provide the patient with a prescription that cannot be obtained over the counter and the prescriber's belief that their individual antibiotic prescribing practices do not contribute to AMR.[5 8 9] Efforts to reduce antibiotic prescribing have been implemented in the outpatient setting with varying sustainability. Studies describing success in reducing outpatient antibiotic prescribing have largely been focused on using behavioural methods such as peer comparison, accountable justification (in which prescribers use free text to provide the reason for antibiotic prescription) and delayed antibiotic prescribing.[10 11]

The authors of this publication noted variable practices within their healthcare system with regard to antibiotic prescribing among outpatient providers, as well as the observational experience that encounters for self-limited viral conditions often resulted in non-guideline-directed prescriptions. Our intervention focused on antibiotic prescriptions for URIs since the CDC deems these as 'high priority conditions' for improving antibiotic prescribing in the outpatient setting.[12 13] Recognising the importance of antibiotic stewardship in the outpatient setting, the Joint Commission mandated that antimicrobial stewardship requirements would take effect in ambulatory healthcare organisations in 2020.[14] The Infectious Diseases Society of America and Society for Healthcare Epidemiology of America Guidelines for Implementation of an Antimicrobial Stewardship Programme suggest against the use of education alone, but rather as an adjunct to other stewardship interventions.[15]

Report cards or scorecards have been increasingly used in quality improvement initiatives within healthcare, with perhaps the longest-standing example being in improving patient outcomes in surgery.[16] There is a growing body of literature supporting targeted feedback and scoring systems in reducing outpatient antibiotic prescriptions for URIs.[17] Our choice of intervention was informed in part by results from a 2016 randomised controlled trial looking at 47 primary care sites in the USA, where researchers attempted to assess the effects of behavioural interventions and rates of inappropriate antibiotic prescribing during ambulatory visits for acute URIs by using three behavioural strategies in addition to education alone.[11] These included 'accountable justification (which) prompted clinicians to enter free-text justifications for prescribing antibiotics into patients' electronic health records; peer comparison emails to clinicians that compared their antibiotic prescribing rates with those of 'top performers' (those with the lowest inappropriate prescribing rates) and suggested non-antibiotic alternatives in electronic order sets. This study showed that accountable justification and peer comparison resulted in statistically significant improvement in reduced inappropriate antibiotic prescriptions. Subsequent studies, which were published after the initiation of our quality initiative, have noted similar improvements with audit and feedback using peer comparison of prescribing rates.[18 19] Based on this data, we used both individual and peer-comparison feedback scorecards for our quality improvement design. We did not choose accountable justifications as part of our intervention, given the time it would require to integrate this into our electronic medical record (EMR) and the feasibility of reproducing this over the iterations of the project.

Notably, the stewardship term, 'audit and feedback' has variable definitions in the literature. In inpatient or hospital-based stewardship, the term refers to the process of a real-time review of a patient's antimicrobial therapy with the ordering clinician after the antimicrobial is prescribed, after which the clinician can choose to accept the feedback. The intention of 'audit and feedback' is to prospectively optimise antimicrobial therapy on an individual patient basis. Our project, however, is retrospectively evaluating antimicrobial therapy and no real-time feedback for individual antibiotic prescriptions occurred. Instead, we aimed to reduce inappropriate antibiotic prescribing among outpatient primary care providers (PCPs) as a whole within our healthcare system with individual scorecards as well as peer comparison.

METHODS

Cooper University Healthcare comprises a tertiary care centre located in Camden, NJ along with 34 satellite primary care offices, three urgent care clinics and outpatient surgical centres. We investigated the number of URI-coded office visits in the primary care office setting over three consecutive influenza seasons (November–February) that resulted in an antibiotic prescription. We compared prescribers' individual prescribing patterns to their peers' average and created a scorecard that was shared with each prescriber over a series of intervention phases; the intervention and data collection timeline is displayed in figure 1.

All PCPs, composed of physicians and advanced practice providers (APPs), were employed by one health system and provided care for adult patients aged >18 years. We excluded paediatric practices, outpatient subspecialty clinics, urgent cares and outpatient surgical centres. Resident physicians were excluded in order to avoid confounding factors such as the influence or practice patterns of both the attending physician as well as resident. Providers from a total of 14 clinics were included. Of these, three clinics provided care to an underserved patient demographic in Camden, NJ. The remainder of

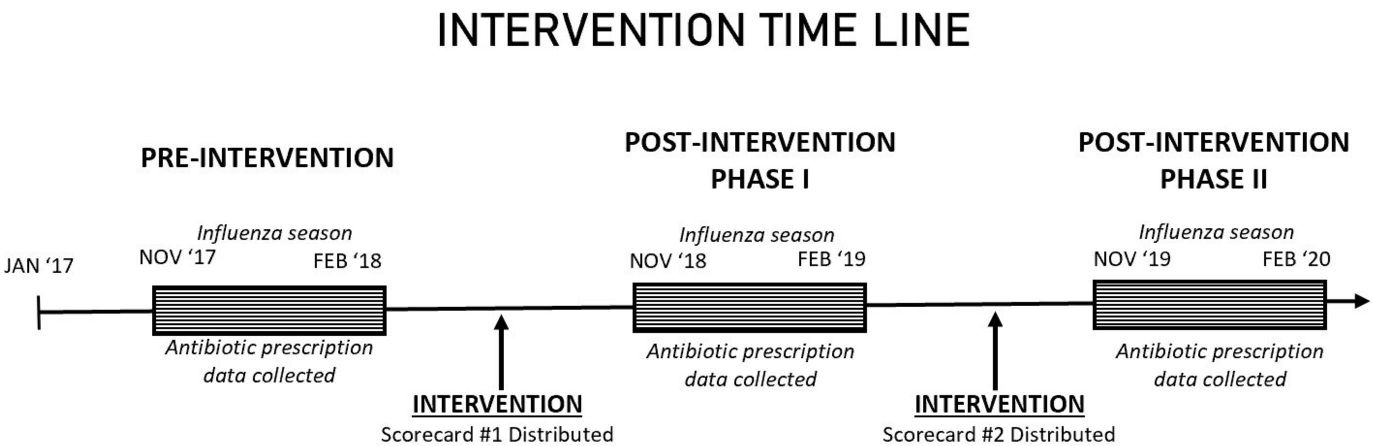

Figure 1 Intervention data timeline.

the clinics were located in suburbs throughout Southern New Jersey.

A report of outpatient office visits was generated using data from the EMR in EPIC. During the preintervention period (November 2017–February 2018), phase I (November 2018–February 2019) and phase II (November 2019–February 2020), we identified all office visits associated with a list of URI- related ICD-10 diagnosis codes, or the International Classification of Diseases, Tenth Revision, Clinical Modification which is used to code and classify medical diagnoses (online supplemental appendix A). The office visits were then sorted by those that resulted in an antibiotic prescription versus those in which no antibiotics were prescribed. The data were also sorted by EPIC context, individual provider and office location. The data collection was designated as QI by our institutional IRB.

In phase I, a personalised digital scorecard containing URI-associated antibiotic prescription data from the prior influenza season (November 2017–February 2018) was emailed to each PCP before the start of the influenza season in September–October. It included (1) the department's average percentage of antibiotic prescribing for URI-coded office visits, (2) individual prescriber's percentage of antibiotic prescribing for URI office visits, (3) individual prescriber's total number of URI-coded office visits and (4) individual prescriber's total number of URI-coded office visits where an antibiotic was prescribed. In phase II, prescribers were given an individual scorecard of prescribing rates but also a ranking of individual prescribing patterns in comparison to their peers, in line with transparent reporting of quality metrics already in use within the health system for chronic conditions such as diabetes (ie, providers saw their personal data along with their colleagues). This was also administered at the start of the influenza season in September–October. In both phase I and phase II, the scorecard was attached to an email with educational material which included CDC resources surrounding topics of outpatient antibiotic stewardship as well as ways to facilitate patient education (online supplemental appendix B). Prescribers were also encouraged to post or distribute these resources in their offices during the winter months.

To analyse the data, the extensive list of viral URI-associated ICD 10 codes used for data extraction (online supplemental appendix A) was regrouped into five broad categories: 'bronchitis', 'sinusitis', 'sore throat excluding strep', 'influenza' and 'tonsillitis excluding strep'. These are all groupings of primarily viral aetiologies for which antibiotics should not be given as treatment (as they are mostly self-limited). We excluded visits in which the antibiotic prescribed was not expected to be used for an infection of the respiratory tract (eg, we excluded a visit associated with a viral URI diagnosis code in which nitrofurantoin was ordered since this antibiotic is not active outside the urinary tract). Excluded antibiotics are listed in online supplemental appendix C. Data cleaning was performed by one infectious disease physician. Charts or individual encounters were not individually reviewed.

We calculated the proportion of URI-coded office visits associated with an antibiotic prescription for each individual prescriber by dividing the number of URI-coded office visits that resulted in an antibiotic prescription by the total number of URI-coded office visits for each individual prescriber. We also calculated the departmental mean percentage of antibiotic prescriptions for URI-coded office visits over the intervention periods. Lastly, for each of the five diagnosis categories, the proportion of antibiotic prescriptions between the preintervention period and postphase I, preintervention and postphase II, and postphase I and postphase II were compared using two sample proportion tests (z test of proportions).

PATIENT AND PUBLIC INVOLVEMENT

It was not appropriate or possible to involve either patients or the public in the design, conduct, reporting or dissemination plans of our research.

RESULTS OF ASSESSMENT

Of the 141 PCPs who were included in our data, 43% were male and 57% were female. Most providers (76%)

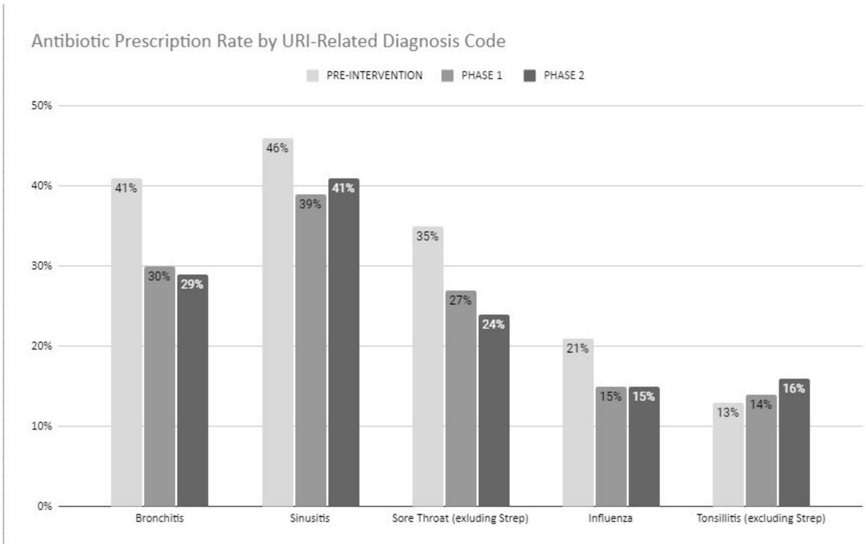

Figure 2 Example provider scorecard.

were physicians in the department of internal medicine and 17% were physicians from the department of family medicine. A total of 7% were APPs from both divisions. None of the providers included in our study left their practice during the study periods, although there were new providers to the division over the three phases.

A total of 16 140 URI-coded office visits were identified over the three phases. During the preintervention phase, 37.9% (2106/5552) of the URI-associated visits resulted in an antibiotic prescription (figure 2). During phase I, 30.8% (1599/5193) of the URI-associated visits resulted in an antibiotic prescription. During phase II, 30.7% (1646/5355) of the URI-associated visits resulted in an antibiotic prescription. This represents a 7.1% reduction during phase I ($p<0.00001$) and a 7.2% reduction during phase II as compared with preintervention ($p<0.00001$) (figure 3).

From preintervention to phase I, there was a statistically significant reduction ($p<0.0001$) in antibiotics ordered for all diagnoses except for 'influenza' and 'tonsillitis excluding strep'. From preintervention to phase II, there was also a statistically significant reduction ($p<0.0001$) in antibiotics ordered for all diagnoses except for 'influenza' and 'tonsillitis (excluding strep)', showing that the intervention was sustainable over the two intervention phases (figure 3).

We also compared phase I (where an individual scorecard of prescribing rates was provided in addition to educational resources) to phase II (where prescribers were given an individual scorecard of prescribing rates, educational resources but also a ranking of individual prescribing patterns in comparison to their peers). When comparing phases I and II, the reduction in antibiotic prescription was not statistically significant for any of the diagnoses.

DISCUSSION

Our aim was to reduce the number of inappropriate antibiotics prescribed for URIs via a modified audit and feedback approach (individual and peer comparison feedback coupled with education). We demonstrated a statistically significant reduction in antibiotic use for select URI diagnoses by providing an individualised scorecard and appropriate antibiotic use education. Obtaining data for the subsequent year allowed us to assess the sustainability and impact of an easily reproducible outpatient antimicrobial stewardship intervention.

The reduction in antibiotic prescriptions was not significantly different from phase I to phase II for any of the diagnoses, implying that the additional intervention of ranking individuals did not impact prescribing. However, phase II data were consistent with phase I data, and we hypothesise that annual reminders may be necessary to prevent antibiotic prescription rates from returning to preintervention levels.

The Pew Charitable Trusts and the American Medical Association conducted a national survey of 1550 primary care physicians between August and October 2018 in order to better understand physician attitudes towards antibiotic resistance, inappropriate antibiotic prescribing, and the need for and impact of stewardship interventions. Based on survey responses, most physicians felt that although resistance and inappropriate prescribing were a problem nationally, these issues were not as common in their own practice. Additionally, 60% of respondents felt that they prescribe antibiotics more appropriately than the average rate of their peers.[9] This notion that other providers are more culpable in contributing to antibiotic resistance than themselves is important when considering barriers to outpatient antibiotic stewardship and may be a possible explanation for why the reduction in prescription rates after individual versus transparent peer comparison feedback was not statistically significant; providers may

PRE-INTERVENTION DATA	Total # Abx for OV per DX	Total # OV per DX	Antibiotic Prescription Rate (%)
Bronchitis	714	1762	41
Sinusitis	785	1718	46
Sore Throat (excluding Strep)	493	1404	35
Influenza	71	346	21
Tonsillitis (excluding Strep)	43	322	13
TOTAL	2106	5552	38

PHASE 1 DATA	Total # Abx for OV per DX	Total # OV per DX	Antibiotic Prescription Rate (%)	p-value pre-intervention to Phase 1
Bronchitis	367	1227	30	< 0.00001
Sinusitis	753	1917	39	< 0.0001
Sore Throat (excluding Strep)	388	1414	27	< 0.00001
Influenza	36	240	15	0.090
Tonsillitis (excluding Strep)	55	395	14	0.830
TOTAL	1599	5193	31	<0.00001

PHASE 2 DATA	Total # Abx for OV per DX	Total # OV per DX	Antibiotic Prescription Rate (%)	p-value Phase 1 to Phase 2	p-value Pre-intervention to Phase 2
Bronchitis	363	1247	29	0.660	< 0.00001
Sinusitis	854	2082	41	0.260	<0.0001
Sore Throat (excluding Strep)	322	1329	24	0.060	< 0.00001
Influenza	41	273	15	0.990	0.080
Tonsillitis (excluding Strep)	66	424	16	0.770	0.400
TOTAL	1646	5355	31	0.950	< 0.00001

Figure 3 Prescription rates by diagnosis code.

have felt that their indications for prescribing antibiotics were more 'justified' than their peers.

Antibiotic prescription rates for 'influenza' and 'tonsillitis excluding strep' were not statistically significant from preintervention to postintervention. We feel that the reduction in influenza prescriptions from 71 in the preintervention phase to 36 in phase I and 41 in phase II reflects a clinically important change despite not being statistically significant, which could be attributed to the small number of overall prescriptions. We also hypothesised that choosing the aetiology 'influenza' implies that the provider was relatively certain about the aetiology (vs something like bronchitis or sinusitis which could be viral or bacterial) and this can account for the statistically insignificant change in prescribing patterns.

Prior studies have assessed whether a disproportionate number of antibiotic prescriptions could be attributed to a small number of individual prescribers. This was evaluated in a report that showed that the highest 10% of antibiotic prescribers prescribed 41% of total antibiotic prescriptions for Medicare Part D beneficiaries in 2019.[20] Although our quality initiative focused on both individual and peer comparison of prescribing rates, targeted feedback to high individual prescribers was not the focus of our intervention, but rather the aggregate change in prescribing habits over time. This could be an area of future research.

We felt that our study is simple in design and can be readily replicated at other institutions, in comparison to some larger studies which required additional resources. For example, a 2021 quality study, which aimed to reduce inappropriate antibiotic prescriptions for bronchitis in the outpatient setting, had an interprofessional antibiotic stewardship team designated to provide audit and feedback.[21] They also had specific advanced training in plan-do-study-act methodology. This study also found that a small proportion of high prescribers contributed to most of the antibiotic prescriptions and provided targeted feedback with telephone encounters that averaged 20–30 min; this is difficult to sustain in most healthcare systems without funding for a designated team, with time built in for targeted intervention during work hours. Targeting high prescribers and providing individualised or peer comparison feedback is also an intervention that may not be well received, and this needs to be taken into consideration when training a team to provide feedback in a manner which aligns with the institution's culture and values.

Trainees may not be reflective of the institution's prescribing culture for a variety of reasons. They were not included due to factors such as variable practice patterns of the attending physician or resident practice variations due to the level of training. We also wanted to remove the inherent 'check and balance' that comes with presenting a care plan to an attending provider, which is not present in independent practitioners. Our academic outpatient practice setting has both a resident clinic as well as residents rotating at external offices; therefore, the attending provider may be listed as a prescriber even if it was a resident visit, which is challenging to separate in a retrospective chart review. Comparing resident visits versus non-resident visits could be an interesting question to answer for a future study. Similarly, practice variability in APPs versus physicians may be an area of research.

Since our intervention did not specifically track whether educational materials were accessed, the level of engagement with education materials (via multiple choice questions, polling or attestation of review) may be an area for further study.

In addition, more research is needed to evaluate whether performance measures for appropriate antimicrobial prescribing are positively influenced by financial incentives. A 2022 study evaluated Japan's national healthcare policy in which eligible medical facilities could claim a financial reward when antibiotics were not prescribed for early-stage respiratory and gastrointestinal infections.[22] When compared with ineligible facilities, financial incentives for reducing antibiotic use in paediatric clinics resulted in a statistically significant reduction in antibiotic prescribing. More information is needed to address the ethical and practical limitations of such financial incentives, and whether they are applicable to different healthcare systems, such as the USA.

LIMITATIONS

Our intervention showed a statistically significant reduction in antibiotic prescribing rates for URI-associated diagnoses from preintervention to both postintervention phases, but our multipronged approach made it difficult to discern which of the interventions (education vs scorecard vs transparent reporting of scorecards) was the most effective intervention. We were unable to confirm whether providers read the emails which included their scorecard and antibiotic education. There was no control group (all providers received intervention through scorecards and education) so we could not assess whether rates of prescribing would have diminished without the intervention. Since our samples (both physicians and patients) were not the same in all three study periods, there is a potential for unmeasured confounding.

No individual chart review was performed; we were unable to verify whether antibiotics were in fact indicated for each individual office visit. Due to a lack of individual chart review, we were unable to adjust for prescriptions intended for delayed antibiotic prescribing. Providers also had the potential to adjust diagnosis coding to 'justify' their antibiotic prescription during the post-intervention periods although the total number of URI-coded visits in each period was similar. We could not account for diagnosis coding variability among providers nor antibiotics that were coded with multiple diagnoses.

Our intervention was limited to URIs alone and we cannot generalise this study to other infectious aetiologies. Lastly, our phase II intervention ended before the COVID-19 pandemic truly came to the forefront of medical care in March 2020. Our study cannot account for how outpatient antibiotic stewardship measures for URIs play out in the postpandemic USA.

CONCLUSION

Our intervention showed that a reproducible EMR report containing provider prescribing data used in combination with educational information can significantly reduce antibiotic prescribing for URIs in the outpatient setting. PCPs may benefit from regularly scheduled reminders that include their prescribing data and educational resources in order to maintain this benefit over time. Although we found that transparent peer comparison did not affect prescribing rates when compared with individual performance feedback, future studies are needed to evaluate whether this may be of benefit. Further efforts in outpatient antimicrobial stewardship, such as incentivising physicians who prescribe judiciously, may be necessary to have a lasting effect.

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Contributors NS and MK were responsible for study conception and design, as well as collection of data. NS, MK and LR wrote the manuscript. MK created the figures. DB performed the data cleaning, statistical analysis, and reviewed/edited the manuscript. All authors read, edited and approved the final manuscript. NS accepted full responsibility for the finished work and/or the conduct of the study, had access to the data and controlled the decision to publish.

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Patient consent for publication Not applicable.

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