6. Data-Driven Solutions for Improving the Continuing Disability Review Process

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INTRODUCTION

The Social Security Disability Insurance (SSDI) and Supplemental Security Income (SSI) programs are the largest federal income programs for individuals with disabilities. In 2014, these programs paid out $175 billion to 15 million beneficiaries (House Committee on Oversight and Government Reform Subcommittee on Energy Policy, Health Care and Entitlements 2014). To ensure that only those who remain disabled stay on the rolls, the Social Security Administration (SSA) is required by law[1] to conduct medical continuing disability reviews (CDRs) on all disability insurance beneficiaries, some SSI recipients,[2] and all SSI children.[3] The law requires that CDRs be conducted every three years for SSDI beneficiaries with potentially non-permanent disabilities, while beneficiaries with permanent disabilities are to be reviewed at such times as the SSA Commissioner determines to be appropriate. Since the inception of the SSDI program, Congress has emphasized the importance of CDRs as a way to preserve the social safety net for disabled individuals. In fact, when the SSDI program was established in 1956, Congress created a provision to allow SSA to monitor a beneficiary's continued eligibility for disability benefits. Periodic medical reviews are one of the most cost-effective provisions available to SSA to improve program integrity. However, in recent years the backlog of CDRs that need to be completed has grown to over 1.3 million cases. While completion of CDRs is often limited by funding and resources, the process is also hampered by a lack of access to and availability of medical or functional data, as well as a fragmented system that is slow to adapt and make the most of modern technological advances. To address the CDR backlog and improve the overall efficiency of the CDR process, we propose four main strategies: investment in information technology for collecting and leveraging data; acquiring new and additional data; use of data analytics and predictive modeling for discovering insights, informing policy, and optimizing business processes; and creation of a dynamic CDR case prioritization queue ordered by expected lifetime savings. The scope and direction of these initiatives would have positive agency-wide implications by increasing the productivity and consistency of handling all SSA claims, not just CDRs.

[1] Section 221(i) of the Social Security Act (SSA 2011).

[2] Section 1614(a)(4) of the Act gives SSA discretionary authority to conduct periodic CDRs of SSI recipients. (SSA 2011).

[3] Public Law 104-193 required SSA to redetermine the eligibility of all SSI child recipients who attain age 18 based on the adult initial eligibility criteria. This law also required that SSA perform a CDR: 1) at least once every three years for SSI recipients under age 18 who are eligible by reason of an impairment that is likely to improve; and 2) not later than 12 months after birth for recipients whose low birth weight is a contributing factor material to the determination of their disability. Since SSA has no backlog for the for the age 18 redetermination process, this paper will address only those benefit categories with CDR backlogs (SSA 2011).

BACKGROUND

When a decision is made that an applicant is, or continues to be, disabled, SSA sets a medical diary, which classifies beneficiaries into three categories: medical improvement not expected (MINE), medical improvement possible (MIP), and medical improvement expected (MIE). Medical diary designations are based on rules developed in the early 1990s that have not been updated. The MINE rules were developed in a data-driven fashion using historical SSA decisions. The MIE rules were based on a medical literature review. The MIP category includes everyone not in the MIE or MINE groups, and consists of roughly 60 percent of SSA beneficiaries. Approximately 35 percent of beneficiaries are designated as MINE and the remaining 5 percent are designated MIE (SSAB 2014). SSA intends to review cases every five to seven years, every three years, or every six to 18 months, depending on the respective diary designation.

SSA conducts two types of medical CDRs: full medical reviews and mailers. A statistical profiling model (the CDR predictive model) is applied to cases every year to assign scores that reflect the likelihood of cessation were a full medical CDR to be conducted. The CDR predictive model uses SSA program data including age, impairments, length of time in disability status, basis for the original determination, data on prior CDRs, and recent earnings as variables for its estimations (SSA 2012). The predictive model is used to determine which cases with medical diaries due that year should be given a full medical CDR. Cases are assigned to low, medium, or high likelihood of cessation groups based on the model's predictions. Cases in the low group are typically sent a short-form mailer and those in the high group are given a full medical review. Beneficiaries in the medium group may be sent a mailer or undergo a full medical CDR depending upon other factors such as the CDR budget for that fiscal year.

The mailer is a questionnaire designed to obtain additional information about a beneficiary's impairments, treatment, and earnings. This information is then used to determine if a full medical review should be initiated. Only about 2.5 percent of beneficiaries who return the completed mailer are referred for full medical CDR based on the information received. A full CDR involves development by SSA of a complete medical history covering the most recent 12 months.. The goal of the case development for a full CDR is to obtain sufficient medical evidence for a comparison point decision of the status of the beneficiary's impairments under the Medical Improvement Review Standard (MIRS), which differs from initial determination criteria since the CDR is looking to establish whether there is any change in the beneficiary's function and ability to return to work.

The CDR process consistently yields a favorable ratio of savings-to-costs. SSA estimates that the CDR process yielded a savings-to-costs ratio averaging $10 to $1 for fiscal years 1996 through 2011, and a savings-to-costs ratio of $14.6 to $1 for fiscal year 2012 (SSA 2014). In January 2014, SSA reported that it had accumulated a backlog of 1.3 million CDRs (GAO 2014). SSA has cited resource limitations and a greater emphasis on processing initial claims as reasons for falling behind on the number of CDRs conducted despite the consistently favorable ratio of savings-to-costs generated by these reviews. When CDRs are not conducted as scheduled, the potential for improper payments increases as some recipients receive benefits for which they are no longer eligible. In the March 2010 OIG report entitled "Full Medical CDRs," SSA estimated that between 2005 and 2010 the agency will have made benefit payments of between $1.3 billion and $2.6 billion that could have been avoided if SSA had conducted the 1.5 million full medical CDRs that were in the backlog during that time as soon as they became due (SSA OIG 2010).

While the current CDR process is very cost effective, it is possible to significantly improve it by increasing productivity and accuracy in the handling of cases, better targeting cases for full medical review, and guaranteeing sufficient funding of the CDR program. With the use of the CDR predictive model, about 6 percent of full medical CDRs result in disability program cessation (SSAB 2014). While this level of cessations still makes the program cost effective, there is room for improvement. The most significant limitations of both the CDR predictive model and the overall accuracy and efficiency of the CDR process stem from lack of access, use, or acquisition of accurate and reliable medical data and inefficient use of electronic business processes that mimic antiquated paper-based processes and do not take full advantage of automatic data entry and collection.

The following sections give detailed descriptions of our proposed solutions for addressing these issues and improving the CDR process, including implementation challenges, interim steps, and critical success factors.

INVESTMENT IN INFORMATION TECHNOLOGY FOR DATA ACQUISITION, ACCESS, CONSISTENCY, AND INTEGRITY

The Problem

The most significant limitations to SSA data-driven tools such as the CDR predictive model are access to, and availability of, the most relevant data related to measuring a beneficiary's medical improvement. The inability to quickly access the right data can lead to poorly informed decisions. SSA's existing information technology (IT) infrastructure was not designed to process today's magnitude, complexity, or workload of data. SSA's IT system is fragmented amongst its departments and programs and across each stage of the disability adjudication process. To access all relevant information for one beneficiary, one needs to query many databases and make use of many applications. This creates problems regarding data consistency and duplication. Moreover, access to these data sources is limited even within the agency, making these data difficult to use for analytics purposes. For example, a beneficiary's electronic health record contains the most pertinent evidence related to her conditions and the possibility of medical improvement. However, the database housing that data was set up in such a way that it cannot be directly queried to extract records in bulk by most SSA personnel. Previously, we obtained access to a small sample of electronic medical records for research purposes by writing a program that uses SSA's eView system (an application created to allow adjudicators to view case evidence) and automatically clicks on all relevant links to download the files of interest.[4] We were unable to identify a way to more efficiently download medical evidence in bulk. The problem of being unable to download data in bulk from databases is not limited to medical evidence. This is a major impediment to all initiatives to make data-driven decisions and policy changes.

The data analysis of medical evidence to improve the accuracy and consistency of SSA processes is hampered by the lack of medical and functional evidence stored in structured format, even though this evidence is routinely generated as part of SSA business processes. These processes mimic a paper-based system where SSA staff fill out various forms and templates and then save them as TIFF[5] images,

[4] This research was supported by the Intramural Research Program of the National Institutes of Health, Clinical Research Center and through an interagency agreement with the US Social Security Administration.

[5] Tagged Image File Format for storing images, which is common with scanned or faxed images, but has a large

which prevents these forms from being searched automatically or their contents included in a structured database. The development of a modern system for capturing this information and automatically sending it to structured databases would allow SSA to use data analytics to improve its processes, would increase program consistency, and would reduce costs. For example, a 2007 Government Accountability Office report found that between fiscal years 1995 and 2005, the number of disability appeals reviewed by the federal district courts increased, as did the proportion of decisions that were remanded (GAO 2007). More disability claims were remanded than affirmed, reversed, or dismissed over this period, and the proportion of total decisions remanded ranged from 36 percent to 62 percent with an average of 50 percent (GAO 2007). SSA has addressed the need to reduce remands, and in 2006, along with other initiatives, introduced new decision-writing templates to improve efficiency and reduce errors. SSA has made additional efforts to improve efficiency and consistency of decisions with the development of the electronic Claims Analysis Tool (eCAT) system, a web-based application designed to document the disability determination rationale of a disability examiner and to ensure that SSA policies are adhered to during claims adjudication. This application facilitates the standardization of state disability determination practices. The eCAT automatically captures case characteristics, functional information, and examiner actions. However, eCAT addresses only a small part of the disability determination process and is built on top of the SSA legacy system. The system is not yet being used for the CDR process. Additionally, SSA still relies heavily upon Microsoft Word templates that can be edited manually. The standardization and modernization of this process is necessary in order to make full use of data to improve business processes and policy.

Investment in information technology has yielded great success for SSA in the past. Some of the agency's very successful investments in technology include the CDR predictive model; iClaim, an online system for applying for disability, retirement, and Medicare; mySocialSecurity, a personalized online portal that individuals can use to view detailed information on benefits received, get a benefit verification letter, start or change direct deposit information, and change their address; the Access to Financial Institutions program, which allows SSA employees to automatically and electronically gather SSI recipients' financial account information directly from financial institutions; the SSI Telephone Wage Reporting System, an automated toll-free number that allows SSI recipients to update the wage information on their records and a mobile wage-reporting application; and, the Continuing Disability Review Enforcement Operations Predictive Model, which identified DI beneficiaries who appear to have substantial earnings after disability onset through an automated matching of the current DI beneficiaries with earnings reported to the Internal Revenue Service (IRS). Many other agencies including the Department of Veterans Affairs (VA), Department of Defense (DOD), and Centers for Medicare & Medicaid Services (CMS) achieved their most successful reductions in backlogged cases by maximizing the use of technology and the corresponding data it can put at their disposal. For example, in the VA's 2013 Strategic Plan to Eliminate the Compensation Claims Backlog, the department anticipated that over 40 percent of their backlog cases would be removed with implementation of new and additional technology (Veterans Benefits Administration 2013). All these agencies have introduced methods for electronic filing and management of claims and cases as both a strategy for reducing backlog and for improving their systems overall. The VA, DOD and CMS have introduced online portals, which are used not only for electronically submitting claims, but also for keeping claimants appraised of the status of cases and for storing data that claimants and the agency may need now or in the future. The CMS portal also allows professionals involved in claimants' cases, such as attorneys and insurance carriers, to directly enter case information into the portal, which reduces cost and time spent following up with these sources (Centers for Medicare & Medicaid

amount of variability

Services 2013). And with the shift toward electronic filings, the agencies can now ensure that all necessary information is collected before a case progresses, reducing the need for claims to be returned due to insufficient case development. While SSA has made some great strides in using information technology to handle the CDR backlog, the agency needs to make greater use of data and technology in order to truly improve the CDR and the overall adjudication processes.

Recommendations

Below, we describe investments in information technology that would allow SSA to efficiently acquire and leverage medical and functional data, thus addressing the issues outlined above.

1. Data modernization and integration through an Enterprise Data Environment (EDE) with the following components (described later in this section)
    - Integrated master data repository
    - Operational business intelligence repositories
    - Unstructured data repository
    - Enterprise metadata and services repository
    - Enterprise data services and enterprise business services
    - Demonstration environment
2. IT infrastructure modernization

These recommendations are informed by CMS's plan for "Modernizing CMS Computer and Data Systems to Support Improvements in Care Delivery," released in 2010 (Centers for Medicare & Medicaid Services IT Modernization Program 2010). Indeed, CMS faced a lot of the same challenges SSA is currently facing. CMS's detailed plan to modernize its systems and put data at the core of its operations can serve as a model for SSA's modernization effort and provide insight into overcoming implementation challenges and lessons learned. Below is a more detailed description of the recommendations.

SSA needs to create an EDE to stand at the core of its data and IT infrastructure modernization efforts. An EDE is an integrated, modular environment for managing enterprise data and optimizing data-driven applications and decision making over its lifetime. This environment needs to be created from a global, agency-level perspective, and not be broken up into silos artificially created by the agency's departments and programs. The essence of the enterprise data environment core design should be to improve the integration, completeness, quality, timeliness, and accessibility of SSA data. SSA should treat data as an enterprise asset and should focus on collecting and storing data necessary to identify opportunities to improve business processes and policies, and not just data required for applications that lead to operational expedience. The EDE should provide timely access to authoritative data sources at all levels within the agency, empower collaboration, automate and simplify operations, and support enterprise growth. This initiative should result in improved security through implementation of privacy controls to ensure protection of sensitive data via roles, policies, and business processes.

SSA needs accurate, timely, complete, and authoritative information about its applicants and beneficiaries. This is vital to maintaining core program operations and program integrity, and to evaluate the effectiveness and performance of new and existing initiatives. This data is also necessary to hold programs, states, and adjudicators accountable, promote transparency, and support agency research and data-driven decision-making needs. The EDE should provide an overarching plan for

managing SSA's data using best practices from Master Data Management (MDM), the discipline in which IT specialists engage business experts in the development and maintenance of consistent and accurate lists of an enterprise's most critical information. MDM methodology focuses on eliminating redundancy, inconsistency, and fragmentation by having a single, synchronized, comprehensive, authoritative source of master information.

The integrated master data repository should contain all structured information pertinent to an applicant. It should be structured as a relational database and it should uniquely identify beneficiaries, claims, cases, providers, and representatives. Data should be stored in a format that permits partial updates (e.g. an applicant's address changes but all other fields remain unchanged) and a variable number of fields (e.g. current SSA systems only allow for two impairment codes even though there are applicants with as many as 11 impairments). The master data repository should serve as the authoritative source of information for the entire agency. It should support both operational and research and demonstration needs. The operational business intelligence repositories will serve as the authoritative source of near-real-time and/or historic data for individual SSA programs and components. Whereas the master data repository is SSA's enterprise solution for creating highly integrated information products, the operational business intelligence repositories will allow for timelier, more consistent, and greater dedicated operational support. Only one extract of the operational business intelligence repositories will be sent to the master data repository for integration. The unstructured data repository should include the millions of unstructured documents that SSA receives or produces every year. This unstructured data includes medical evidence, SSA forms, SSA reports, and SSA decision documentation. The business processes associated with the generation and processing of these documents are manual, time-consuming, and inefficient. Unstructured data objects are ultimately stored by the agency as TIFF images, making them difficult to use to gain insight or create work- and time-saving applications. Unstructured data should be saved in its native format and classified through unified classification schemes. When storing this data, the agency should take into account the requirements for capacity, latency, access, security, cost, persistence, flexibility, and application awareness for both business operations and research and demonstration initiatives. The agency should explore using NoSQL (Pokorny 2011) databases for unstructured data. The enterprise metadata and services repository should manage and store all information about SSA data, such as data models, data exchange layouts, data definitions, data lineage, data integrity rules, operational metrics, and data services under configuration management. It should support application developers by providing detailed information about SSA data. It should support data analysts by providing a better understanding of historical analytics and by enabling traceability of information. SSA should also manage a library of reusable software building blocks that can be combined in ways specific to each applications' needs. Enterprise data services should be technically oriented services that interact with the databases directly and can be aggregated or combined to support the specific needs of the organization. Enterprise business services are business-oriented services that can be used across the enterprise or services provided by off-the-shelf products.

The flexibility of the EDE infrastructure should offer the potential for reconfiguration in novel ways—sometimes using EDE production data and systems "as is" and sometimes using a demonstration environment or sandbox where experimentation can take place without impacting the production environment. Dedicated IT infrastructure should exist to support prototypes, demonstrations, and simulations for a wide variety of administrative and research innovations. The demonstration environment should have access to the entire range of data and services offered by the EDE.

In order to implement the vision of a modern enterprise data environment, SSA needs to also invest in its IT infrastructure. The agency should create a sound plan for implementation of a robust, secure architecture to support the EDE. This would include support for a virtual data center providing improved security, modern network capabilities, required capacity, and high availability for critical information and business continuity. SSA should carefully establish system requirements, keeping in mind both business operations and research and demonstration needs. It should consider a combination of technologies that together meet all of the system requirements, rather than trying to invest in a one-size-fits-all solution. It should consider all approaches, including virtualization or shared services such as Cloud Computing and Infrastructure.

Implementation

The data and information technology projects outlined above are very ambitious and present numerous challenges. The EDE would reach across all SSA departments and programs and require a major overhaul of both data management and storage solutions and all applications requiring access to these data. A list of major challenges is presented below.

Major challenges:

- Fragmented, unsynchronized data
- Outdated data systems that can only be accessed and supported by a limited number of technicians
- Poor documentation of legacy systems
- Stressed data processing capacity
- Limited capabilities to accept and process clinical data for automated decision support, workflow management, and knowledge discovery
- Lack of an authoritative data source
- Lack of enterprise services that facilitate easy access to SSA systems and data
- Monolithic, closed systems that were created with a single purpose in mind and have contributed to an inflexible architecture
- Degree of manual manipulation required before data can be used for analyses
- Communication challenges caused by fragmented agency operations and leadership
- Transition to data-driven enterprise-level decision making and policy changes

Strong management is critical to ensure the establishment and adoption of the EDE by the entire SSA organization. At a minimum, data management should address standards, organizational readiness, budgetary capitalization of shared enterprise data assets, enterprise data engineering and planning, and business transformation. SSA should build its shared, integrated data and service model in incremental steps. It should maintain its existing systems to continue its day-to-day business operations while preparing them for the new environment. The agency should employ a coordinated approach that includes short-term investments to sustain the existing systems and longer-term business change that utilizes authoritative data and new analytical techniques. The new IT and data storage infrastructure should be developed independently of SSA legacy systems and deployed incrementally to ensure a smooth transition.

Implementation of the EDE involves a series of phased, highly interdependent initiatives to achieve data improvement, business process modernization, enhanced security and privacy, best practice standards, and enterprise data center enhancements. A list of possible interim steps is described below.

Interim Steps

- Identify all SSA data stores that need to be integrated into the EDE.
- Identify new data to be acquired and stored in the EDE.
- Create conceptual architectural design for collecting, organizing, and integrating SSA data stored in the enterprise data repository.
- Create detailed system requirements for all phases
- Build the enterprise infrastructure capability to enable the needed scalability, agility, and flexibility to handle all SSA processes and big data analytics
- Build a case processing and workflow management architecture that can address all requirements and disability processing levels and steps, enable automatic data acquisition during case processing, be flexible to policy changes and regional differences (without requiring the purchase of additional software or database systems). Successful implementation involves agility and cooperation between SSA components and alignment within departments and regions to develop an enterprise-wide vision.
- Agile Cycles through multiple Plan, Do, Study, Act cycles (Highsmith 2004)
- Incremental cost-benefit analyses as components of the system are tested and deployment is performed on a small scale at first
- Incremental retirement of legacy applications

Creating and implementing a complex data and IT modernization plan is a challenging undertaking that requires an incredible communication effort. Previous successful and failed IT initiatives can help in identifying some critical success factors.

Critical Success Factors

- Solid executive and business sponsorship
- Centralized guidance with an agency-wide vision for initiatives
- Incrementally retiring legacy applications
- Acceptance of an SSA-wide information-centric approach
- Agile response to new business demands
- Comprehensive planning
- Aggressive risk management
- Adequate engagement of users in the entire process
- Adequate sharing of risks with vendors and creating contracts that properly align incentives
- Quality-driven procurement options
- Clear performance metrics established during the planning phase
- Sound fiscal and project management
- Good communication and involvement of stakeholders throughout the process
- Updated security and privacy regulations
- Adequate alignment of incentives and sharing of risks, responsibilities, and credit for successes with those involved in approval processes
- Good interagency coordination and communication
- Willingness to focus on long-term gains rather than short-term solutions

While the upfront cost would be high, a complete modernization of SSA IT and data storage infrastructure to a system capable of leveraging data is cost-effective in the long run because of the relative high cost of creating new IT applications on top of fragmented, antiquated legacy systems. This would also protect SSA from the hidden costs of smaller IT initiatives. Organizations often sprout small, independent data initiatives throughout their departments. This disparate, small-scale approach often costs more, takes longer, and delivers meager results. Below is a list of potential cost savings or cost avoidance that could be generated by the EDE.

Cost Savings

- Reduced risk of systemic failure due to overly complex, customized systems
- Simplified infrastructure through the retirement of hardware, applications, and databases
- Retirement of legacy systems will reduce the burden of maintaining product licenses and support costs (monitoring, upgrades, and patches) of retired systems
- Reduced labor activities related to the legacy hardware, applications, and databases (acquisition, storage, analysis, enhancement, maintenance, troubleshooting, archival, and distribution)
- Negotiation of better rates for resources that do not require domain knowledge or expertise that is presently required for the complicated infrastructure of legacy assets
- Significant administrative savings once the core infrastructure capabilities are established; other more modest administrative savings as the enterprise technology systems are integrated and the data services mature during the initial phases
- Enhanced program integrity
- Optimization of business processes and workflows
- Easy two-way information sharing with other government agencies
- Ensure complete, timely, and accurate data across the agency

NEW DATA ACQUISITION

The Problem

The effectiveness of the CDR predictive model is determined by the timeliness of the data used in its predictions. Therefore, the inability to quickly access the right data poses significant limitations to the CDR predictive model and can lead to poorly informed decisions. Even if existing data access and consistency issues were addressed, the lack of medical and functional data collected between full medical reviews would still be a severe limitation to the CDR process. At the time a decision is made whether to perform a full medical CDR, most of the data available is from the beneficiary's last review, thus typically collected at least three years prior to the CDR. While SSA has invested in applications to automatically collect financial information and to allow applicants to report changes in their financial circumstances, the agency has not made significant strides to collect medical and functional data or to allow applicants to report changes in their disability status between reviews of their case. According to the 2014 Office of Inspector General (OIG) report "Full Medical Continuing Disability Review Cessations Reversed at the Reconsideration Level of Appeal," 80 of every 100 cases reversed at the reconsideration level were reversed because there was new documentary evidence or testimony at the reconsideration level that was not available during the initial CDR (SSA OIG 2014a). Allowing beneficiaries to easily provide this evidence early in the CDR review process would likely result in cost savings, an increase in efficiency, and a reduction in the emotional burden on disabled beneficiaries.

Recommendations

We recommend that SSA explore three new functional and data collection initiatives to address the issues outlined above:

1. Acquisition of periodic Work Disability Functional Assessment Battery (WD-FAB) scores to precisely measure capacity across the full continuum of human functioning, in areas such as mobility, cognition, interpersonal interaction, communication, self-care, and general tasks and demands
2. Development of a web-based application that would enable claimants and their representatives to view their cases and upload their recent medical evidence
3. Automatic collection and leveraging of electronic medical records such as Medicare and Medicaid data, data from other health insurers, and electronic health records from providers and pharmacies

Implementation

Here are the steps through which the three data-acquisition recommendations can be implemented incrementally, and in parallel with each other. It should be noted that while the automatic collection of electronic medical records does not depend upon first having a functional version of the web-based application for their upload, the two initiatives synergize well once both are operational. Also, the same web-based application could eventually be used to both collect WD-FAB scores and to allow for the upload of medical records.

Acquisition of periodic WD-FAB scores

The Work Disability Functional Assessment Battery (WD-FAB) is currently being developed for use in the SSA data collection and disability evaluation processes.[6] In order to understand distinct factors influencing work, individual capabilities as well as workplace demands and critical features of the workplace environment must be captured. This modern concept of function has been embraced by the global community and is rooted in the World Health Organization's International Classification of Function, Disability and Health (ICF).

The WD-FAB uses Computer Adaptive Testing (CAT) coupled with Item Response Theory (IRT) to precisely measure capacity across the full continuum of human functioning. IRT-CAT represents a simple form of artificial intelligence software requiring a computer for administration. These assessment instruments will cover all the major ICF areas that are highly related to work, such as basic mobility, cognition, interpersonal interaction, communication, self-care, and general tasks and demands. The National Institutes of Health (NIH) is working with researchers from Boston University on IRT-CAT development. The utilization of IRT-CAT technology could potentially allow the SSA to collect more relevant, comprehensive, and precise data about human functioning in a much more efficient fashion. This could promote simplification of the determination process, reduce processing time and cost, strengthen medical evidence resulting in more accurate and consistent decisions, and allow the SSA to collect data at points in the process when it proves most useful for decision making.

[6] The development of the WD-FAB tool was supported by the Intramural Research Program of the National Institutes of Health, Clinical Research Center and through an interagency agreement with the Social Security Administration.

Major Challenges

- WD-FAB will require pilot testing within SSA
- Adoption of WD-FAB will require integration into SSA's business process

Interim Steps

- WD-FAB domain calibration, item replenishment, and methods to counter "cheating" or malingering
- Validation of WD-FAB scores through comparison to legacy instruments, test-retest comparisons, and SSA determination outcomes
- User simulation demonstration projects at state Disability Determination Services (DDS) offices for SSA and NIH to examine how best to include WD-FAB data collection into the existing business practice
- Usability support for the WD-FAB through multiple methods to connect scores to outcomes from SSA business practices
- Development of web-based, in-office, and phone-based applications for the collection of WD-FAB scores from claimants online, at DDS or hearings offices, or by phone
- Capstone demonstration project to compare SSA determination process to an augmented process that collects and uses WD-FAB data
- Progressive rollout of the WD-FAB to SSA regions to allow for comparison of business processes and to make adaptations from insights received from the field offices and DDS centers

Boston University is, as of June 2015, in the final stages of a study to calibrate the Learning and Applying Knowledge and Daily Activity domains of the WD-FAB. The other two domains of Interpersonal Interactions and Physical Function have already been calibrated and are undergoing item replenishment in this study, which is where new items are considered for inclusion and older items may be dropped to improve the overall quality of the instrument. Item replenishment is a continual process through which the WD-FAB can take advantage of improvements in the science of functional measurement or changes in functioning of the population. The instrument is being developed through the methods of Item Response Theory, which is the methodology used for the SAT, GRE, and other modern computerized tests that are able to analyze response patterns to automatically detect discrepancies. The implementation of WD-FAB as a computerized adaptive test allows it to detect malingering by comparing a claimant's combinations of response patterns to existing patterns of response from earlier users who had alleged similar impairing conditions.

Validation of the WD-FAB is done at several levels of specificity. These efforts include an ongoing predictive validity study of SSDI claimants to be completed in 2016 in which the WD- FAB scores of those who are approved or denied for benefits as of their most recent determination date will be compared. One user simulation demonstration has already been conducted at four field offices in the New England and Mid-Atlantic regions in which case workers read the items to claimants and filled in their responses on a computer. Caseworkers reported almost unanimously that the administration of the WD-FAB was straightforward and understandable to them and rarely took more than 30 minutes of their time. Finally, the WD-FAB has already been developed as a program that can run on any modern operating system. The decision on how to implement it within SSA's network should be decided by SSA's systems divisions, but NIH will cooperate with them as needed and can make the code for the program available.

Critical Success Factors

- The proposed changes in SSA policies to require the collection and use of WD-FAB data are implemented
- Adjudicator use of WD-FAB to provide a systematic summary of functioning that helps guide their development of the medical evidence
- Making WD-FAB scores interpretable to SSA adjudicators, administrators, and researchers

The acquisition of periodic WD-FAB scores (by phone, through an online application, or through eCAT) early in the adjudicative process would allow SSA to paint a full picture of applicants' and beneficiaries' functional status over time. The WD-FAB scores could be collected at times that SSA is already collecting beneficiary data, such as acquiring the WD-FAB in addition to the mailer, which would then provide more relevant function information for deciding whom to target for a full medical CDR while keeping administrative costs low. Acquiring these data periodically, such as every year, would allow SSA to set more flexible individualized diary dates, identify new rules for setting diary types, and more accurately target cases for full medical reviews.

Cost Savings

- Change (or lack thereof) in WD-FAB scores can be used to detect changes in functioning status between initial determination and CDR
- Improved timeliness of adjudication by identifying claimant's functional domains of greatest impairment
- Detection of unexpected functional improvement between diary dates

Web-based self-service application for uploading recent medical evidence

The development of a web-based application for claimants and their representatives can expand upon existing SSA efforts to support electronic rather than paper claims submissions. SSA applicants and beneficiaries should be permitted to upload medical evidence while their cases are not actively under review. Once an adjudicator "checks out" a case to begin actively working on it, the system would temporarily restrict applicants' and beneficiaries' ability to upload new evidence. At the beginning of the process, applicants should be informed that the timely upload of information is advised, and that their ability to make uploads will be temporarily suspended while the case is actively under review. When uploading medical evidence, users should be required to provide the date of service and to select what type of document they are uploading (e.g. doctor's notes, radiology report, laboratory findings, etc.) to mimic SSA's current process of labeling files. The options may change according to the information provided, such as impairments, body systems affected, etc. Statistical models can be used to identify potentially missing types of information and to request that users upload it or provide an explanation as to why it is not available.

Major Challenges

- Changes to operational structure are needed in order to take advantage of frequent and "real time" updating of claimant records
- Integration with existing databases and SSA efforts

Interim Steps

- Assess the feasibility of expanding the existing online disability application system to allow uploads of medical evidence in an effort to reduce duplication
- Identify key stakeholders and engage them throughout the process
- Create a strategy for labeling documents based on body systems and impairments
- Identify the application requirements for the back end and for the user interface. Allow flexibility for later adding the collection of WD-FAB and the use of statistical models to identify potentially missing information.
- Develop the application (using Agile project management techniques (Highsmith 2004)) and perform quality testing before rollout
- Deploy the application in beta mode and allow time to fix issues before using the information collected in the adjudication process
- Start using uploaded data in the adjudication process
- Build and test statistical models of medical evidence necessary based on case characteristics and add corresponding functionality to the online application

Critical Success Factors

- Engaging key stakeholders to determine how to best make use of uploaded medical information in the adjudication process
- Maintaining the trust of claimants in the security of their data and its use by SSA.

The automatic collection of medical and functional evidence in structured format through efficient IT applications would enable automatic integrity checks, a speedier grasp of medical evidence that could lead to faster, more efficient decisions, and the development of data analytics projects for finding patterns in the medical evidence. These projects could lead to faster, less costly, and more consistent decisions for specific subsets of applicants, as in the example of the Compassionate Allowances. The implementation of an application to allow beneficiaries and their representatives to upload their own medical information and keep their files current would allow an improved targeting of cases for full medical review and a faster, cheaper case development process. Having this medical evidence would make the full medical development of a case less costly and time consuming.

Cost Savings

- Improvements to CDR decision timeliness and accuracy
- Enhanced decision-making for full medical CDR targeting in advance of claimant diary dates

Automatic collection of electronic medical records and administrative data

Automatic collection and leveraging of electronic medical records such as Medicare and Medicaid data, data from other health insurers, and electronic medical records from providers and pharmacies could help SSA more accurately target CDR cases for full medical reviews, to corroborate information submitted by beneficiaries, and to monitor adherence to prescribed treatment. SSA is already partnering with CMS to obtain CMS data and use it to take people out of the CDR full medical review queue if their administrative claims data shows evidence of continued impairments. CMS has been going through an extensive IT modernization process that should allow real-time information sharing with SSA in the future. SSA should continue to make efforts to gain access to provider electronic

health records and to drive the policy changes necessary for the standardization of these records and for the ensured seamless communication and information transfer between electronic health record systems.

Major Challenges

- Under the current agreement, CMS data can only be used by SSA to support continuances
- Real-time downloading from CMS and provider databases requires compatible structures and careful coordination
- Multitude of health care providers need to be convinced to participate in automatic data-sharing agreements
- The transfer of information between different types of electronic health record systems is sometimes difficult or impossible.

Interim Steps

- Organize presentation to SSA stakeholders by CMS representatives on recent database changes that allowed improved access and use of CMS data by researchers
- Pilot efforts to expand existing SSA-CMS coordination on sharing of Medicare health records
- Use lessons from the CMS partnership to inform planning by SSA stakeholders in designing a web portal that facilitates the transfer of claimant medical records from insurers and health professionals

Critical Success Factors

- Partnership with CMS at a higher level to facilitate timely transfer of data to SSA
- Applying lessons from CMS to data-sharing agreements with other insurers and providers
- Coordinated modernization of SSA IT systems

DATA ANALYTICS AND PREDICTIVE MODELING TO IMPROVE ASPECTS OF THE CDR PROCESS

The Problem

SSA administers a very complicated and compartmentalized adjudication system which relies on many rules and policies that are not evidence-based and that have not been updated in a long time. The creation of this system was necessary at the inception of the SSI and SSDI programs. However, advances in technology have changed how organizations are run. Our world today is marked by an overabundance of information. Powerful big data analytics solutions are now being used to analyze this explosion of information and to fundamentally change the way organizations manage their daily operation. The advantages that can be gained from data analytics are substantial. Insights from big data analytics have helped organizations differentiate themselves from their competition and gain a stronger foothold in their market. SSA could benefit tremendously from integrating big data and analytics into its business processes and using them to inform policies. The agency should analyze the tremendous amount of data it collects and generates to discover new insights and previously hidden correlations. These new insights can be used to reduce latency in decision-making and to increase the consistency of decisions and the efficiency of the disability adjudication processes.

Recommendations

Areas of the CDR process where data analytics can have a strong impact are outlined below.

1. Using data and text mining to improve medical diary designations (MIE/MIP/MINE designations)
2. Setting individualized diary dates using periodic scores and historical CDR decisions
3. Checking for adherence to prescribed treatment using CMS and other electronic claims data

Data and text mining to improve medical diary designations

Medical diary designations are based on rules developed in the early 1990s that have not been updated. The MINE rules were developed in a data-driven fashion, using historical SSA decisions. The MIE rules were based on a medical literature review. The MIP category includes everyone not in the MIE or MINE groups, and consists of roughly 60 percent of SSA beneficiaries. Recent medical advances have made new treatments, medications, medical equipment, and assistive devices readily available to individuals with disabilities. Regular updates of medical diary designation rules are thus necessary in order to keep the rules relevant. Furthermore, since there is usually a multiyear period between two CDRs for the same beneficiary, medical advances may change that individual's diary designation before their case matures. Being able to reclassify individuals' diary designations periodically, between consecutive CDRs, in order to take into account medical advances and individual functional and medical data available since the last review may lead to significant improvements in the CDR process.

We recommend using data analytics to devise new rules for setting the diary type by leveraging functional and medical evidence, medical literature, and current SSA compassionate allowance and medical listings data. This process can be done incrementally, based on the types of functional and medical evidence available. We also recommend automatic periodic updates to individual diary designations by collecting and utilizing new data sources and by accounting for medical advances. A predictive model for individual medical diary designations could be created if enough of the relevant functional and medical evidence were collected or extracted. In addition, the periodic collection of Work Disability Functional Assessment Battery (WD-FAB) scores would allow for creation of a functional decline or improvement curve that would help measure the expectation of medical improvement and thus assist in the setting of the diary. The optimal periodicity for collecting WD-FAB scores and updating individual medical diary designations should be evaluated in a data-driven fashion. Performing these updates yearly will likely lead to optimal results. Below is a description of how various types of data can be used to improve MIE/MIP/MINE rules and individual medical diary designations. Note, though, that any changes to medical diary designation rules identified using data analytics methods should be evaluated and confirmed by medical experts.

Medical Diary Designation Rules

1. *Medical listings, impairments, and historic CDR decisions*

The SSA medical listings (including compassionate allowances), impairments, and relevant beneficiary characteristics (such as age and education) could be used in conjunction with historical CDR decisions to create new MINE rules. Medical listings and compassionate allowances allow SSA to target the most obviously disabled individuals for allowances based on objective medical information that can be obtained quickly. Presumably, individuals who meet the medical listings are also some of the least

likely to improve because they have some of the most disabling impairments. Therefore, we propose using data analytics to identify combinations of characteristics of beneficiaries (met medical listings, impairments, etc.) that, according to death records and historical CDR decisions, indicate benefits are never or almost never ceased. A description of pattern recognition methodology that could be used to create new rules is provided in Appendix A. An issue of concern regarding this model is the availability of an accurately labeled dataset representative of the distribution of CDR cases. Theoretically, if all CDRs were performed accurately and on time, this dataset would be available. However, the limitations introduced by the delays in performing CDRs and the decision to revert to mailers more in some years than others need to be evaluated.

2. *Medical and functional information extracted from beneficiaries' electronic folder*

Medical information extracted from beneficiaries' electronic folders could be used to find additional MINE rules by expanding the set of individual characteristics or variables used in the method described above.

Medical evidence can also be used to find possible medical advances, and thus to eliminate old MINE rules or identify new MIE rules. Natural language processing methods can be used to extract relevant information from unstructured text. Such information includes a complete list of the beneficiary's impairments, symptoms, medications, procedures, and laboratory tests, as well as the frequency of different types of doctors' visits and procedures. While information extraction will never be 100 percent accurate, it can be very useful in identifying previously unknown associations. Information extracted from medical records can be used to estimate the distribution of disability benefits applications and determination decisions given specific case characteristics.

Changes in the distribution of recent applications for disability benefits can be used to identify medical advances and, potentially, to eliminate old MINE rules. Similarly, decreases in approval rates for cases with certain characteristics can also signal medical advances.

It may also be possible to identify changes in treatment by comparing the medical records of beneficiaries with similar impairments and case characteristics using natural language processing methods.

3. *Work Disability Functional Assessment Battery scores*

The acquisition of yearly WD-FAB scores would eventually lead to creation of a dataset that could be used to identify better medical diary designation rules. The timeliness and frequency of full medical CDRs and the lack of functional information during the period in between full medical reviews pose significant statistical challenges to using Residual Functional Capacity (RFC) forms or historical CDR decisions to mine for medical diary designation rules. Thus, a gold standard on individuals' medical improvement does not exist in the current SSA data. Administering the WD-FAB annually would provide the gold standard "labels" necessary to mine for medical diary rules or to create a medical diary predictive model without the high cost of conducting full medical reviews often and on all individuals. These scores would be similar in cost to the CDR mailer, but they would provide a far better picture of a person's functional abilities and changes in these abilities over time. Learning about these changes is necessary to more accurately predict medical improvement at the time of adjudication.

4. *Medical claims records*

Medicare, Medicaid, and other health insurance claims records offer structured data that could be used to identify medical advances. This data can be used to identify new medication, devices, and treatment options, and link these advances to changes in survival rate or changes in the number of applications for disability benefits.

Automatic Individual Diary Designations

Data analytics can be used to update medical diary designation rules and to create new rules. However, it is also necessary to understand which subgroups of current beneficiaries are affected by these changes. For example, when identifying medical advances, it is important to be able to identify which subgroups of SSA beneficiaries could benefit from these medical advances and to update the probability of their MINE/MIP/MIE designation. This can be done by comparing the medical records of beneficiaries to those of people who benefited from new medical advances. Other techniques include using a more comprehensive, web-based version of the mailer that includes the acquisition of WD-FAB scores and also asks questions pertinent to medical advances to those individuals to whom the medical advances might apply. It is important to note that environmental factors may make medical advances and assistive devices inaccessible to some claimants. All pertinent factors should be taken into account when determining continuing disability status. The automatic individual medical diary designation should only be used to determine the likelihood of medical improvement and the frequency of review.

The change in an individual's functional ability measures is the most relevant information related to the medical diary designation. If functional ability were measured over time, it would be possible to estimate a mapping between CDR cessation decisions and changes in functional ability. The yearly acquisition of WD-FAB scores could be used to estimate functional improvement or decline curves and to set the optimal functional thresholds for performing full medical CDRs. Medical advances, WD-FAB scores, mailer information, medical records uploaded online, and administrative health records from insurers can be used to update individual diary designations annually, with small additional costs.

An updated, improved, and possibly more detailed medical diary designation based on medical evidence collected between full medical reviews, at very low costs, would constitute a highly predictive input variable for the CDR predictive model.

Individualized diary dates

Diary dates indicate when cases become due for CDRs, and thus the frequency of CDRs. SSA intends to review cases every five to seven years, every three years, or every six to 18 months depending on the medical diary designation. These time periods are selected from a programmatic perspective and are not tightly linked to evidence related to medical improvement. If cases are reviewed too early, SSA incurs unnecessary administrative costs and beneficiaries have to go through the emotional hurdle of unnecessary full medical reviews. On the other hand, if cases are reviewed too late, SSA may make unnecessary payments to beneficiaries who no longer meet program eligibility requirements. Individualized diary dates could be set to find the optimal functional threshold to perform a full medical CDR, provided that periodic functional information such as WD-FAB scores was acquired. As individualized diary dates would be determined by a predictive model, this would also result in

more consistent and equitable treatment of claimants and beneficiaries by removing the examiner-level variation in setting of diary dates.

Checking adherence to prescribed treatment

One other area where data analytics could be used to identify individuals who may benefit from special interventions is in automatically checking for adherence to treatment. We propose using administrative data and electronic health records to track adherence to treatment and to identify beneficiaries who are not following their prescribed treatments. Early intervention and support given through an SSA program could help these beneficiaries to improve their health faster.

If beneficiaries are unwilling to follow prescribed treatment that may improve their functional abilities, these individuals should undergo a thorough full medical review. SSA needs to determine if the treatment is prescribed by the treating source, is expected to restore ability to work, and whether it is justifiable not to follow the treatment. If these conditions are not met, SSA policy dictates that these individuals' benefits should be ceased. Estimating if a treatment has the potential to improve functioning can be done by examining whether there are a significant number of SSA beneficiaries with similar case characteristics who followed the prescribed treatment and whose function improved.

In its May 2014 audit report, "Medical Improvement Review Standard During Continuing Disability Reviews," the OIG found that in 2012, the DDSs used MIRS exceptions in 9,517 cases of the 39,660 cases where benefits were ceased. Of those 9,517 cases where MIRS exceptions were used, the Group II exception "failure to follow prescribed treatment" was used in only 22 (SSA OIG 2014b). Further investigation is necessary to determine whether this exception is underutilized or whether there are very few instances of this exception actually occurring. If the exception is underutilized because of lack of relevant data or a lack of instructions on how to make such a determination, then a data analytics solution may be helpful.

Implementation

Data analytics can have a tremendous impact on the efficiency and consistency of the CDR pro- gram. However, the success of the analytics efforts described above depends on the acquisition and ease of access to functional and medical data of good quality. A set of major challenges is provided below.

Major Challenges

- Lack of structured medical and functional information
- Structured data lying in silos across the organization
- Difficulty accessing scanned medical evidence in bulk
- Dependence on legacy systems for data processing and management
- Lack of IT infrastructure for "big data" predictive analytics
- Lack of IT infrastructure dedicated to IT demonstration projects
- Difficulty identifying and engaging stakeholders and users early in the process
- Developing strong but flexible security policies and guidelines that allow the use of open source software and other technologies prevalent in industry

The implementation of data analytics to improve medical diary designations and dates and to check adherence to prescribed treatment should follow a phased approach, with more sources of data being

built in at every stage. To ensure the success and validity of these methods, they need to be implemented in an environment where their performance can be monitored and incremental updates and improvements can be made over time. A list of interim steps for deploying such applications is presented below.

Interim Steps

- Identify key stakeholders and put together a comprehensive list of assumptions, existing practices, goals, requirements, and measures of success
- Retrieve relevant historical data; start with existing data to achieve near-term results and build in new data through phased approach
- Implement method prototypes and test on simulation data, historical data, and possibly new data
- Perform cost-benefit analysis based on prototype and historical data
- Dedicate IT infrastructure environment for testing/demonstration of promising methods
- Implement method inside SSA IT infrastructure; try to automate data access
- Perform demonstration study (e.g. use the method for one DDS, one program, or in con- junction with current method, etc.); ensure validation sample is available and demonstration is performed in such a way that performance can be evaluated
- Perform cost-benefit analysis based on demonstration
- Document a detailed project plan for mitigating pilot into production
- Deploy application globally; ensure validation samples are available and deployment is per- formed in a way that facilitates performance evaluation
- Integrate model with other applications or models
- Train and engage users
- Refine, improve, and monitor the validity of models over time
- Quantify returns of investment

The success of the data analytics methods suggested is dependent on the willingness to make changes to the current workflow. Without a strong desire for change, the adoption of these methods will be deterred by inflexible workflows and the benefits will be marginal. Below, we identified some critical success factors.

Critical Success Factors

- Trust in and understanding of the methodologies and their applications from users
- Sufficient data
- Well-defined performance metrics
- Applying Agile project management methodology (Highsmith 2004) to allow for a sufficient level of interactions between users and developers
- Adoption by users
- Strong model life-cycle management
- Deployment platform that allows regular model validation and testing

While highly cost-effective, the current CDR predictive model results in an average cessation rate of only 6 percent (SSAB 2014). If the model had 100 percent accuracy, then only cases leading to benefit cessations would undergo full medical reviews. An accurate model would be advantageous to all. It would allow SSA to cut the costs of unnecessary reviews and it would save beneficiaries the stress of

undergoing a full medical CDR. Due to the lack of availability and access to medical and functional data, the current CDR predictive model uses very little medical evidence, even though this evidence is the most relevant when it comes to medical improvement. The current model uses only program data such as age, impairments, length of time in disability status, basis for the original determination, data on prior CDRs, and recent earnings as the variables for its estimations (SSA 2012). Thus, any of the steps described above are likely to increase the accuracy of the model significantly. This would result in substantial savings to SSA. As an exercise, let's assume that SSA performs 280,000 full medical reviews per year and that the rate of cessation is 6 percent. Let's assume that a full medical review costs $914, and a mailer costs $24. Let's also assume that the number of cessations remains the same (16,800), but that the predictive model gets better at identifying these cases. If the cessation rate for the CDR predictive model were 25 percent, 50 percent, or 75 percent, that would result in administrative savings of $190 million, $220 million, or $230 million, respectively. Below is a list of cost savings that would be generated from the use of data analytics to extract information from medical evidence.

Cost Savings

- Lower administrative costs through more accurate targeting of cases for full medical review
- Identification of insights that can lead to listings-type rules that reduce processing time and backlogs
- Enhancements to program integrity by improving the consistency of the CDR process.

DYNAMIC PRIORITIZATION QUEUE FOR OPTIMIZING THE PROCESSING OF NEW AND BACKLOGGED CDR CASES UNDER FUNDING CONSTRAINTS

The Problem

In recent years, SSA has cited resource limitations, a greater emphasis on processing initial claims, and requests for hearings appeals as challenges for conducting large numbers of CDRs despite the consistently favorable ratio of savings-to-costs generated by these reviews. According to OIG estimates, performing full medical reviews in a timely manner could save SSA billions of dollars per year (SSA OIG 2010). Without a mechanism to provide annual designated CDR funding, SSA is having difficulty performing full medical reviews when they become due. Given this reality, an optimal strategy for setting the order in which due and past due medical reviews are performed is necessary in order to maximize efficient use of resources. Furthermore, current SSA business processes are unable to reclassify cases in the backlog in light of new evidence before they are reviewed, other than through the yearly reclassifications of the CDR predictive model. As the predictive model does not incorporate medical records or functional information directly, this may result in wasted resources performing reviews that are no longer likely to result in cessations. Additionally, the desired frequency of CDR reviews (every six to 18 months, three years, or five to seven years) determined at the setting of the medical diary setting is chosen without the guidance of any scientific evidence to ensure consistent and accurate entry.

Recommendations

In order to efficiently make use of limited CDR funding, we recommend that SSA:

1. Prioritize CDR workload assignments according to their probability of cessation and expected lifetime savings
2. Update the priority queue yearly at the end of each fiscal cycle to support budgetary decisions on CDR funding levels
3. Reprioritize cases in the queue biannually or quarterly in light of any new data sources obtained, as described earlier in this paper

The SSA's Office of the Chief Actuary currently estimates the average cost-benefits of performing CDRs each year. These recommendations propose to take this office's work further by estimating individual, rather than aggregate, cost-benefits and then making use of these statistics to improve cost efficiency of the business process. The accumulated expertise and insight of the office of the Chief Actuary will be invaluable when developing the proposed individualized expected lifetime savings model.

Implementation

The proposed changes in the current CDR business processes pose significant organizational challenges. This proposal involves the use of a model for setting individualized diary dates, the creation of an automated CDR case queue, and the automation of the current CDR workload assignment process. Automating CDR case assignments would mean that cases at the front of the queue would be assigned to an adjudicator who could not open new CDR cases until the ones initially assigned are closed. While these steps are likely to result in organizational hurdles, we believe they are necessary for optimizing the use of resources and maximizing savings. Issues of fairness may be raised regarding the ordering of the queue according to expected lifetime savings if insufficient funding for CDRs is available to prevent a backlog in the queue forming from year to year. While we believe that a resource optimization strategy is justified, the queue could be ordered according to alternative measures, such as the likelihood of cessation.

Major Challenges

- Necessary changes in business processes could be challenging and time consuming
- Current IT infrastructure may not allow for implementation of a queue-based CDR case assignment strategy
- Ability of the queue to optimize CDR spending depends upon quality of CDR predictive model and estimate of lifetime savings

The expected lifetime savings for a case is the product of the likelihood of cessation and the lifetime savings generated by a cessation. The CDR predictive model will provide the expected likelihood of cessation initially. The lifetime savings generated by a cessation needs to be estimated, and will take into account the monthly payout, the cost of associated expenses such as Medicare, the likelihood of return to the rolls in the future, and time until retirement age. The queue will order cases by estimated lifetime savings. When a beneficiary's diary has matured, their case will be adjudicated at that time if the expected savings would place them at the front of the queue. Set up that way, the queue need only be determined once a year as it can include any backlogged cases as well as all those coming due that

fiscal year. The use of the queue would ensure that cases are always processed according to their current expected savings, thus resulting in the most efficient use of resources regardless of the amount of CDR funding available. Once implemented, these steps will result in a more efficient business process and greater program savings.

If an extended version of the CDR predictive model was developed that included functional or more detailed medical information, its predictions of the likelihood of cessation could replace those of the existing CDR model at that time. Once the extended model was developed and validated, its implementation in the queue would be straightforward. To minimize disruptions to business practices, it is recommended that the extended version not be used to determine queue size and order until the start of the following fiscal year. Similarly, once the model for individualized diary dates has been created and validated, its diary date determinations can be incorporated into the queue without changing how the queue itself is set up.

Interim Steps

- Estimate expected lifetime savings using existing CDR predictive model
- Create the queue using current diary dates and expected cost-benefits
- Develop models as described in the previous section to implement extensions of the CDR predictive model or individualized diary dates
- Use the updated CDR predictive model and/or individualized diary dates to improve the queue
- Perform cost-benefit analysis of changing business processes to include queue-based workload assignment
- If indicated, create the infrastructure necessary for the queue-based workload assignment, test, and deploy it using a phased approach and sound project management techniques.

Critical Success Factors

- Acquiring large quantities of functional data on claimants through WD-FAB or suitable medical records to inform an improved CDR predictive model
- Modernized IT system that allows for automatic workload assignments
- Willingness to rethink and optimize business processes, not just make the minimal changes necessary.

Through determination of queue size and expected cost-benefits of those in the queue, SSA and Congress would have a valuable tool in future discussions of the CDR budget. As the first cases in the queue would be the most cost-effective, if insufficient funding was available to prevent a backlog in a given year the queue would support the efficient allocation of funds. The queue would also aid in clarifying the short-term CDR funding versus long-term program solvency tradeoffs by enabling estimation of the cost of not performing CDRs on those cases that may be backlogged for a year in absence of funding for clearing the queue.

Cost Savings

- Computation time to update predictions and sort into the queue is not expensive or lengthy
- Optimizes money spent on CDRs in years when there is insufficient funding to complete all cases coming due

- No additional expenses in years SSA has funding to clear any CDR backlog and all cases coming due

SUMMARY

Our proposals for improving the medical continuing disability review process have been developed and presented in such a way that we hope emphasizes not only the need for greater system consensus, but also the importance of having a strong technology foundation in order to build up specific program initiatives. These recommendations are meant to work seamlessly and in support of each other. The Enterprise Data Environment would be the backbone of SSA's data and technology systems, allowing for the easy storage and retrieval of data as would be necessary for the optimal use of data acquisition and analytics proposed in our second and third recommendations. For the CDR program specifically, once SSA has a comprehensive and flexible IT infrastructure, it will be possible to collect, store, and analyze data that can then be used to build and update the predictive models that generate the queue for processing CDRs. The connections among the recommendations are underscored by the fact that often the major challenges and critical success factors of one solution are addressed by the ones that come before it. To see the specific connections, we can think through the proposals in reverse order of suggestion. The three recommendations made for establishing a queue for optimizing CDR case processing are all initiatives that can be started right away. These recommendations fit into the business practice as it exists now, but they would be more effective with additional changes, most notably with the addition of predictive analytics. The data analytics recommended above would provide more accurate probabilities of cessation, which would improve the ordering of the queue. But these data analytics also rely on access to the most relevant and up-to-date medical and functional evidence, which is best collected periodically and stored in data environments that allow for easy access for adjudicators and researchers alike. The following is a possible course of immediate next steps, which can be taken either sequentially or concurrently:

Immediate Next Steps

- Conduct study of current diary designation system and history to evaluate its accuracy
- Identify key stakeholders in each initiative and ensure the relevant participants are engaged throughout the process
- Update SSA regulations on medical CDR diary designations to allow for more flexible and individualized diary dates
- Use WD-FAB validation studies to determine optimal use of WD-FAB scores with SSA business practices, which may include CDR-specific uses such as collecting scores with the current mailer or more program-wide uses such as collecting scores at time of initial application
- Designate medical and policy experts to review MINE/MIP/MIE designation rules and compare them with other SSA medical listings to check for disparities
- Begin collection of historical data relevant for comparison in order to update MINE/MIP/MIE designation rules
- Introduce a case processing queue to the current CDR processing system that will be updated annually
- Work with the Office of the SSA Chief Actuary to collect accurate figures for shifting current CDR predictive model to order cases in the queue by expected lifetime savings
- Develop an automated system to deliver CDR cases to adjudicators that will only release the next case when the file is closed

- Investigate data-mining techniques for pulling from SSA's electronic folders system evidence that could be relevant to medical diary designations
- Assess the feasibility of expanding the existing online disability application system to allow electronic completion of SSA forms and the uploading of medical evidence
- Open dialogue with CMS about improved access, exchange, and use of data

In addition to improving the CDR process and handling the backlog, these strategies for improving information technology, data collection, and analytics are also critical to supporting other SSA programs and initiatives. Having a more comprehensive IT infrastructure with access to data that are then available for analytics will increase the overall efficiency of any type of case processing and will eliminate most need for repetition or rework. Most of the proposed methods or applications are flexible enough that they could be adapted to other areas. For example, the queue could be expanded to handle initial claims cases in addition to CDR cases. This might be an eventual application that would also address the issue of CDRs being overlooked in order to work more initial cases. Systems that centralize information to both ensure consistency and remove duplication are also key for fraud detection and prevention. In a special report from September 2014, the OIG pointed to both the disparity of the DDS systems and the lack of a comprehensive records profile and search system as significant vulnerabilities that leave the agency at a disadvantage for detecting or preventing fraudulent activity (SSA OIG 2014c). Both of these are issues that the recommendations provided in this paper will naturally address and correct.

CONCLUSION

In this paper, we proposed modernizing SSA IT infrastructure to better support business processes, automatically store data generated through these processes, and integrate analytics-optimized systems and insights into the agency's adjudication process. We believe that a large-scale approach to data storage and IT infrastructure designed to handle the magnitude and complexity of the agency's data is the most cost-effective long-term solution. This type of approach can dramatically increase the efficiency, consistency, and timeliness of the SSA adjudication process in general, and the CDR process in particular. We proposed specific data analytics projects that could improve parts of the CDR process and result in considerable savings to the agency while being advantageous for its disability beneficiaries. Some details and implementation challenges of these proposals remain to be worked out. However, we believe that this paper serves as a good starting point for an open discussion about SSA's IT modernization efforts and how the agency might benefit from large-scale big-data analytics projects.

Pattern Recognition Methodology for Identifying New MINE Rules

Assume we have a labeled dataset, where the data points correspond to an individual's characteristics (met a specific medical listing, impairments, age, education, etc.), and an associated label, seven-year-cessation, which is a binary variable that is true if the beneficiary had his or her benefits ceased within seven years of the previous decision, and false if the beneficiary either died within seven years of the previous decision or had a CDR and their benefits were not ceased. We are using the seven-year mark because MINE cases are supposed to be reviewed every seven years. However, if the historical data show that these cases are generally reviewed less often, this threshold can be adjusted. Given this labeled dataset, an ensemble of decision trees can be used to identify case characteristics associated with a low probability of seven-year-cessation. A decision tree is a predictive model that maps observations about an item to conclusions about that item's label. In a decision tree, leaves represent

class labels and branches represent conjunctions of features that lead to those class labels. The goal is to predict the label based on several input variables. A tree can be learned by iteratively splitting the data into subsets based on variable value tests. This process is repeated on each derived subset in a recursive manner, until the subset at a node has all the same value of the target variable or splitting any further no longer adds value to the prediction. The splitting variable at each step is usually selected as the variable that best reduces the "impurity" of the labels in the resulting subsets. In a decision tree, all paths from the root node to a leaf node proceed by way of conjunctions. If the leaf contains data with a very low probability of seven-year-cessation, then these conjunctions can be used to form a MINE rule. In order to maximize the chance of identifying MINE rules, we can search over a set of decision trees by using a randomized procedure to select splitting variables at each node.

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