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A 'Sludge Audit' for Health System Colorectal Cancer Screening Services

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Abstract

Objectives—'Sludge' (frictions or administrative burdens that make it difficult for people to attain what they want or need) is an unexplored healthcare delivery factor that may contribute to deficiencies in colorectal cancer (CRC) screening. We aimed to identify and quantify sludge in a southeastern U.S. health system's delivery of CRC screening services.

Study Design—Mixed methods 'sludge audit'.

Methods—We collected and analyzed quantitative (insurance claims, electronic health record, and administrative files) and qualitative (stakeholder interviews and process observations) data associated with CRC screening for instances of sludge. Since it contributes to sludge and reduces system capacity for high-value screening, we also evaluated low-value care (no net clinical benefit) in the CRC screening process.

Results—This health system had a 60.4% overall screening rate. Approximately half of screening orders were completed. The following categories of sludge were identified: communication, time, technology, administrative tasks, paperwork, and low-value care. For

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example, the average wait time for screening colonoscopy was 221 days; duplicate orders were common; and some test results were not viewable in the electronic health record. Of completed screenings, 32% were low-value and 38% were associated with low-value pre-operative testing. There was evidence of a differential negative impact of sludge on vulnerable patients.

Conclusions—This systematic sludge audit revealed numerous instances of sludge in a health system's CRC screening processes. As sludge may decrease access to and capacity for high-value CRC screening, further research is needed to expand our sludge audit method and assess the varied costs and consequences of sludge.

Precis:

A systematic, mixed methods 'sludge audit' identified excessive and unjust frictions and administrative burdens in the health system delivery of colorectal cancer screening services.

Keywords

sludge; screening; behavioral economics; burden; cognitive scarcity

INTRODUCTION

Screening for colorectal cancer (CRC) is broadly recognized as effective in reducing disease-related mortality.[1] The U.S. Preventive Services Task Force (USPSTF), American Cancer Society (ACS), and U.S. Multi-Society Task Force on Colorectal Cancer recommend regular screening for average-risk individuals 45 to 75 years of age (Table 1).[2–4] Even so, approximately one in three Americans fails to receive up-to-date screening, and substantial disparities in screening exist.[1] For example, only 55% of people with low income and less than half of people living in rural areas in the U.S. received on-time screening in 2019.[5,6] To date, efforts to improve the implementation of CRC screening have largely focused on enhancing patient demand for screening or promoting clinician referrals for screening.[7–9] Factors within the health system itself (e.g., governance and regulatory structure, policies and procedures, technological infrastructure, resource allocation, communication, quality control processes, setting, culture) are infrequent intervention targets despite evidence of their role in decreasing healthcare organization capacity for and patient access to CRC screening.[10,11]

Many health system barriers to CRC screening can be described as 'sludge'. Sludge is a behavioral economics concept that describes frictions or administrative burdens that make it difficult for people to attain what they want or need.[12] Unnecessary or repetitive paperwork, complicated administrative processes, and long wait times are common sources of sludge. The relevant frictions and burdens might well be excessive and unjust; they might be understood as "time taxes." Within healthcare organizations, there is evidence that clinicians themselves must deal with sludge when referring patients to CRC screening and that patients face significant levels of sludge throughout the screening experience. Cumbersome electronic health record (EHR) navigation, gaps in referral procedures, complicated instruction materials, and long wait times for screening are some examples.[11,13–15] Low-value CRC screening (inconsistent with evidence-based recommendations, resulting in no

net benefit or possibly harm)[16] (Table 1) can also be described as sludge since it decreases capacity and resources available for high value screening.

Sludge audits, understood as systematic steps to identify and quantify existing levels of sludge, have proven instrumental to increasing access to important services and opportunities in non-healthcare settings.[17,18] For instance, auditing sludge in the process of enrolling children in the National School Lunch Program informed the transition to modified enrollment procedures ("direct certification"), which has contributed to millions of children obtaining access to subsidized school meals.[12] Large impacts from sludge audits and sludge reduction have been described in the college application process, occupational licensing, and enrollment in public insurance programs.[17–19] The Department of Homeland Security has followed a sludge audit, which it has made public, with a specific directive, which is to reduce 20 million hours in annual paperwork burdens.[20] We are not aware of published examples of sludge audits in the healthcare setting, but we hypothesize that the identification and quantification of sludge in the delivery of clinical preventive services will facilitate targeted process improvement and increased access to and capacity for preventive services delivery. For that reason, we aimed to identify and quantify sludge within a large health system's CRC screening delivery process through the administration of a proof-of-concept sludge audit.

METHODS

This mixed methods sludge audit took place within a southeastern U.S. health system in 2021. This health system includes 47 primary care practices, performs colonoscopy procedures in six hospitals and one office-based endoscopy suite, and contracts with a large national laboratory services provider. The audit involved the collection of quantitative and qualitative data focused on standard CRC screening metrics and sludge (paperwork, technology, communication, administrative tasks, time, and low-value care in the CRC screening process). For the purpose of this study, the CRC screening process was defined as the events and time spanning from the opportunity for referral to screening (e.g., primary care visit) and ending with the receipt of screening results by clinicians and patients. The Carilion Institutional Review Board determined that this project is a quality improvement initiative that does not meet the definition of human subjects' research as outlined in 45 CFR 46.102(d) and therefore, does not require IRB oversight or approval.

Colorectal Cancer Screening Metrics

We used EHR and internal administrative data obtained in spring 2022 to assess several CRC screening metrics. The overall screening rate was calculated using National Quality Forum (NQF) [(# of patients 51 to 75 years of age during the measurement year who had one or more screenings for CRC) / (# of patients 51 to 75 years of age during the measurement year)] and HEDIS [(# of patients 51 to 75 years of age during the measurement year who had one or more screenings for CRC) / (# of patients 51 to 75 years of age during the measurement year who had at least one medical visit during the measurement year)] approaches.[21] We compared screening rate to the target of 80% of eligible individuals established by the National Colorectal Cancer Roundtable.[22]

We also compared the number of CRC screening tests ordered with the number completed within 12 months for four modalities: colonoscopy, CT colonography, flexible sigmoidoscopy, and stool-based tests [i.e., fecal immunochemical test (FIT), guaiac-based fecal occult blood test (gFOBT), and multitargeted stool DNA]. To assess potentially missed opportunities for screening, we documented the number of patients who had a primary care visit in the previous year but were not up to date on CRC screening, the number of screening referrals that were not complete within 12 months, and the volume of positive stool-based tests that were not followed up by colonoscopy within 12 months, as is recommended by the US Multi-Society Task Force.[23]

Sludge

To identify and quantify sludge (frictions or administrative burdens imposed on clinicians or patients), we analyzed EHR data, internal administrative records, and research assistant observational field notes for the following categories, as informed by previous sludge audits in the non-healthcare sector:[12,17,18]

1. **Time**- average wait time between colonoscopy referral and scheduling during the past 12 months; average wait time between colonoscopy referral and procedure during the past 12 months
2. **Paperwork**- number of insurance pre-authorization forms completed for CRC screening in the previous 12 months
3. **Communication**- average number of patient interactions with health system throughout the screening process; number of patients in the CRC screening queue who have received >3 missed calls for colonoscopy scheduling.
4. **Technology**- number of mouse clicks required to order CRC screening in the EHR
5. **Other Administrative Tasks**- number of duplicate referrals for screening colonoscopy received in the past 12 months; “no-show” rate for colonoscopy during the previous 12 months
6. **Low-Value Care**- number of low-value CRC screenings, classification of low-value CRC screenings, number of low-value peri-procedural testing associated with CRC screening. For the low-value care analyses, we extracted insurance claims associated with CRC screening and peri-procedural testing prior to CRC screening using the Virginia All-Payer Claims Database (APCD), which collects medical and pharmaceutical claims for more than 7 million Virginians insured by traditional Medicare, Medicare Advantage, Medicaid, dual (Medicare-Medicaid), and commercial payers. The Milliman Medinsight Health Waste Calculator, proprietary algorithm-driven software, was used to classify APCD claims as *guideline concordant* or *low-value* as described in previous research.[24–26] Briefly, CRC screening was classified as *low-value* if it took place in average-risk patients <45 or >85 years of age, or more frequently than once in 10 years (colonoscopy), 5 years (CT colonography or flexible sigmoidoscopy), 3 years (FIT-DNA), or 1 year (FIT/gFOBT) (Table 1). Patients who were

symptomatic, had a history of gastrointestinal cancer, polyps, or other indications for more frequent screening were excluded by the Health Waste Calculator. Peri-procedural testing (laboratory, EKG, chest x-ray) associated with CRC screening was classified as low-value if the patient met criteria for minimal risk (American Society for Anesthesiologists category ASA 1 or 2).

We also invited 12 key stakeholders [a convenience sample of clinicians (n=4), staff members (n=3), and administrators (n=5) involved in the health system's CRC screening process] to participate in 30-minute semi-structured interviews focused on strengths and weakness of the health system's CRC screening process. From interview transcripts, two research team members coded examples of the five categories of sludge highlighted above, in addition to other emerging themes. Coding agreement between the two researchers was approximately 88% on first pass. Differences were resolved via discussion with a third team member.

Data were integrated for analysis and interpretation by the research team and compiled into a sludge audit summary report.

RESULTS

The sludge audit summary is shown in Figure 1. This health system's CRC screening rate was 60% (per NCQA methodology) with 85% of screenings conducted via colonoscopy. The screening rate was 64% for Medicare, 59% for commercial, and 42% for Medicaid patients. A total of 1814 (32%) CRC screening tests were classified as low-value, with the most common reason being that the patient was not yet due for screening. Of screening tests ordered for EHR-denoted Black or African American patients, 39% were low-value vs. ≤32% for all other races.

Our audit revealed multilevel sludge in the CRC screening process (Figure 1). In the stakeholder interviews, *time* and *communication* were the most frequently described categories of sludge (38 and 32 mentions, respectively), followed by *technology* (24), *other administrative tasks* (16), and *paperwork* (13). The average wait time between colonoscopy referral and procedure exceeded 6 months (*time*), but some patients did not receive the procedure after 12 months (*time*). Others were asked to attend multiple visits prior to a screening colonoscopy (*other administrative tasks*), sometimes making long commutes to do so (*time*). The average wait time between colonoscopy referral and scheduling exceeded 6 weeks (*time*) and during this period, numerous patients received multiple missed calls for scheduling (*communication*) and some were asked to complete duplicative forms (*paperwork*). The process of ordering a screening colonoscopy required clinicians to make an average of 17 mouse clicks in the EHR (*technology*). Sludge related to clinicians' receipt of screening results was consistently described (e.g., inability to access results of screenings conducted outside of the health system, stool-based test results not viewable in the EHR, etc.) (*technology*).

One stakeholder summarized the sludge experienced by some patients in the CRC screening process:

> *"It seems like patients are being asked to do way too much. First, they wait several weeks to hear from us, then we want them to come for a separate pre-op visit, and then we want them to come pick-up their* [colonoscopy] *prep, and then finally have the procedure itself, which by the way, isn't very pleasant. And this doesn't include all the phone calls and messages involved in setting all this up. I really think about our patients who live a couple of hours away. It's not a surprise that they drop out of the process or do it once but never again."* -Staff member

Another described sludge-related to insurance coverage and some of its impacts:

> *"I am aware that the Affordable Care Act made certain screenings available at no charge to patients, which sounds good and right. However, the reality of operationalizing that isn't as pretty at all. I can't tell you how many patients we get complaints from when they were charged for a [stool-based test] that their insurance doesn't cover or a colonoscopy after positive [stool-based test]. One physician told me that patients complain about this weekly."* -Staff member

Two additional themes emerged in the stakeholder interviews. The first was concern about disparate impacts of sludge in the CRC screening process.

> *"There are many confusing steps and I am concerned about how people who have limited knowledge of healthcare or have a lot of other barriers to care, how our process is another one of those barriers. So, I worry about how it creates disparities, actually."* -Administrator

The second was the association of the CRC screening process with negative emotional effects, including frustration, stress, and burnout among healthcare team members. Several stakeholders described enhanced responsibilities and stress associated with the COVID-19 pandemic and lower tolerance for "*burdensome processes*" such as those incurred in CRC screening. The increased volume of patients in the CRC screening queue as a result of pandemic has "*made the problem feel insurmountable to providers and they just stop dealing with it.*" -Administrator

DISCUSSION

Colorectal cancer screening rates remain well below the national target of 80% and demographic disparities are prevalent.[1,22] We performed a proof-of-concept sludge audit of the CRC screening process of a large regional health system with a 60% screening rate. The audit revealed substantial, multilevel sludge in the form of communication, time, technology, administrative processes, paperwork and low-value care. As this sludge was associated with decreased health system capacity for screening, decreased patient access to screening, and disparities in screening, we conceptualize sludge as a novel target for interventions to improve the rate and equity of CRC screening.

Interventions to improve CRC screening rates commonly aim to enhance patient demand for or clinician referrals for screening.[7–9,27,28] Our findings suggest that health system sludge stands in the way of CRC screening, even for highly motivated patients and clinicians. We posit that, when faced with sludge in the CRC screening delivery process,

patients and clinicians are deterred (consciously or not) from initiating or completing screening. Furthermore, increasing demand for screening without addressing existing sludge is likely to further exacerbate capacity challenges faced by many health systems. Care disruptions associated with the COVID-19 pandemic, a national shortage of endoscopists and anesthesiologists, and a reduction in the recommended minimum screening age from 50 to 45 years (introducing up to 20 million more Americans into the screening process) have played a role in screening colonoscopy backlogs and delays reported throughout the U.S.[22,29–34] Although increased utilization of stool-based tests over colonoscopy is an important and broadly recommended strategy for improving access to and capacity for CRC screening, our audit identified sludge in the stool-based test process as well (e.g., complicated or conflicting instructions, results inaccessible in EHR/patient portal, inconsistent insurance coverage, separate phone calls/messages, etc.). Importantly, health system sludge is not necessarily a reflection of the quality of care provided by a particular healthcare organization or system. Rather, it is likely a result of numerous evolving factors – environment, policy, reimbursement, staffing, and demand changes, to name just a few.

In addition to delayed or deferred screenings, navigating sludge may have other consequences. Sludge can not only impose “time taxes”; it might also be associated with frustration, embarrassment, and shame.[12,35] It may increase clinician workload and burnout, and influence decision-making.[36,37] It may more broadly decrease trust patients have in the health care system. Sludge may exacerbate existing disparities in CRC screening. In our health system audit, stakeholders perceived disparate impacts of sludge in the CRC screening process to some members of the population, such as those with poor health literacy or those living in rural areas. Others have previously highlighted the potentially disproportionate costs of sludge to certain groups and individuals, due at least in part to the concept of cognitive scarcity, understood as limited bandwidth to manage various burdens, including administrative burdens.[17,38] Those who have financial challenges, impaired health status, poor trust in healthcare, or other obstacles to screening may lack the time, bandwidth, or means to persevere through sludge-laden systems. Although we are unable to assess the causative impact of sludge on adverse outcomes in the current study, we did observe evidence of poorer quality screening among Black/African American, low-income (insured by Medicaid), and rural-residing patients. Stakeholders also highlighted the impact of a burdensome screening process on clinicians’ stress level and sense of well-being. Reducing sludge in the CRC screening delivery process has the potential to narrow the known equity gaps in CRC screening through simplifying the process for patients and healthcare team members alike.

President Biden’s Cancer Moonshot Initiative 2.0 (2022) aims to reduce the cancer death rate by at least 50% over the next 25 years with an enhanced focus on reducing the burden of cancer screening and diagnosis.[39] Our sludge audit uncovered numerous actionable targets for future efforts to increase CRC screening rates through minimizing associated burden. A variety of approaches to the reduction of sludge have been described by others and may serve as valuable templates. For example, in his work with the White House Office of Information and Regulatory Affairs (OIRA), Sunstein promoted the identification of paperwork burdens, followed by evaluation of necessity, setting goals for reduction, and public reporting on progress.[12] Soman et al.[18] designed a dashboard and series of checklists

to reduce sludge. Others have designed creative ‘nudges’ to counter the sludge in an environment. [28,40–42] Building upon common healthcare quality improvement approaches (Plan-Do-Study-Act cycles,[43] Lean Performance Improvement, Six Sigma[44]) may also be effective. For instance, a sludge audit would be an invaluable starting point to a PDSA process. Finally, an increasing number of theories, frameworks, and approaches to the de-implementation of low-value healthcare services have been evaluated and may be applicable.[45–47]

This study had several limitations. First, it took place within a single health system. Sludge audits implemented within other systems may encounter different categories and quantities of sludge. Second, data obtained from the EHR were limited to that which was available within the system. For example, if a patient received a CRC screening test at a different health system, that may not have been reflected in our health system’s EHR. Limitations to any use of insurance claims analysis of low-value care also exist since clinical nuance is not captured. However, claims data is commonly considered reliable for analysis of low-value care trends in large population sizes. Finally, although our stakeholder interviews provided great insight about sludge in the CRC screening process, we did not represent the important voice of patients themselves.

Much more research is needed to describe and quantify sludge in other health systems’ screening processes, incorporate perspectives of patient stakeholders, and characterize the association between sludge and adverse outcomes (e.g., delayed or deferred screenings, mistrust, disparities). Additionally, improving understanding of how much sludge is too much would benefit interventions to de-implement sludge. Some metrics are well-established, such as the 80% screening rate target established by the National Colorectal Cancer Roundtable.[22] We can easily assess that our 60% screening rate and the national 65% screening rate are well beneath the 80% target.[1] However, targets for other sludge audit components are less clear. For example, the >7 month wait for screening colonoscopy felt too long to the stakeholders we interviewed, but recommendations for an appropriate timeframe are lacking. Likewise, the observation that nearly one-third of completed screenings were classified as low-value (non-concordant with guidelines) was surprising to the stakeholders we interviewed and was higher than some previous studies, but a specific target recommendation is not available. Sludge audits create opportunities for health systems to establish internal performance improvement goals and metrics for evaluation of improvement.

CONCLUSIONS

Our health system sludge audit uncovered multiple opportunities to improve deficiencies in CRC screening service delivery. This audit revealed sludge in the categories of communication, paperwork, technology, administrative tasks, time, and low-value care; suggested disparate impacts of sludge to vulnerable populations; and highlighted frustrations of CRC screening process sludge to healthcare team members. Next steps include further characterizing the consequences of sludge in the delivery of CRC screening services and expanding sludge audits to include additional stakeholders (i.e., patients), varied health systems, and other healthcare services.

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Take-Away Points:

‘Sludge’ is a behavioral economics term that describes frictions or administrative burdens that make it difficult for people to attain what they want or need. Those frictions or burdens are frequently excessive and unjust. Our mixed methods sludge audit identified multiple categories of sludge in a health system’s delivery of colorectal cancer (CRC) screening services: communication, time, technology, administrative tasks, paperwork, and low-value care.

Findings of the audit suggest that:

- Sludge is an organization-level barrier to achieving target CRC screening rates.
- The differential impact of sludge may perpetuate CRC screening inequities.
- Sludge audits may inform interventions to improve healthcare delivery.

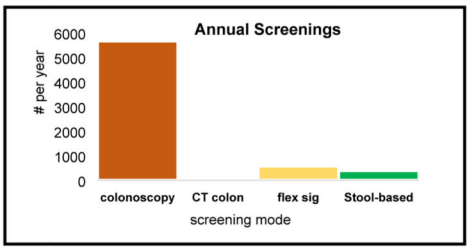
SLUDGE AUDIT SUMMARY

Key Findings from a One-Year Health System Colorectal Cancer Screening Sludge Audit

SCREENING SNAPSHOT

Overall screening rate	**60.4%** (NQF)/ **51.3%** (HEDIS)
Screenings completed	**6679 (50% completion rate)**

Potentially missed opportunities	
Screenings ordered, but not completed within one year	**6738**
Patients who had PCP visits & are not up to date on CRC screening	**64,520**
(+) Stool tests not followed up by colonoscopy within one year	**206 (52%)**



SLUDGE- excessive or unjust administrative tasks incurred by patients and healthcare team members during CRC screening processes

Type of sludge	Examples from quantitative data	Examples from qualitative data
time	Wait time for colonoscopy scheduling: **48 days** Wait time between referral and colonoscopy: **221 days**	Primary care staff receipt of messages regarding wait time or prep/stool-based test instructions; billing staff spending hours "on hold" with insurance companies; patients' lengthy repeated commutes for one screening test
paperwork	Number of insurance pre-authorization forms: **3900**	Repetitive intake forms; duplicate/triplicate in-procedure notes; miscoding/recoding *"Depending on the patient, they may have to fill out essentially the same intake form 3 different times."* -Staff
communication	Number of touch points with patients throughout screening process: **7** Patients in colonoscopy scheduling queue who have received >3 missed scheduling phone calls: **787**	Referrals back to ordering clinicians for order clarification; conflicting FIT instruction sheets; excessive fax-only forms; patients unable to recall test results (anesthesia or other causes); high call volume from patients wishing to reschedule colonoscopy; high call volume from patients confused about charge for adenoma removal during screening colonoscopy
technology	Electronic medical record "clicks" required to order screening: **14 to 30**	Instructions/results not viewable via patient portal; barriers to accessing data for tracking screening rates, processes, and outcomes; lack of interoperability between EMRs; inability to access screening results
other administrative tasks	Duplicate orders/referrals: **1950** Colonoscopy no-show rate: **27%** Patients charged out-of-pocket $ for screening: **1202 (18%)**	Separate pre-procedure process required prior to colonoscopy; FIT tests lost in mail, with results never received; inconsistent insurance requirements and procedures
low-value care	Screenings that were not guideline-concordant: **1814 (32%)** *-duplicate test performed:* **490 (27%)** *-patient not due for screening:* **889 (49%)** *-patient >85 years:* **363 (20%)** *-patient <50 years:* **73 (4%)** Low-value pre-op tests prior to screening colonoscopy: **2537 (38%)**	Receipt of screening referrals from multiple specialties; low-risk patients undergoing blood tests, EKG, and an extra pre-operative process prior to colonoscopy; early follow-up for diagnostic surveillance colonoscopy *"There's no chance that we are screening people who don't need to be screened. As hard as it is to get patients to do it, I can't imagine any of our docs sending someone who doesn't need it."* -Administrator *"We have a bunch of systems in place to prevent unnecessary screenings."* -Physician

POPULATION VARIATION/ DISPARITIES DATA

- Screening rate in Medicaid patients = **42%** (vs. **59%** in commercial, **64%** in Medicare, and **60%** overall)
- Higher rate of low-value screenings in Black/African American patients (39% vs. 32% overall)
- Lower rate of stool-based test uptake in primary care clinics (<**1%** vs. **6%** overall)
- Sludge in the screening process was related to disparities in care:

  "There are many confusing steps and I am concerned about how people who have limited knowledge of healthcare or have a lot of other barriers to care, how our process is another one of those barriers. So, I worry about how it creates disparities, actually." -Administrator

Figure 1.
Sludge Audit Summary

Table 1.

High and Low-Value Colorectal Cancer Screening Definition and Details

Appropriateness Classification	Definition	Details
High-value	Consistent with professional guidelines; associated with net clinical benefit	In average-risk patients ages 45 to 75, one of the following: Colonoscopy (every 10 years) *OR* CT colonography or flexible sigmoidoscopy (every 5 years) *OR* Stool-based test (every 1 to 3 years)
Low-value	Inconsistent with professional guidelines; associated with no clinical benefit, waste, and harm	Screening in patients <45 years or older than 85 years OR More frequently than: Colonoscopy (every 10 years) *OR* CT colonography or flexible sigmoidoscopy (every 5 years) *OR* Stool-based test (every 1 to 3 years)