INNOVATIONS IN CLINICAL PRACTICE

Development and Implementation of National Time in Therapeutic Range Reports and Establishing Quality Standards Within Veterans Health Administration

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INTRODUCTION

Warfarin had long been the sole oral anticoagulant until the advent of direct oral anticoagulants (DOACs). Improving the management of warfarin is an important goal because warfarin, or any anticoagulant, has the potential to cause great harm to patients if not managed closely. A well-established metric for measuring the quality of anticoagulation control for warfarin is percent time in therapeutic range (TTR)^{1, 2}. Although calculating TTR is seemingly straightforward, there are many challenges when implementing a standardized methodology across a large, integrated healthcare system.

In the Department of Veterans Affairs (VA), most warfarin therapy is managed by pharmacists (86%). However, the structure of care ranges from a centralized, telephone-based anticoagulation clinic to decentralized, face to face integration of anticoagulation therapy within a primary care pharmacist's duty as part of the VA's patient-centered medical home model. There was a lack of reports to measure and compare the quality of anticoagulation control using TTR across these varied practices.

SETTING AND PARTICIPANTS

The goal of the program was to develop a single reporting tool to standardize the measurement of TTR at the national, regional, medical center, and individual patient levels. This would allow for benchmarking across all facilities, identify opportunities for improvement, and highlight effective practices. The scope of the project was broad. Leadership can assess the quality of anticoagulation control across the system while a practitioner can use TTR to guide anticoagulation therapy for an individual patient across all practice areas.

PROGRAM DESCRIPTION

Prior to this initiative, TTRs were available from two regional reports that supported 16 medical centers. Otherwise, facilities measured TTR locally or had no reports at all. Discrepancies on how TTR was calculated made the reports difficult to compare. These discrepancies required reconciliation and presented significant challenges for consensus on a unified methodology across all > 140 VA facilities. Table 1 summarizes the various decision points that impact TTR calculations and what VA selected for the reports.

At its core, calculating TTR using the Rosendaal method is dependent on obtaining accurate and applicable international normalized ratio (INR) dates and values. The two existing reports differed regarding time frames of INR collection and minimum number of INRs required. While one group used 3 INRs in the last 120 days, the other used 4 INRs in the last 180 days. After evaluating differences in how these methodologies impact TTR and the number of patients eligible for a TTR calculation, a compromise of 3 INRs within 160 days was selected. This was because it did not have a significant impact on TTR while being more inclusive by increasing patients eligible for TTR calculations up by 4.4% nationally, and up to 26% at the medical center level.

Identifying which INRs to include required review such as whether or not to include INRs during inpatient stays and those related to temporary discontinuations of warfarin. Inpatient stays tended to be a small portion of the 160-day time frame which meant minimal impact on TTR. And while inclusion of these INRs can significantly impact an individual patient's TTR, they did not significantly change the TTR at the medical center level and above. Furthermore, there is no reliable way to identify when a patient requires a temporary discontinuation of warfarin. As a result, the national report included all INRs available to reflect a patient's TTR regardless of setting. Standardizing these business rules meant we could compare outcomes and quality across programs, which is an important part of being a High Reliability Organization.

Understanding anticoagulation practices helped to resolve cases when multiple INRs are drawn within a single day. These typically occur due to an out of range point of care INR needing confirmation through a venous draw. In these

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Table 1 Factors Considered for TTR Calculation—VA Decisions

Factors	VA decision
Time frame (how many days to look back)	160 days
Minimum number of INRs	3
INRs drawn outside VA	Provide mechanism to capture and include when available
Inpatient INRs	Include
Prescriptions filled outside VA	Exclude due to data limitations
Temporary discontinuation of warfarin therapy (e.g., surgical procedure)	Unable to identify due to data limitations
Warfarin new starts	Exclude new starts for first 42 days of therapy
Minimum days between INRs	None established

cases, the lab drawn latest in the day is used for the calculation. Furthermore, INR labs drawn outside the system presented a challenge since their results are not reported back in a structured way. This was overcome by providing a standardized template to document non-VA labs as discrete data elements in the VA corporate data warehouse.

In addition to INRs, TTR is dependent on the patient's INR goal. In VA, a patient's INR goal is not a discrete data element that can be extracted. Patients documented with ICD10 codes for atrial fibrillation, deep vein thrombosis, or pulmonary embolism were assumed to have an INR goal of 2 to 3 and those with heart valve conditions were excluded. To overcome challenges with accurate ICD coding, a methodology was developed that took into account how often codes were documented, time frame, and the setting (inpatient or outpatient) to define the cohort with a high degree of confidence. This allowed for 80% of warfarin patients to have a TTR calculated. In the end, it was felt that as long as the same methodology was used across all facilities, the negative impact on its utility as a quality metric would be minimal.

Multiple reports were developed to ensure data were readily accessible dependent on the user including a national report for leadership to compare national and regional TTR differences. The reports also allowed clinicians to drill down to individual patient TTRs and the individual INR values and dates that comprise them.

Since actionability was an important consideration, a report was generated that flags patients based on certain parameters to indicate potential actions for follow-up. Many of these flags are consistent with VA policy and literature and have shown their impact on improving TTRs. These include warfarin patients with no INR in the last 42 days, no INR in the last 56 days, supratherapeutic (> 4) or subtherapeutic (< 1.5) INR with no follow-up in 7 days, and TTR $< 60\%$ ^{3, 4}.

A national workgroup was established, led by the Pharmacy Benefits Management (PBM) Clinical Pharmacy Practice Office (CPPO), and included members of other national PBM program offices including Medication Safety, Academic Detailing, and National Formulary. Anticoagulation subject matter experts, practitioners, and

developers of the existing reports were also invited. Regular meetings were set up to present, evaluate, and resolve any challenges throughout the yearlong development process. Prior to release, a national teleconference was conducted to request volunteers for data validation. Key data were reviewed to ensure the accuracy of patients included and their TTRs based on established business rules.

Final release of the reports took the form of multiple national teleconferences that were widely marketed to pharmacy leadership and anticoagulation practitioners. These teleconferences educated users on the reports, addressed data limitations, and described how variability in practice can impact the TTR such as differences in the follow-up time interval after an out of range INR. Since their release, the reports have been used widely but implementation has varied. Some medical centers had anticoagulation management software in place and only check the TTR reports quarterly to compare against other sites while others have incorporated the reports into their daily workflow by evaluating flagged patients. Many have used it as a starting point for identifying patients to convert to a DOAC.

PROGRAM EVALUATION

Since the reports were released in late 2016, the national average TTR has increased from 65.8 to 69.1%. Change in TTR was more dramatic at the medical center level with 38 sites showing an increase of 5% or greater and the largest change for a single site being 14.2%. Although there were 6 sites that showed a greater than 1% decrease in TTR, 4 of these sites are still above 65%.

Numerous studies have shown the reduced morbidity and mortality as well as cost savings associated with increases in TTR. Studies have estimated that improving overall TTR within VA by just 5% would save at least \$8 million annually in averted adverse events⁵. When adjusting for the 32% decrease in the number of veterans receiving warfarin for atrial fibrillation, the savings is still estimated at \$5.4 million annually with a 5% increase in TTR.

One major success of this project was the ability to establish a national benchmark for the quality of anticoagulation control provided at each medical center. With the recent CHEST guidelines using TTR less than 65% as a cutoff for a low time in therapeutic range, we analyzed the progress of medical centers to reach this mark and engaged pharmacy leadership to build consensus on what actions need to be taken to address any outliers. The data show a drop in the number of medical centers with a TTR of less than 65% from 54 to 13 (Fig. 1).

Pharmacy executive leadership has agreed that a minimum TTR standard should be created for all facilities and be set at 65%. The medical centers that have remained consistently below 65% are tasked with developing an action plan to review their warfarin patients and address

Figure 1 Reduction in VA medical centers with TTR < 65%.

their low time in therapeutic range. The increased attention to these low-performing sites and implementation of an action plan will lead to an improvement of patient TTRs and thereby patient outcomes. The focus on a standard TTR report has created an impetus at many sites to focus on this quality metric, and as a result, the number of facilities who had TTRs less than 65% has decreased from 54 in 2017 to 13 in 2019 (an 80% decrease). The national mean TTR has gone from 65.9 to 69.4% during this time period. Actions that facilities can take by utilizing the same report include identifying patients with low TTRs and re-evaluate the need and use of warfarin and consider alternative treatment strategies. Moving low outlier patients to DOACs or to other treatment modalities improves not only the facility TTR but also patient care overall.

DISCUSSION

The concept of implementing a validated tool to measure a quality metric and allowing users to compare their practices can be applied broadly across many settings. This project was particularly effective since pharmacy is the primary provider of warfarin therapy in VA and is a major stakeholder when addressing the practice of anticoagulation care. This gave pharmacy leadership a sense of accountability and made it easier to develop, promote, and implement the tool broadly. In addition, it provides a tool to measure, identify, and reduce clinical variation in the area of anticoagulation.

The most straightforward parts of development were the technical aspects while most of the time and effort was put towards obtaining consensus to address the various factors that can impact TTR. Subject matter experts helped to identify issues and a data-driven approach was used to measure each issue's impact on TTR and evaluate patients that would be excluded. A data validation process was important to quantify data limitations and help users understand the assumptions made.

The limitations to this approach are primarily data related. The reports notably exclude a significant population of patients with heart valves. While many patients are converted to DOACs, these patients remain on warfarin which has dropped the proportion of patients eligible for a TTR calculation from 80 to 70%. A solution is underway to capture these missing data like the approach taken with outside labs.

To compare TTR measures across healthcare systems, a comprehensive understanding of each decision point is required and all healthcare systems would need to work together to provide consensus to establish a true comparison. Having such a standardized benchmark across multiple healthcare systems would provide internal and external benchmarking that is critical for quality improvement and improved patient care.

The TTR reports were successful in developing a standardized metric for measuring the quality of anticoagulation control for patients on warfarin across national, regional, and facility practices. Furthermore, the tools were able to provide a clear metric to set a standard for all medical centers to achieve and thus drive change to improve overall care for patients. We were able to measure overall improvement and identified medical centers that may still be struggling with this population. The experience from the development and implementation of this initiative can be applied to other practice areas of need. As the landscape of anticoagulation continues to shift, opportunities are open for similar population management approaches for DOAC patients.

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Compliance with Ethical Standards:

Conflict of Interest: The authors declare that they do not have a conflict of interest.

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