Title

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Journal

Arthritis Care & Research, 68(12)

ISSN

2151-464X

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Publication Date

2016-12-01

DOI

10.1002/acr.23089

Peer reviewed

HHS Public Access

Author manuscript

Arthritis Care Res (Hoboken). Author manuscript; available in PMC 2017 December 01.

Published in final edited form as:

Arthritis Care Res (Hoboken). 2016 December ; 68(12): 1866–1873. doi:10.1002/acr.23089.

The Rheumatology Informatics System for Effectiveness (RISE): A National Informatics-Enabled Registry for Quality Improvement

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Abstract

Background—The Rheumatology Informatics System for Effectiveness (RISE) is a national electronic medical record (EMR)-enabled registry. RISE passively collects data from EMRs of participating practices, provides advanced quality measurement and data analytic capacities, and

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fulfills national quality reporting requirements. Here we report the registry's architecture and initial data, and demonstrate how RISE is being used to improve the quality of care.

Methods—RISE is a certified Centers for Medicare and Medicaid Services Qualified Clinical Data Registry, allowing collection of data without individual patient informed consent. We analyzed data between October 1, 2014 and September 30, 2015 to characterize initial practices and patients captured in RISE. We also analyzed medication use among rheumatoid arthritis (RA) patients and performance on several quality measures.

Results—Across 55 sites, 312 clinicians contributed data to RISE; 72% were in group practice, 21% in solo practice and 7% were part of a larger health system. Sites contributed data on 239,302 individuals. Among the subset with RA, 34.4% of patients were on a biologic or targeted synthetic DMARD at their last encounter, and 66.7% were receiving a non-biologic DMARD. Examples of quality measures include: 55.2% had a disease activity score recorded, 53.6% a functional status score, and 91.0% were taking a DMARD in the last year.

Conclusion—RISE provides critical infrastructure for improving the quality of care in rheumatology and is a unique data source to generate new knowledge. Data validation and mapping is ongoing and RISE is available to the research and clinical communities to advance rheumatology.

Healthcare in the United States is undergoing rapid change, and rheumatologists face significant challenges in adapting to new payment and delivery models, evolving certification requirements and the rapid implementation of electronic medical records (EMRs). As part of a strategic plan to address these challenges, the American College of Rheumatology has developed the Rheumatology Informatics System for Effectiveness (RISE). RISE is a novel EMR-enabled registry that passively extracts EMR data from individual practices, aggregates and analyzes these data centrally, and feeds this information back to clinicians as actionable data using a web-based interface. RISE aims to decrease the burden of data collection on practices, to streamline participation in federal quality programs, and to facilitate local rapid-cycle quality improvement by providing continuous performance feedback and benchmarking.

In 2014, RISE passed a critical milestone and was designated a federally Qualified Clinical Data Registry (QCDR). The American Taxpayer Relief Act established the QCDR quality reporting option, allowing physicians to submit data for the Physician Qualify Reporting System (PQRS) directly through registries (1). Because data collected through QCDRs is meant to improve quality, there is a waiver of individual patient informed consent for registry data capture. All RISE data used for research is de-identified. Moreover, RISE can be used to fulfill a meaningful use objective measure (reporting to a special registry), and is being developed as a tool for maintenance of certification. As the transition to a value-based system of reimbursement advances in the United States, RISE will allow rheumatologists to track their performance on measures of quality of care and efficiency. RISE will also serve as an important tool for research in rheumatology.

In this paper, we present the informatics structure of RISE, provide an overview of the type of data currently available to advance rheumatology care and research, report early results on quality measures, and share our vision for the future of the registry.

METHODS

RISE informatics structure

RISE is an EMR-enabled registry that automatically extracts data from individual practices' EMRs on a scheduled basis and transfers these data to a central data warehouse. RISE has been constructed to minimize impact on practice workflow. No data entry into a separate database is required; instead, RISE collects data that is entered during the course of routine clinical care into the EMR. This is made possible through technology that uses a light weight connector, installed locally, to establish a connection between the practice and RISE (Figure 1). RISE can connect to most certified EMR systems in the United States; currently, the registry can map to over 30 different EMRs used by rheumatologists. Once an EMR is connected, the RISE data mapping team works to identify participating clinicians and their patients and creates an initial EMR data extract. Practices then spend 6–10+ hours validating data elements and quality measure performance data before moving into full production. This latter step allows RISE to customize data capture to the particular EMR configuration and workflow within each practice. Once data mapping is complete, further time commitment from practices will only be required if there are data aberrancies or new measures that require mapping.

Data contributed to RISE are cleaned and analyzed centrally and feed a performance dashboard. Rheumatologists can access their practice dashboard through a web-based interface, where they can view national benchmarks for quality measures, performance means across the registry, as well as practice and clinician-level performance. Participating practices can also run customized queries on their own patient population and perform basic data analyses. For example, practices can run a query to identify all patients with a specific diagnosis code or on a specific medication. These data can then be used for quality improvement activities or for local research purposes.

Privacy and waiver of informed consent

RISE is a federally Qualified Clinical Data Registry (QCDR). The QCDR framework was introduced for the Physician Quality Reporting System (PQRS) in 2014, and allows the collection of data without patient informed consent for the purpose of disease tracking and to foster improvement in the quality of care (1). CMS has the ability to access Medicare patient data in RISE for quality reports through CMS oversight authority. For non-Medicare data, CMS may request the QCDR to mask the protected health information (PHI) when aggregate data is requested.

The Western Institutional Review Board (IRB) reviewed RISE and determined that because RISE is a quality improvement registry focused on healthcare delivery and on measuring and reporting data for clinical, practical or administrative uses, individual practices do not need IRB approval or patient consent to implement RISE. The RISE data extraction protocol is Health Insurance Portability and Accountability Act (HIPAA) compliant. When a patient's information is uploaded, PHI is stored separately. Any data used by third parties for research is de-identified and aggregated. However, participating practices can access their own PHI

data and use this data for their clinical and quality improvement needs and for reporting quality measures to CMS.

Quality measures and reporting

As a QCDR, RISE helps practices report clinical quality data to the PQRS program. This reporting allows eligible professionals to avoid negative payment adjustments in 2017. In addition, submission of PQRS data through RISE also satisfies an objective of the Meaningful Use program: reporting to a specialized registry. By fulfilling this Meaningful Use objective, RISE helps practices further avoid reporting penalties.

Research data repository

In addition to quality measurement and reporting, RISE serves as a resource for research. Both structured data (laboratories, medications, problem lists) and unstructured data (i.e. text from clinical notes) from the EMR are available for analysis. Research requests undergo formal committee review for feasibility. The ACR has contracted with three data analytic centers (University of California at San Francisco, University of Alabama at Birmingham, and Duke University) with special expertise in large dataset analyses to execute RISE data requests. These centers will work with de-identified data extracts; any identified data, including text from clinical notes, will remain within the clinical data warehouse and will be analyzed centrally.

Analysis of initial data in RISE

We analyzed data in RISE from October 1, 2014 through September 30, 2015, including the characteristics of participating practices and patients. We examined both sociodemographic characteristics of patients (age, sex, race/ethnicity, insurance status and U.S. region) as well as clinical characteristics (smoking status, blood pressure, billing and problem list diagnoses as defined by International Classification of Diseases (ICD) codes, and medications).

All sociodemographic characteristics and clinical data were examined from the most recent clinical encounter. When querying diagnoses, we generated a list of ICD9 codes for common rheumatic diseases and calculated the frequency of these diagnoses at the last available clinical encounter. We did not require these diagnoses to be mutually exclusive; in other words, patients with two diagnoses are represented twice.

Because a key initial focus of the registry is rheumatoid arthritis (RA), we examined clinical data for the subset of patients with this diagnosis in further detail to demonstrate the type of data in RISE. First, we examined active medications at the end of the most recent RA clinical encounter, including all non-biologic DMARDs (methotrexate, hydroxychloroquine, leflunomide, sulfasalazine, azathioprine, minocycline, cyclosporine, cyclophosphamide, penicillamine and gold), as well as biologic and targeted synthetic DMARDs (etanercept, adalimumab, infliximab, golimumab, certolizumab, abatacept, anakinra, tocilizumab, rituximab, tofacitinib). To create these categories, we built algorithms that collated instances where a single drug (e.g. methotrexate) appeared more than once as an active medication. This meant removing duplicate prescriptions and also collapsing instances where two formulations of the same drug were listed.

Similarly, we built algorithms to create mutually exclusive categories for the biologic DMARDs. For example, we manually reviewed all records in which patients were listed as being on two TNF inhibiting biologic drugs (1.1% of records). We contacted a sample of practices to understand the workflows leading to these within-class duplicates. Reasons identified included incomplete medication reconciliation or clinicians routinely ordering more than one drug at time of initiation while waiting for insurance authorization. In these instances, we either looked into future encounters to see which drug persisted and selected only the persistent drug, or randomly sampled one of the drugs.

Among individuals in RISE, we also examined performance on selected quality measures, including those recently endorsed by the National Quality Forum, such as *Rheumatoid arthritis: Assessment of Disease Activity* (NQF 2523), *Rheumatoid arthritis: Functional Status Assessment* (NQF 2524), *Rheumatoid arthritis: Tuberculosis Screening* (NQF 2522), and *Rheumatoid arthritis: Disease Modifying Anti-Rheumatic Drug (DMARD) Therapy* (NQF 2525), as well as additional measures in the areas of drug safety (use of high-risk medications in the elderly), osteoporosis (screening and treatment), preventive health (tobacco use, obesity and blood pressure management), gout (monitoring and serum urate), and medication reconciliation. We assessed the number of times the recommended process of care was performed among the eligible denominator population to arrive at the average performance on each measure. A higher average denotes higher quality with the exception of the measures regarding high-risk prescribing in the elderly, in which a lower average denotes higher quality.

A complete list of the 2015 RISE measures is included in the Appendix. The measures are evaluated and updated annually.

RESULTS

As of September 30, 2015, there were 312 clinicians and 55 practices participating in RISE. Seventy two percent of clinicians were in a group practice, 21% were solo practitioners and 7% were part of a larger health system.

Sociodemographic and clinical characteristics of the 239,302 patients are in Table 1. A majority of patients were women (74.8%), 22.2% were racial/ethnic minorities, and most had commercial insurance (47.8%). Almost a third (29.6%) had Medicare health insurance. At their last clinical encounter, 10.4% of patients were smokers, and 14.6% were hypertensive (systolic blood pressure of >140 mmHg or a diastolic blood pressure of >90 mmHg).

In Table 2, we list the diagnoses captured in RISE, as defined by ICD9 codes at the last clinical encounter. Among the diagnoses examined, osteoarthritis was the most prevalent (n=76,381), followed by RA (n=60,102). RISE also includes a significant number of individuals with other rheumatologic disorders, such as Sjögren's syndrome (n=15,841), systemic lupus erythematosus (n=13,940), dermatomyositis (n=1,129), and temporal arteritis (n=1,596). Less common conditions, such as relapsing polychondritis (n=886), Behcet's syndrome (n=301), and Takayasu disease (n=85) are also represented.

For the subset of individuals with ICD9 codes for RA (n=60,102), active medications at the last clinical encounter are listed in Table 3. Only 9% were on no DMARD therapy. Thirty-four percent of individuals were using a biologic or targeted synthetic DMARD (n=20,759), while 67% were using a non-biologic DMARD (n=40,272). Twenty three percent were on biologic DMARD monotherapy. As expected, methotrexate was the most commonly used DMARD (43.5%), followed by hydroxychloroquine (23.3%).

Performance on selected RISE quality measures is listed in Table 4. For example, performance on *Rheumatoid Arthritis: Assessment of Disease Activity* (NQF 2523) was 55.2%. Among those satisfying this measure, the most commonly used outcome measures were RAPID3 (56.0%) and CDAI (36.9%), with fewer patients having SDAI (0.04%), DAS28 (3.8%), or PAS-II (3.2%) scores recorded in the EMR. For *Rheumatoid Arthritis: Functional Status Assessment* (NQF 2524), performance was 53.6% and a majority of practices used the RAPID3/MDHAQ (45.2% of scores reported in the EMR) or a version of the HAQ (original HAQ 38.5% or HAQII 3.3%). As is reflected in the medication data, 91.0% of patients met the criteria for *Rheumatoid Arthritis; Disease Modifying Anti-Rheumatic Drug* (NQF 2525). For *Rheumatoid Arthritis: Tuberculosis Screening (NQF 2522)*, performance was 55.2%. Across all measures in Table 4, performance was highest for a measure regarding medication reconciliation (96.8%) and lowest for serum urate monitoring in gout patients (31.0%).

Some information was missing for all variables, but the proportion of missing data was low for most sociodemographic data except for insurance status (19.3%). Work is ongoing to understand the accuracy of diagnosis codes and medications in RISE, with initial data suggesting very good specificity for RA and for DMARDs (2). The extent of missingness as well as accuracy is expected to improve as mapping and validation procedures for RISE continue in the coming years.

DISCUSSION

Payment reform, a proliferation of new medication options, and the widespread introduction of EMRs are transforming the practice of rheumatology in the United States. Given these changes, the ACR launched the RISE registry to help rheumatologists succeed in advancing the triple aim of improving the care experience, improving the health of populations and reducing the costs of care (3). The enthusiastic participation of U.S. rheumatologists has allowed the registry to grow quickly since its launch in 2014.

RISE represents the first attempt to create a national EMR-enabled rheumatology registry in the United States, thereby avoiding separate entry of data by clinicians or office staff. The registry has made headway in addressing some of the challenges of interoperability that have previously made data sharing across health systems difficult. This is because RISE’s clinical informatics structure was designed to be agnostic to the EMR system used by rheumatologists, and can be adapted to draw data from most certified systems. Central mapping of data also creates efficiencies for practices that have limited information technology support or data analytic software capabilities. Additionally, automation permits uploading of a clinician’s entire population of patients, preventing biases in patient selection.

The data in RISE therefore provides a unique and inclusive view of rheumatology practices because patients with all medical conditions managed by rheumatologists and all types of insurance are included.

Initial data in RISE provide an interesting birds-eye view of the clinical characteristics of patients seen in participating rheumatology practices. Although prevalent rheumatologic conditions (e.g. osteoarthritis and rheumatoid arthritis) are well-represented in the registry, RISE already includes data on individuals with several less common conditions, such as inflammatory myopathies and vasculitides. As we try to improve the quality of rheumatologic care across these conditions, we anticipate that data on the natural history, treatment patterns and clinical outcomes on these disorders will make quality improvement efforts increasingly data-driven. Moreover, the generalizability of data in RISE is anticipated to improve as the registry grows and better reflects the racial/ethnic and geographic diversity of patients seen by rheumatologists.

In the area of RA, RISE has started to build a foundation for measuring and understanding outcomes, treatment patterns and also patient safety. Two nationally endorsed RISE electronic clinical quality measures (eCQMs), *Rheumatoid Arthritis: Assessment of Disease Activity (NQF 2523)* and *Rheumatoid Arthritis: Functional Status Assessment (NQF 2524)* are the first examples of EMR-enabled measures that collect outcomes, including patient-reported outcomes, across the registry. We are encouraged by the fact that over one half of rheumatologists participating in RISE are routinely capturing this information in practice. Measurement of these outcomes using validated tools enables evidence-based care by facilitating a treat-to-target approach in RA, and also allows for tracking of outcomes and benchmarking across rheumatology practices. In addition, the considerable effort made by rheumatologists and their staff to collect this information in routine clinical care has resulted in one of the largest national efforts to collect patient-reported outcomes for a chronic disease via the EMR in the United States.

Another quality measure, *Rheumatoid Arthritis: Disease Modifying Anti-Rheumatic Drug Therapy (NQF 2525)*, has created a foundation for ensuring that accurate information about medication utilization is collected across the registry. Not surprisingly, performance on this measure across rheumatology practices participating in RISE is high (91.0%). The data presented in this study demonstrate that RISE is capturing the full spectrum of medications used in RA. Work is ongoing to further refine and validate medication information, including initiation and discontinuation dates and ensuring that medications that may not be as reliably recorded in the EHR, such as infusible biologic DMARDs, are captured. In addition, *Rheumatoid Arthritis: Tuberculosis Screening (NQF 2522)* is an example of a patient safety measure. Our experience validating this measure suggests that lower performance on this measure indicates both a gap in quality and the fact that reliably capturing TB screening in practice requires further work to ensure accurate data capture (2). Efforts are ongoing to improve mapping and further validate all quality measures in RISE.

For clinicians, RISE provides new opportunities to participate in efforts to improve the quality of care in rheumatology. Locally, the RISE user interface allows rheumatologists to track their performance on quality measures in conditions such as RA, gout and

osteoporosis. RISE allows rheumatologists to not only participate in national quality reporting programs such as PQRS, but also provides critical data analytic capacity to facilitate rapid cycle quality improvement. Clinicians participating in RISE can run reports to view their performance on quality measures, and compare these data to others in their practice as well as against both the registry mean and national benchmarks. This marks a shift away from previous approaches to quality measurement, which have largely relied on administrative claims data or chart review. Limitations of claims data have included the lack of detailed clinical data and the sometimes significant delay in aggregating results; similarly, chart reviews required significant time investment which impeded rapid cycle quality involvement. By aggregating up-to-date EMR data and passively collecting more detailed clinical data, RISE is attempting to address some of these previous limitations.

In addition, as payers, particularly Medicare, increasingly tie payments to value assessments, there is an urgent need to develop measures to define “value” in rheumatology. The Medicare Access and CHIP Reauthorization Act (MACRA) of 2015 has put into place an aggressive timeline for a Merit-Based Incentive Payment System (MIPS) and for Alternative Payment Models (APMs). For rheumatologists to be successful under these payment reforms, it will be critical to generate both the measures and tools to capture the value of rheumatologic care in a meaningful way. Being able to develop, test and rapidly implement novel measures in RISE that define quality and efficiency will be critical. Understanding the scientific validity, feasibility, usefulness, and both intended and unintended consequences of these measures, are important strategic goals of RISE.

For researchers, RISE aims to generate data that can advance our understanding of the natural history, outcomes and treatment of rheumatologic disorders. Aggregated population-wide EMR data is a relatively new data source in the United States, and both management and analyses of these data will require rapid innovation in research methods and practices. First, RISE will include new types of data, including the text of clinical notes. Extracting information from this unstructured data will require developing new algorithms to identify variables of interest, using techniques such as text mining, natural language processing and machine learning. Second, although RISE’s privacy and security framework is HIPAA compliant and research procedures have been approved by a national Institutional Review Board, addressing future threats to data security will require continuous vigilance and innovation. Third, data in RISE is observational in nature, and will accumulate rapidly. Analysis of “big data” will require new methods, including approaches to deal with missingness, censoring, non-uniform variables across a population, and evolving computational methods to recognize patterns in data such as machine learning. Moreover, changes in health data standards (e.g. implementation of ICD10) will require ongoing data integration and validation. Fourth, we anticipate that there will be interest in integrating RISE with other data sources and platforms, such as patient-powered networks, clinical trials networks, administrative claims data or disease-specific registries. Building the scientific and privacy frameworks to facilitate such integrations will also require significant collaboration, funding and innovation. In the near term, we hope that RISE will facilitate creating learning networks to share best practices and close gaps in quality of care.

In summary, the ACR has developed RISE to help rheumatologists leverage the new wave of big data from EMRs. By aggregating, analyzing and continuously feeding back data to rheumatology practices, RISE aims to advance our shared goals of improving knowledge about rheumatologic conditions, refining treatment strategies and outcomes, and improving the quality and safety of care.

Acknowledgments

Disclosures: This work was supported by the American College of Rheumatology. Dr. Yazdany is also supported by the Robert L. Kroc Chair in Rheumatic and Connective Tissue Diseases (I), AHRQ R01 HS024412 and the Russell/Engleman Medical Research Center for Arthritis. The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality.

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Appendix

Quality measures in RISE.

	Measure Number						
Measure Title	**CMS**	**NQF**	**PQRS**	**Measure Description**	**NQS Domain**	**Measure Type**	**Cross-cutting Measures**
Osteoporosis: Communication with the Physician Managing On-going Care Post-Fracture of Hip, Spine or Distal Radius for Men and Women Aged 50 Years and Older	N/A	0045	024	Percentage of patients aged 50 years and older treated for a hip, spine or distal radial fracture with documentation of communication with the physician managing the patient's on-going care that a fracture occurred and that the patient was or should be tested or treated for osteoporosis	Communication and Care Coordination	Process	
Screening or Therapy for Osteoporosis for Women Aged 65 Years and Older	N/A	0046	039	Percentage of female patients aged 65 years and older who have a central dual-energy X-ray absorptiometry (DXA) measurement ordered or performed at least once	Effective Clinical Care	Process	

	Measure Number						
Measure Title	**CMS**	**NQF**	**PQRS**	**Measure Description**	**NQS Domain**	**Measure Type**	**Cross-cutting Measures**
				since age 60 or pharmacologic therapy prescribed within 12 months			
Osteoporosis: Management Following Fracture of Hip, Spine or Distal Radius for Men and Women Aged 50 Years and Older	N/A	0048	040	Percentage of patients aged 50 years and older with fracture of the hip, spine, or distal radius who had a central dual-energy X-ray absorptiometry (DXA) measurement ordered or performed or pharmacologic therapy prescribed	Effective Clinical Care	Process	
Osteoporosis: Pharmacologic Therapy for Men and Women Aged 50 Years and Older	N/A	N/A	041	Percentage of patients aged 50 years and older with a diagnosis of osteoporosis who were prescribed pharmacologic therapy within 12 months	Effective Clinical Care	Process	
Preventive Care and Screening: Influenza Immunization	147v4	0041	110	Percentage of patients aged 6 months and older seen for a visit between October 1 and March 31 who received an influenza immunization OR who reported previous receipt of an influenza immunization.	Community/ Population Health	Process	X
Pneumonia Vaccination Status for Older Adults	127v3	0043	111	Percentage of patients 65 years of age and older who have ever received a pneumococcal vaccine.	Community/ Population Health	Process	X
Documentation of Current Medications in the Medical Record	68v4	0419	130	Percentage of visits for patients aged 18 years and older for which the eligible professional attests to documenting a list of current medications using all immediate resources available on the date of the encounter. This list must include ALL known prescriptions, over-the-counters, herbals, and vitamin/mineral/ dietary (nutritional)	Patient Safety	Process	X

	Measure Number						
Measure Title	**CMS**	**NQF**	**PQRS**	**Measure Description**	**NQS Domain**	**Measure Type**	**Cross-cutting Measures**
				supplements AND must contain the medications' name, dosage, frequency and route of administration.			
Pain Assessment and Follow-Up	N/A	0420	131	Percentage of visits for patients aged 18 years and older with documentation of a pain assessment using a standardized tool(s) on each visit AND documentation of a follow-up plan when pain is present	Community/ Population Health	Process	X
Preventive Care and Screening: Tobacco Use: Screening and Cessation Intervention	138v3	0028	226	Percentage of patients aged 18 years and older who were screened for tobacco use one or more times within 24 months AND who received cessation counseling intervention if identified as a tobacco user.	Community/ Population Health	Process	X
Controlling High Blood Pressure	165v3	0018	236	Percentage of patients 18–85 years of age who had a diagnosis of hypertension and whose blood pressure was adequately controlled (<140/90 mmHg) during the measurement period.	Effective Clinical Care	Intermediate Outcome	X
Use of High-Risk Medications in the Elderly	156v3	0022	238	Percentage of patients 66 years of age and older who were ordered high-risk medications. Two rates are reported. a. Percentage of patients who were ordered at least one high-risk medication. b. Percentage of patients who were ordered at least two different high-risk medications.	Patient Safety	Process	
Disease Activity Measurement for Patients with Rheumatoid Arthritis (RA)	ACR 1	N/A	No	Percentage of patients 18 years and older with a diagnosis of rheumatoid	Effective Clinical Care	Process	

	Measure Number						
Measure Title	**CMS**	**NQF**	**PQRS**	**Measure Description**	**NQS Domain**	**Measure Type**	**Cross-cutting Measures**
				arthritis whose disease activity is assessed using a standardized measurement tool at 50% or more encounters for RA with the same clinician during the measurement period.			
Functional Status Assessment for Patients with Rheumatoid Arthritis (RA)	ACR 2	N/A	No	Percentage of patients 18 years and older with a diagnosis of rheumatoid arthritis whose functional status is assessed using a standardized measurement tool at least once during the measurement period	Effective Clinical Care	Process	
Disease-Modifying Anti-Rheumatic Drug (DMARD) Therapy for Active Rheumatoid Arthritis (RA)	ACR 3	N/A	No	Percentage of patients 18 years and older with active rheumatoid arthritis who are treated with a disease-modifying anti-rheumatic drug (DMARD) during the measurement period	Effective Clinical Care	Process	
Tuberculosis Test Prior to First Course Biologic Therapy	ACR 4	N/A	Yes	Percentage of patients 18 years and older with a diagnosis of rheumatoid arthritis that are newly prescribed a biologic therapy during the measurement period and whose medical record indicates tuberculosis testing in the 12 months preceding the biologic prescription.	Patient Safety	Process	
Glucocorticosteroids and Other Secondary Causes	ACR 5	N/A	No	Percentage of patients 18 years and older with one of the following conditions or therapies: receiving oral glucocorticosteroid therapy for greater than 3 months OR hypogonadism OR fracture history OR transplant history OR obesity surgery OR malabsorption disease	Effective Clinical Care	Process	

	Measure Number						
Measure Title	**CMS**	**NQF**	**PQRS**	**Measure Description**	**NQS Domain**	**Measure Type**	**Cross-cutting Measures**
				OR receiving aromatase therapy for breast cancer who had a central DXA ordered or performed or pharmacologic therapy prescribed within 12 months.			
Serum Urate Monitoring	ACR 6	N/A	No	Percentage of patients aged 18 and older with a diagnosis of gout who were either started on urate lowering therapy (ULT) or whose dose of ULT was changed in the year prior to the measurement period, and who had their serum urate level measured within 6 months.	Effective Clinical Care	Process	
Gout: Serum Urate Target	ACR 7	N/A	No	Percentage of patients aged 18 and older with a diagnosis of gout treated with urate-lowering therapy (ULT) for at least 12 months, whose most recent serum urate result is less than 6.8 mg/dL	Effective Clinical Care	Process	
Gout: ULT Therapy	ACR 8	N/A	No	Percentage of patients aged 18 and older with a diagnosis of gout and either tophus/tophi or at least two gout flares (attacks) in the past year who have a serum urate level > 6.0 mg/dL, who are prescribed urate lowering therapy (ULT)	Effective Clinical Care	Process	
Use of Imaging Studies for Low Back Pain	312	166v5	Yes	Percentage of patients 18–50 years of age with a diagnosis of low back pain who did not have an imaging study (plain X-ray, MRI, CT scan) within 28 days of the diagnosis.	Efficiency and Cost Reduction	Process	X
Functional Deficit: Change in Risk-Adjusted Functional Status for Patients with Hip Impairments	218	N/A		Percentage of patients aged 18 or older that receive treatment for a functional deficit secondary to a diagnosis that affects the hip in which	Communication and Care Coordination	Outcome	

	Measure Number						
Measure Title	**CMS**	**NQF**	**PQRS**	**Measure Description**	**NQS Domain**	**Measure Type**	**Cross-cutting Measures**
				the change in their Risk-Adjusted Functional Status is measured			
Functional Deficit: Change in Risk-Adjusted Functional Status for Patients with Elbow, Wrist or Hand Impairments	222	N/A		Percentage of patients aged 18 or older that receive treatment for a functional deficit secondary to a diagnosis that affects the elbow, wrist or hand in which the change in their Risk-Adjusted Functional Status is measured	Communication and Care Coordination	Outcome	
Preventive Care and Screening: Body Mass Index (BMI) Screening and Follow-Up Plan	128	69v3	69v3	Percentage of patients aged 18 years and older with a BMI documented during the current encounter or during the previous six months AND with a BMI outside of normal parameters, a follow-up plan is documented during the encounter or during the previous six months of the current encounter Normal Parameters: Age 65 years and older BMI ≥ 23 and < 30 kg/m2; Age 18 – 64 years BMI ≥ 18.5 and < 25 kg/m2	Community/ Population Health	Process	X

- RISE is a novel EMR-enabled registry that passively extracts EMR data from individual practices, aggregates and analyzes these data centrally, and feeds this information back to clinicians as actionable data for quality improvement using a web-based interface.
- RISE's clinical informatics structure was designed to be agnostic to the EMR system used by rheumatologists, and can be adapted to draw data from most certified systems.
- Performance on quality measures across RISE practices presented here provides a useful benchmark for rheumatologists seeking to improve quality in their practices.

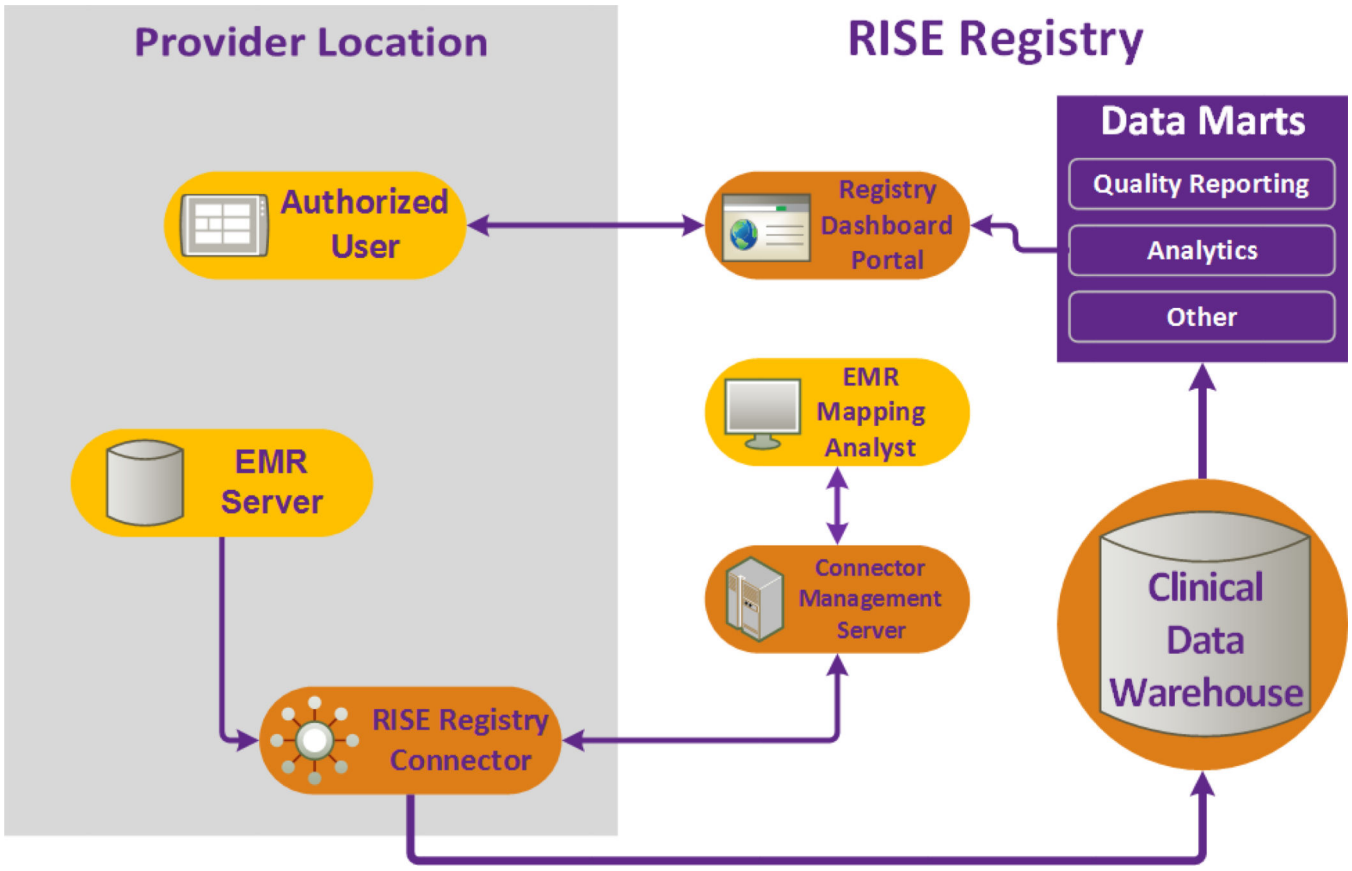

Figure 1. RISE Registry Data Flow for Practice Improvement and Research

The RISE registry uses a lightweight connector to establish a connection between a practice's EMR server and the centralized registry servers. Local practice data is iteratively mapped by the RISE team to ensure accuracy, and verified extracts enter the RISE Clinical Data Warehouse. Data are then aggregated and analyzed for federal quality reporting, research, and practice-based improvement. Authorized users in a practice can access the RISE data dashboard through a web-based registry portal.

Table 1

Selected characteristics of patients in the RISE registry.

Characteristics	N = 239,302
Age, mean (SD)	59 (16.1)
Sex, n (%)	
Female	179,069(74.8)
Male	60,225 (25.2)
Missing	8 (0.003)
Race, n (%)	
White	145,544 (60.8)
Black	18,335 (7.7)
Asian	3,416 (1.4)
American Indian/Alaskan Native	574 (0.2)
Native Hawaiian/Pacific Islander	116 (0.05)
Other	30,744 (12.9)
Missing	40,573 (17.0)
Health Insurance type, n (%)	
Medicare	70,804 (29.6)
Medicaid	3,914 (1.6)
Commercial	114,259 (47.8)
Other	4,210 (1.8)
Missing	46,115 (19.3)
U.S. Region based on patient zip code	
Midwest	29,114 (12.2)
Northeast	32,085 (13.4)
Southeast	91,727 (38.3)
Southwest	50,239 (21.0)
West	11,070 (4.6)
Missing	25,064 (10.5)
Rheumatology encounters *, mean (SD)	2 (2.1)
Smoking, n (%)	
Never	142,562 (59.6)
Current	24,913 (10.4)
Former	51,971 (21.7)
Missing	19,856 (10.0)
Blood pressure	
Systolic mmHg, mean (SD)	125.4 (16.1)
Diastolic mmHg, mean (SD)	75.2 (9.7)
Systolic >140 or diastolic >90 n (%)	34,961 (14.6)
Missing	22,048 (9.2)

All data reflect values at end of last observed clinical encounter.

*Number of rheumatology encounters over study period.

Table 2

Selected rheumatologic diagnoses captured in the RISE registry.

Diagnosis at last encounter*	ICD 9 codes	N
Degenerative Joint Disease		
Osteoarthritis, generalized or localized	715.00, 715.04, 715.09–715.18, 715.20–715.38, 715.80, 715.89	76,381
Inflammatory Rheumatic Diseases		
Rheumatoid arthritis	714.0, 714.1, 714.2, 714.81	60,102
Polymyalgia rheumatica	725	7,850
Sjogren's syndrome	710.2	15,800
Systemic lupus erythematosus	710.0	13,940
Psoriatic arthritis	696.0	13,550
Spondyloarthritides	720.0–720.2, 720.8, 720.89, 720.9, 729.9	10,265
Vasculitis		
Temporal arteritis	446.5	1,596
Granulomatosis with polyangiitis	446.4	686
Behcet's	136.1	301
Henoch Schonlein	287.0	106
Takayasu disease	446.7	85
Goodpasture's	446.21	4
Scleroderma	710.1	2,754
Juvenile Idiopathic Arthritis	714.3, 714.31–714.33	1,342
Dermatomyositis or polymyositis	710.3, 710.4	2,366
Sarcoidosis	135	1,548
Relapsing polychondritis	733.99	886
Crystalline arthropathies		
Gout	274.xx	9,887
Calcium Pyrophosphate	275.49, 712.1–712.3, 712.8	1,131
Deposition Disease (CPPD)		
Pain syndromes		
Myalgia or myositis (fibromyalgia)	729.1	49
Low back pain	724.1	34
Infectious arthritis		
Lyme Disease	88.81	913
Septic arthritis	711.xx	284

All data reflect values at end of last observed clinical encounter.
Diagnoses are not mutually exclusive across diagnostic categories; for example, a patient may be captured twice in the above table if they have both rheumatoid arthritis and osteoarthritis.

Table 3

Active medications among individuals with rheumatoid arthritis at the last clinical encounter in the RISE registry.

Medication	N=60,354 n (%)
Biologics or targeted synthetic DMARDs *	20,759 (34.4)
Anti-TNF	
Etanercept	4,924 (8.2)
Adalimumab	4,714 (7.8)
Infliximab	3,419 (5.7)
Golimumab	1,034 (1.7)
Certolizumab	847 (1.4)
Other biologics	
Abatacept	2,549 (4.2)
Tocilizumab	1,248 (2.1)
Rituximab	988 (1.6)
Anakinra	26 (0.04)
Tofacitinib	1,010 (1.7)
Non-biologic DMARDs‡	40,272 (66.7)
Methotrexate	26,278 (43.5)
Hydroxychloroquine	14,051 (23.3)
Leflunomide	5,136 (8.5)
Azathioprine	860 (1.4)
Sulfasalazine	3,348 (5.6)
Minocycline	271 (0.5)
Cyclosporine	34 (0.05)
Penicillamine	6 (0.01)
Cyclophosphamide	12 (0.02)
Gold	16 (0.03)
Prednisone	19,073 (31.6)

DMARD=disease modifying anti-rheumatic drug. TNF=tumor-necrosis factor.

* Medications in the biologic category are mutually exclusive; in other words, algorithms were constructed to ensure patients were only counted once in these categories. In cases where more than one medication was listed as active at the last encounter, we constructed algorithms to select one drug.

‡ For non-biologic DMARDs, the overall percentage of 66.7 reflects the patients that were on any non-biologic drug. The percentages using specific drugs listed below this are not mutually exclusive; in other words, patients might be represented twice.

Table 4

Performance on selected quality measures in the RISE registry.

Quality Measure	Measure Denominator (n)	Measure Numerator (n)	Performance (%)
Rheumatoid Arthritis: Assessment of Disease Activity (NQF 2523): Patients 18 years and older with a diagnosis of rheumatoid arthritis and >=50% of total number of outpatient encounters in the measurement year with assessment of disease activity using a standardized measure	58,095	32,087	55.2
Rheumatoid Arthritis: Functional Status Assessment (NQF 2524): patients 18 years and older with a diagnosis of rheumatoid arthritis for whom a functional status assessment was performed at least once during the measurement period	58,095	31,127	53.6
Rheumatoid Arthritis: Disease Modifying Anti-Rheumatic Drug (DMARD; NQF 2525) *: patients 18 and older with a diagnosis of rheumatoid arthritis who are prescribed DMARD therapy within 12 months	57,893	52,670	91.0
Drug Safety: Tuberculosis Screening Prior to First Biologic Therapy (NQF 2522): Patients 18 and older with a diagnosis of rheumatoid arthritis who have documentation of a TB screening performed within 12 months prior to receiving a first course of therapy using a biologic DMARD	17,341	9,570	55.2
Drug Safety: Use of High-Risk Medications in the Elderly: Patients 66 years of age and older who received at least one high-risk medication	98,606	3,880	3.9 *
Drug Safety: Patients 66 years of age and older who received at least two different high-risk medications	98,606	121	0.12 *
Osteoporosis: Female patients aged 65 years and older who have a central dual-energy X-ray absorptiometry (DXA) measurement ordered or performed at least once since age 60 or pharmacologic therapy prescribed within 12 months	77,900	45,472	58.4
Osteoporosis: Patients 18 years and older with one of the following conditions or therapies: receiving oral glucocorticosteroid therapy for greater than 3 months OR hypogonadism OR fracture history OR transplant history OR obesity surgery OR malabsorption disease OR receiving aromatase therapy for breast cancer who had a central DXA ordered or performed or pharmacologic therapy prescribed within 12 months.	52,966	32,388	61.2
Osteoporosis: Patients aged 50 years and older with fracture of the hip, spine, or distal radius who had a central dual-energy X-ray absorptiometry (DXA) measurement ordered or performed or pharmacologic therapy prescribed	7,496	3,840	51.2
Low Back Pain: Patients with a primary diagnosis of low back pain who did not have an imaging study (plain x-ray, MRI, CT scan) within 28 days of the diagnosis	16,239	11,389	70.1
Preventive Care and Screening: Patients aged 18 years and older who were screened for tobacco use one or more times within 24 months AND who received cessation counseling intervention if identified as a tobacco user	260,384	213,646	82.1
Preventive Care and Screening: Patients aged 18 years and older with a BMI documented during the current encounter or during the previous six months	259,787	109,093	42.0

Quality Measure	Measure Denominator (n)	Measure Numerator (n)	Performance (%)
AND with a BMI outside of normal parameters, a follow-up plan is documented during the encounter or during the previous six months of the current encounter			
Preventive Care and Screening: Patients 18–85 years of age who had a diagnosis of hypertension and whose blood pressure was adequately controlled (<140/90 mmHg) during the measurement period	26,364	16,258	61.7
Gout: Serum Urate Monitoring: Patients aged 18 and older with a diagnosis of gout who were either started on urate lowering therapy (ULT) or whose dose of ULT was changed in the year prior to the measurement period, and who had their serum urate level measured within 6 months	5,205	1,614	31.0
Gout: Serum urate target: Patients aged 18 and older with a diagnosis of gout treated with urate-lowering therapy (ULT) for at least 12 months, whose most recent serum urate result is less than 6.8 mg/dL.	1,250	786	62.9
Medication Documentation: Visits for patients aged 18 years and older for which the eligible professional attests to documenting a list of current medications using all immediate resources available on the date of the encounter. This list must include all known prescriptions, over-the-counters, herbals, and vitamin/mineral/dietary (nutritional) supplements AND must contain the medications' name, dosage, frequency and route of administration.	718,292	695,430	96.8

NQF=national quality forum.

* = lower % indicates high performance