PROGRESS REPORT

Title: Development of an EMR-integrated Enhanced After-Visit Summary

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1. Abstract

Purpose: The purpose of this study was to maximize the utility of the outpatient after visit summary (AVS) by developing and testing a patient-centered AVS to make it easy to understand and use for self-management, even by patients with limited health literacy, English proficiency, or cognition.

Scope: An optimized AVS can better inform patients and facilitate understanding of their health and healthcare.

Methods: The project was completed in two phases. In phase I, we obtained feedback from health IT leaders to identify potential barriers, interviewed patients and clinicians to determine their preferences for a patient-centered AVS, and developed a redesigned, patient-centered AVS prototype. In phase II, we tested the AVS on patients and providers in pre-treatment and treatment periods.

Results: In Phase I, several domains of patient preferences were identified. A key finding was identification of two groups of AVS users, those who value the document as a summary of the visit, and those who value it as summary of the health and healthcare in general. This observation has important implications for AVS design. A common experience from health IT leaders was that making changes to the AVS was typically limited by restrictions of the EHR software, and many believed the investment was not worthwhile because EHR upgrades often rendered those changes inoperable. Based on qualitative data, we developed a prototype patient-centered AVS in the Epic EHR at Mount Sinai Hospital. Because of restrictions with the software, the version implemented in the EHR lacked many of the patient-centered features we had sought to build. In Phase II trial of the new AVS, we found that the new AVS increased patients' perceptions of the AVS as a tool for reminding them about taking their medications, and that it was associated with greater likelihood of receiving an AVS from the clinician. However, it did not improve patients' views on the understandability of the AVS, the length of the document, its value for reminding about upcoming appointments, and other measures.

Conclusions: We have identified several features of the AVS that can be improved to make the document more patient-centered. However, EHR end-users are limited in their ability to make modifications to the AVS, so any improvements in patient-centeredness remain the responsibility of the vendors.

Key words: After Visit Summary (AVS), Electronic Health Record (EHR), health literacy, patient communication

2. Purpose

The purpose of the study was to improve the outpatient after visit summary (AVS) as a communication tool for clinical practice by 1) identifying the content, formatting, and features of the AVS that are most important to patients, caregivers and healthcare providers, 2) developing a prototype AVS based on these findings, 3) testing the impact of the prototype on patients' experience with care and understanding of their healthcare self-management tasks.

3. Scope

Background. Patient-centered care improves quality and outcomes for patients, and government and non-governmental agencies like the National Committee for Quality Assurance (NCQA) aggressively promote it. Central to this approach is the provision of personal health information with an emphasis on enhanced patient-provider communication. But communication between patients and providers is often poor, impeding improvements in patient self-management behaviors and health outcomes.

Health systems often look to information technology to help close the communication divide between patients and physicians. The electronic health record (EHR) provides outlets for clinician-patient information sharing, like secure messaging and Personal Health Records (PHR), but these strategies have limitations, especially for the aged, low income, and minorities, who are less likely to use EHR portals and other e-health technologies and are more likely than others to have low levels of health literacy. A promising alternative mode of communication with these and other populations is the AVS, a paper document given to patients after a medical appointment. The AVS, also known as a 'clinical summary', is intended to inform patients about their health, the services they received, and what they need to do to take care of their health. If properly designed and used as an educational tool, the AVS can facilitate patients' understanding of their health and health care, reduce problems patients face in remembering what to do and, according to the Social Cognitive-Self-Efficacy theory, highlight and encourage adherence to disease prevention and self-management tasks.

The capacity to create an AVS has become nearly universal in practices in the U.S. because of widespread EHR adoption, resulting from incentives to promote the meaningful use of the latter. Meaningful Use requirements mandated provision of an AVS and specified 20 elements that had to be included. However, patients frequently do not reference, use, or even retain their AVS, suggesting currently designed AVSs are not meeting their needs. As of 2016, Meaningful

Use no longer dictates AVS requirements, so health care systems are free to re-design their AVS to optimize its usefulness for their patients. Given the potential of the AVS to enhance self-management and the limitations of AVS currently available to patients, our objective was to create an AVS that met criteria for patient-centeredness and improved patients' experience with care and understanding of their own health and healthcare. To do so, we sought patients' perspectives on AVS content and design and insights from health IT leaders on AVS redesign and EHR integration. We then used this information to redesign and implement a patient-centered AVS in the Epic EHR system and test its impact on patients' experience with care and understanding of their own health and healthcare.

4.   Methods

The project consisted of two phases. Phase I focused on foundational research to establish preferred AVS context and formatting, identify barriers and facilitators of AVS optimization and implementation from health care providers with previous experience in this area, and create a prototype "optimized" AVS. In Phase II, we tested the impact of the optimized AVS on outcomes as described below. All procedures for Phase I were approved by the institutional review boards of the Icahn School of Medicine at Mount Sinai and Feinberg School of Medicine at Northwestern University. Phase II procedures were approved by the institutional review boards of the Icahn School of Medicine at Mount Sinai and the Montefiore Medical Center.

4A.   Phase I Methods
4A.1   Patient and Physician Focus Groups

Subjects: English and Spanish speaking adults ages ≥18 years attending primary care practices; physicians and nurse practitioners in those practices.

Settings: Hospital and community-based primary care practices in New York City, Long Island, NY, and Chicago, IL. The New York City sites included two internal medicine clinics and one faculty practice of a large, academic tertiary medical center, and a federally qualified health center in upper Manhattan. These sites serve inner-city, predominantly Latino and African-American and low income patients, but higher income and Caucasian populations as well. In Nassau County, NY, we recruited patients in a large adult group practice whose were mostly privately and Medicare insured. Finally, we conducted two patient and one clinician focus groups at a large academic medical center in Chicago, IL. Physicians were interviewed at all sites as well. One site had the Cerner EHR and all other practices used the Epic EHR. One site had recently transitioned to Epic from eClinicalWorks.

Data collection methods: We conducted 45-60 minute focus groups with patients or physicians. We also conducted individual patient semi-structured interviews (10-20 minutes) immediately following physician visits. Interviewers used interview or focus group guides, audio-recorded all discussions, and took notes. Interviews continued until thematic saturation was achieved. Audio recordings were transcribed. Three members of the study team independently reviewed and coded each transcript. Transcripts were analyzed with NVivo software version 10 (QSR International, Burlington, MA).

Measures: Qualitative data on patients' and physicians' views about AVS use and applications, content, order of information, and formatting.

Limitations: The majority of patients and clinicians interviewed received or delivered care in settings that use the Epic EHR. Perspectives on the AVS and thoughts about content and formatting might differ among those at institutions using different EHR platforms. Nonetheless, the earlier Meaningful Use regulations about AVS content pertained to all EHRs. Moreover, in our evaluation, we did not orient patients to a specific AVS. Although we interviewed patients from varied clinical environments, socioeconomic backgrounds, and in multiple cities and achieved thematic saturation, we may not have captured the full range of perspectives regarding the AVS from patient and physician stakeholders.

4A.2   Health IT Leader Qualitative Interviews

Subjects: Health IT leaders.

Settings: Health systems and federally qualified health centers throughout the U.S.

Data collection methods: We identified health IT leaders through an announcement on the American Medical Informatics Association Epic Users' listserv and by snowball sampling, and purposively contacted potential participants, by email, to achieve geographic and practice setting variation. We conducted semi-structured interviews to document their experiences

with AVS improvement and implementation. One investigator (AF) conducted all interviews (20-30 minute duration) using an interview guide. Data collection continued until thematic saturation was achieved.

Measures: Qualitative data changes made to their AVS and facilitators and barriers to implementation.

Limitations: Data collection was conducted with a small number of health IT leaders (n=12); a larger number of interviews might have revealed additional insights into AVS development and implementation. The majority of health IT leaders we interviewed were from institutions using the Epic EHR system. While those we interviewed who worked with other EHR platforms had similar experiences as the Epic users, their numbers were small; discussions with additional non-Epic users might reveal other insights.

4A.3   Optimal AVS development and pretesting

Subjects: English and Spanish speaking adults ages ≥18 years attending primary care practices; physicians and nurse practitioners in those practices.

Settings: The hospital-based primary care practice of the Mount Sinai Hospital, which serves approximately 15,000 adult patients who reside predominantly in low-income communities of upper Manhattan and the South Bronx.

Data collection methods: Qualitative interviews. Investigators used a think-aloud procedure to identify patients' perceptions of the AVS documents they reviewed and their understanding of the content. At the end of the interview, patients were asked to select their preferred AVS from a choice of 3 prototypes. We continued this process with iterative refinement of the AVS prototypes. The AVS was considered optimized when a single mock-up was preferred by a majority of patients interviewed.

Measures: Qualitative data on opinions of the AVS prototypes, with focus on (1) preferred content, (2) order of content, (3) location of page breaks, (4) format of the medication list, (5) header styles and titles, and (6) other formatting features. Patients' responses were noted.

Limitations: While we found patient consensus on design features of the AVS, they were not universally preferred. Additionally, we worked with a small number of patients to review and refine prototypes. Larger numbers and greater diversity of patients might have resulted in multiple prototypes. Ultimately, the best AVS may be one that is customized to the individual patient's preferences, but the technology to provide customization at this level is not currently available.

4B.   Phase II Methods

Subjects: English and Spanish speaking adults ages ≥18 years attending primary care practices; physicians and nurse practitioners in those practices. Physician attendings and residents, and NPs in these practices.

Settings: The hospital-based primary care practice of the Mount Sinai Hospital, located in East Harlem, New York City, a community-based practice of the Montefiore Medical Center, the Bronx, NY. The Montefiore site was selected because of its similarities to the MSH practice: teaching practice that uses Epic, serves a patient population that is predominantly Latino and low income. The Mount Sinai site cares for approximately 15,000 patients annually (35 attendings, 145 residents, and 7 nurse practitioners). The Montefiore practice also serves approximately 15,000 patients annually (18 attendings and 30 residents).

Data collection methods: Data were collected from patients and providers in two waves, a pre-treatment period from June 1 to October 31, 2016, and a post-treatment period, January 1 to March 31, 2017. A convenience sample of participants was recruited in the waiting areas of both practices and were included if they were scheduled to see a physician or nurse practitioner for a routine visit. RAs obtained informed consent prior to the patients' visit with their clinician then conducted an interview (in English or Spanish) immediately following the visit. RAs asked the patient to refer to their AVS, and if they had not received one after their visit the RA printed provided them a copy. A second interview was conducted by telephone 1 week after the visit. The same protocol was followed for recruitment and interviewing in the treatment period. We attempted to survey all clinicians in the two practices (physician attendings and residents and NPs) through email (for a link to a web-based survey) or in-person (paper and pen survey).

Intervention: We designed a revised AVS based on the preferred content, content ordering, and formatting of the AVS described by patients during qualitative interviews conducted in a diverse set of clinical practices in New York City and Chicago, IL. We also applied evidence-based communication principles for print material.

Prior to the first wave of data collection (pre-treatment period), study physicians made a brief presentation to clinical faculty on effective strategies for communicating with patients at faculty meetings and to residents during resident meetings. The presentation touched on strategies such as teach back and teach-to-goal for improving communication with low literacy patients, then highlighted the AVS as a potential tool for enhancing communication. The presenter discussed the value of a print document with information for the patient about their health and healthcare, and their medication list. The presentation was made during the week prior to the beginning of patient recruitment in the first wave of data collection and again 1 week before the collection of data in wave 2 (treatment period). A four-week washout period separated the end of data collection in wave 1 and the beginning of data collection in wave 2. A new presentation was made 1 week prior to data collection in both practices. The revised AVS was activated in the intervention practice (Mount Sinai) but not in the control practice (Montefiore).

Measures: For patients, measures covered four domains: content (relevant medical information), formatting (length of document), ease of understanding (medications and other content), and utility (reminder for medication taking and upcoming appointments). All items were presented as statements with 4 response options: strongly agree, agree, disagree, and strongly disagree. These items were examined individually and as a summary measure of satisfaction with the AVS. For the summary measure, responses were assigned a value of 1 (strongly disagree) to 4 (strongly agree), with the exception of two items that were reverse coded, and values were summed for all items. Other measures included basic demographics, health literacy, and general health. Health literacy was measured using a brief validated screening tool described by Chew and colleagues.

For physicians, we developed questions to assess how often they perform key actions with the AVS, including (1) print it, (2) add tailored instructions to it, (3) give patients a copy, and (4) review it with patients. Response options ranged from never to always on a 5-point scale. To measure their perspectives on AVS content and formatting, we asked clinicians to rate characteristics of the AVS in three domains: content (information on self-management, patient friendly language, and density of information), organization (logical sequence of information, length, and overall organization), and accuracy and clarity of information (accuracy of medication information, accuracy of problems/diagnoses, clarity of information, and clarify medications to take). Physicians were also asked to rate the AVSs ability to achieve its intended patient uses in three domains: to inform (medication changes, planned referrals, and general health), educate (medication use, medication purpose, other self-management strategies) and to serve as a reminder (to take medication(s), schedule appointment(s), and follow specific instructions). They also rated the AVS overall. Responses ranged from very poor to exceptional on a 7-point scale. Additional physician data included level of training (attending, resident, nurse practitioner) and gender.

Limitations: We were unable to conduct a randomized controlled trial because technical limitations of the Epic EHR prevented us from activating the new AVS for selected clinicians or patients. Generalizability is limited because our study was conducted in only 2 primary care practices and with predominantly low-income Latino and African American patients.

5A.   Phase I Results
5A.1   Patient and Physician Focus Groups

Principal Findings of Patient Focus Groups and Individual Interviews: *Purpose of the AVS.* While most patients valued the AVS as a visit summary, others considered it a general summary of their health and healthcare, useful for sharing with family or clinicians even if they had access to their health records via web portals. Patients who accessed the personal health information electronically were more likely to value the AVS as summary of their health and to keep it with them at all times in case of emergencies.

Content and Content Order. Patients expressed different preferences for content and order of content. Patients who preferred the AVS as a visit summary, prioritized and in this particular order, practice contact information, vital signs, special instructions and appointments, and medications. There was less agreement about the importance of including tests ordered and results, immunization history, medication allergies, medical history, and the problem list. Patients who viewed the AVS as a general health summary placed greater emphasis on medical history, problem list, immunization history, and care team.

Formatting. The most common recommendations for formatting changes were greater use of lay terms, larger font, shorter documents (less than 3 pages), and specific ordering of content (as noted above).

Medication Lists. Most patients greatly valued the medication list but wanted improvements. Many wanted the purpose of medications stated. Some patients were confused by multiple medication lists indicating started, stopped, and modified medications, and a single "current" medication list was preferred.

Referrals and Appointments. Patients wanted the purpose of referrals and appointments stated.

Accuracy of Information. Many patients said the AVS often listed incorrect or unfamiliar diagnoses or medications. They said listed medications were often discontinued or were for short term use and no longer used. The inaccuracies caused confusion for some patients about their health and medications.

Customization of the AVS. Most patients believed the AVS should be customized to the patients' preferences for content and formatting.

Principal Findings of Clinician Focus Groups: *Value of the AVS*. Clinicians believed the AVS is a potentially helpful document for educating patients and helping to manage their health. Yet, there was doubt that the AVS effectively communicates key information to patients in its current form.

Content. Many clinicians wanted the purposes of medications and referrals added to the AVS.

Accuracy of Information. Like patients, clinicians noted that medication and problem lists were often inaccurate on the AVS and a source of confusion for patients.

Formatting Improvements. Suggestions included larger font sizes, more white space, and more explicit section headings that used bold typeface or larger font than that of the text. There was concern about the length of the AVS. Many physicians lamented the unavailability of Spanish and other foreign-language AVS options.

Workflow Issues. Three problems of integrating the AVS into clinical workflow were commonly discussed by clinicians. Several had insufficient time during the visit to populate the AVS with information useful to patients, such as specific instructions or goals of care. They reported that doing so typically requires additional typing. They also described inadequate time to review the AVS with their patients, further complicated for some by having to retrieve the document from a centrally located printer. For one group, the printer at the registration desk and the AVS was given to patients by a clerk. Notably, these clinicians saw much less value in providing the AVS to patients than did physicians who provided it directly to patients.

For clinicians who retrieved the AVS from a centralized printer, reviewing the document with a patient meant returning with it to the exam room or doing so in a common area. For the latter, they acknowledged the risk of HIPAA violations. Some tried to circumvent the problem by speaking in a low volume or carefully words selection and pointing. Clinicians offered solutions to these problems, including menus of text to replace free-text for common issues, printers in exam rooms, and review of the AVS by nurses or medical assistants with patients.

Details of Recruitment and Data Collection: We conducted 5 focus groups and 14 individual interviews with a total of 39 patients (Table 1). Median age was 60 years (range 30-90), 72% were female; 39% were black non-Hispanic and 23% Hispanic. We also conducted 8 physician focus groups in Manhattan and Chicago, which included 56 individuals (38 physicians and 18 nurse practitioners), of whom 66% were female; the mean years in practice was 10 (Table 2). We interviewed 12 healthcare IT leaders from eight states. The interviewees were seven chief health informatics officers or directors, one electronic health record "champion," one quality improvement director, one chief medical officer, one clinical investigator, and one primary care-focused division chief. These individuals participated in AVS improvement efforts directly or were regularly apprised of such efforts. Five institutions were academic medical centers or associated clinics with academic medical centers, four were non-academic medical centers with inpatient and outpatient services, two were outpatient clinical networks, and one was a federally qualified health center. The EHR platforms used by these institutions were Epic (n=7), NextGen (n=2), Vista (n=2), and eClinical Works (n=1).

Discussion: Both patients and clinicians consider the AVS a valuable tool for communicating healthcare information, guiding self-management, and relaying information about specific healthcare-related tasks to complete. Yet, they emphasized the need for improvements and identified specific features they would like altered or added. The findings of this portion of the study add significantly to the existing research literatures on AVS and other methods of communicating health information to patients.

Conclusions: Patients' and physicians' have specific recommendations for modifying the AVS that will result in an improved document for physician-patient communication. AVS design should occur with extensive patient and clinician input to achieve a patient-centered, clinician-friendly document to achieves its purpose.

Significance: No previous study has reported on either patients' or physicians' experiences with the AVS, their preferences for content and order, their concerns about the document, and their recommendations for workflow integration. The findings from this study will allow for incremental improvements in AVS content and formatting, but they also demonstrate that next steps in AVS advancement—per patient customization, streamlined clinician workflow, patient-friendly medical terminology—will require outside-the-box thinking by EHR vendors and fundamental programming and design changes.

Implications: The data from this study was used to develop a prototype, patient-centered AVS.

5A.2 Health IT Leader Qualitative Interviews

Principal Findings: All participants reported that their AVS development committees were motivated to improve the AVS because it was a sub-optimal patient education tool, had little value for their patients, and represented their institution poorly. AVS redesign was difficult to achieve and many of the changes they sought to make could not be implemented because of limitations in the extent to which programmers could alter the existing structure of the AVS in their EHRs. Moreover, some found that changes they had implemented could not be carried over to new versions of their EHR when they upgraded, and for this reason they were no longer willing to invest in future programming to modify the AVS.

Outcomes: We identified 3 activity domains for AVS revision: preparation, implementation, and dissemination phases. Four activities were identified for the preparation phase: 1) engaging stakeholders, 2) organizing the redesign effort, 3) identifying changes to be made, and 4) identifying methods to enact the changes (solution discovery). Engagement meant involving stakeholders, including patients, clinicians (e.g., physicians, nurses, pharmacists), and health IT experts.

AVS redesign had numerous challenges. It was highly time-consuming, requiring several meetings over the course of 12 months or more. It was programming intensive and some organizations had contracted with outside consultants to complete the work. There were differences in content and formatting needs for primary care and specialty practices within health systems, adding a layer of complexity to system-wide implementation. There were limitations in their ability to reformat text and images, to create tables for medications, and to incorporate patient-friendly text without creating additional work for clinicians. Most said that as a result, the redesigned AVS at their institution was "not optimal."

Several respondents highlighted the importance of bringing awareness to the new AVS among clinicians. Repeated presentations of the new AVS were thought necessary to ensure that faculty or staff clinicians were fully apprised of the document's features and were using it routinely.

Discussion: The project involved identifying practices used by other institutions to optimize and implement their revised outpatient AVS in their EHR systems, and then followed those procedures to create a patient-centered AVS. The lessons learned from other institutions and from direct experience in implementation of AVS redesign provide rich insights into future AVS improvements. They also present the challenges to achieving this objective and to improving the quality of patient-facing print and electronic documents generated by EHRs more broadly. An unexpected but critical finding of this work was that several sites learned that their investment in AVS redesign was largely lost when upgrading to a newer EHR version, rendering their AVS optimization non-functional.

Conclusions: Health IT leaders view the AVS as a valuable source of information for patients. However, limitations to AVS modifications in EHR systems present challenges to optimizing the tool.

Significance: EHR vendors can incorporate the learning from health care system innovation into their products.

Implications: Vendors should consider building more flexibility into their programming to permit tailoring at the health care systems level. Such flexibility could generate more advances for the vendor's EHR as well as build customer loyalty and greater market value.

5A.3 Optimal AVS Development and Pretesting

Principal Findings: A limited number of modifications to the AVS were possible because of many features of the Epic EHR are not modifiable even by an advanced Epic programmer. Possible modifications included: changing the order of "print groups" on the document, modifying font size and bolding of section headers, and inserting page breaks. Print

groups are predefined groups of formatted text that auto-populate data pulled from other areas of the medical record. Their order in the document can be easily changed. The "medication" print group auto-populates information on current medications and allows limited manipulation of how information is displayed (e.g., table vs. line format). Some but not all text in print groups can be modified and information in one print group cannot be moved to another. Key features of the AVS which were unalterable included: substitution or deletion of medical jargon terms in auto-populated text, limited options for adding auto-populating features of new text, inability to ensure accurate and up to date medication and problem lists, and no mechanisms for creating an aesthetically appealing document.

Outcomes: We created a prototype AVS based on the qualitative data from Phase I. We then refined it based on data from cognitive interviews conducted with 19 patients. We then modified the Epic AVS at Mount Sinai to resemble the prototype as closely as possible.

Limits to Modification. The process for linking easy-to-understand terms to content like medications and ordered tests would require additional steps by the clinician and was therefore considered unlikely to be used by clinicians in busy practices, even with training. The default procedure for auto-populating content involves pulling the administrative data (e.g., ICD-CM 10 diagnoses and codes) for which an order is placed and a billable code is generated. The diagnostic terminology may be confusing or difficult for patients to understand (e.g. cardiac-induced pulmonary edema due to heart failure with reduced ejection fraction versus heart failure). As with medication records, diagnosis records are maintained via a third party data that uses structured data fields. These data reflect descriptions maintained for the nearly 80,000 ICD-10 codes in that value set, and there are no algorithms to convert codes to plain language. Additionally, free-text can only be added to one area of the AVS.

Problem Lists. We chose to place the problem list toward the end of the AVS because expecting clinicians to modify it was impractical. This did not address the aim of reducing the length of the AVS, but it enabled us to keep prioritized information near the front of the document.

Limited Flexibility to Create an Aesthetically Appealing Document. The AVS can have uneven margins, inconsistent spacing, and multiple font sizes, which are visually distracting and inconsistent with other printed materials provided to patients at our institution. We were unable to adjust margins, found that the addition of new features created a cluttered appearance, and found that altering font size unexpectedly created multiple page breaks resulting in a considerably longer AVS and irregular tables.

Discussion: Despite concerted and resource intensive attempts at customization, the modified AVS we created, while an improvement over the existing AVS, was more cluttered, lengthier, and less aesthetically pleasing AVS than what we intended to create. Moreover, we were unable to implement most of the strategies we had for making the AVS more accessible for low health literacy patients.

Conclusions: EHRs are too restrictive in their architecture to enable health systems to customize the AVS and achieve a low health-literacy, patient-centered document.

Significance: If the rigid architecture remains, the responsibility for improving the AVS will increasingly lie with EHR vendors, possibly stifling innovation and advances in health literate, patient-centered care.

Implications: EHR vendors, for their part, should consider building more flexibility into their programming architecture to permit tailoring by health systems. Regardless, vendors should strive to improve the patient-centeredness of the AVS by including plain language translations of ICD-10 codes and following other best practices for health literate communication and principles of patient-centeredness.

5B.   Phase II Results

Principal Findings: Patients in both practices had high positive views of the AVS at baseline. The modified AVS resulted in only one improvement in patients' or clinicians' views of the AVS, that it serves as an effective reminder to take medications. In contrast, people who received the new AVS were more likely to view it as too long. There were no significant changes in regard to clarity of medication information, comprehensiveness, and appointment reminding.

Outcomes: Patients reported very high ratings of the AVS in both practices and in the pre- and post-intervention periods. This result was a surprise to the study team because patients' reports during qualitative analyses and pre-testing of study questions suggested greater variation than we found during the study. The very high floor values limit the conclusions that can be drawn from the data.

A note on interpreting the results presented in Tables 4-6: These tables show the raw percentages of patients agreeing or strongly agreeing with the statement abbreviated in the far left column. The 6th column shows the difference-in-differences (DiD) of the raw percentages from the intervention and control arms in the pre- and post-test periods, as follows: DiD = (Intervention$_{t1}$ – Intervention$_{t0}$) – (Control$_{t1}$ – Control$_{t0}$). The 7th column shows the beta coefficients of the multivariate regression DiD models. The P-value for the site x phase interaction term represents the significance level for the DiD and the directionality of the beta-coefficient indicates the directionality of the association, intervention arm relative to control. Hence, a negative coefficient indicates that the patients in the intervention arm were less likely to agree with the statement.

Impact of the Modified AVS on Patients' Perceptions of the AVS, Immediately After Visit (Table 4): Because of the high floor, the model assessing patients' assessment of the understandability of the medication information on the AVS did not converge. The new AVS was significantly associated with relative improvement in patients' perceptions of the value of the AVS as a tool for reminding them to take their prescription medications (DiD for percent agreeing, 18.0%, adjusted P=.004). However, patients in intervention practices were also more likely to report that the AVS was too long (DiD for percent agreeing, 8.9%, adjusted P=.04). There were no significant differences between sites between the pre- and post-test periods with regard to the AVS having all necessary information, serving as a reminder for future appointments, and its understandability. Patients in the intervention sites were significantly more likely to have received an AVS (by direct observation of the RA) than patients in the control site when comparing the pre- and post-test periods (DiD for percent agreeing, 26.8%, adjusted P=.002). There was no significant difference, however, between patient reports of physicians reviewing the document with them at the conclusion of their visit (DiD for percent agreeing, -1.4%, adjusted P=1.00).

Impact of the Modified AVS on Patients' Perceptions of the AVS, 1-Week After Visit (Table 5): As with the immediate post-visit interview results, the model of medication understanding did not converge. Patients in the intervention arm were more likely than control patients to say that the AVS served as a reminder to take their medications in comparison of the pre- and post-test periods, consistent with the findings of the immediate post-visit survey (DiD for percent agreeing, 19.7%, adjusted P=.02).

Process Evaluation: Impact of the Modified AVS on Patients' Handling of the AVS (Table 6): At baseline, the clinicians in the intervention site were significantly less likely to print the AVS, provide it to patients, or to review it with patients. The new AVS was not associated with statistically significant changes in handling of the AVS by clinicians in the intervention sites relative to the control sites, pre- vs. post-test periods. This included printing of the AVS, providing the patients a copy of the AVS, and reviewing the AVS with the patient. There was also no change in the proportion of clinicians rating the AVS as overall good or better between the sites, comparing the pre- and post-test periods. Satisfaction with the AVS was significantly higher in the control site. At baseline and across the two sites, satisfaction with the AVS among clinicians was not significantly associated with providing the AVS to patients when adjusting for the practice, clinician gender, and clinician type (Table 7).

Discussion and Conclusions: The patient-centered AVS we developed and implemented in Epic was associated with patients considering the AVS a useful tool for reminding them about taking their medications, and there was a greater increase in the proportion of patients receiving the AVS in those practices than in the control practices. High floor effects in our measures of patients' and physicians' views of and experiences with the AVS may have limited detection of changes in actual patient and physician views. Aside from this limitation in measurement, limitations in our ability to achieve our original design objectives when implementing our prototype in the EHR may have contributed to the overall limited impact it have on views and experiences with the AVS.

Significance and Implications: Improving patient's experiences with the AVS is possible, and a better designed AVS may result in more patients getting it. However, health systems must rely on EHR vendors to develop and implement patient-centered AVS as the opportunity for end-users to modify these important tools is limited. EHR vendors should incorporate more flexible designs in their product development to allow health systems to optimize the AVS to better serve their patients.

List of Publications and Products

Publications

Federman AD, Sanchez AM, Jandorf L, Salmon C, Kannry J. Patient and Physician Perspectives on the outpatient after visit summary: a qualitative study to inform improvements in visit summary design. *J Amer Med Informatics Assoc*. 2016 Aug; 24(e1): e61-e68.

Manuscripts in Preparation

Federman AD. Sarzynski E, Brach C, Francaviglia P, Jacques J, Jandorf L, Sanchez Munoz A, Wolf M, Kannry J. Implementation Trumps Design: Challenges in Optimizing the After Visit Summary.

Federman AD, Jandorf L, DeLuca J, Gover M, Sanchez Munoz A, Chen L, Wolf M, Kannry J. The Standard vs. Redesigned After Visit Summary: Patients' Perceptions and Experiences with the outpatient tool.

Sanchez Munoz A, Chen L, Jandorf L, Kannry J, Deluca J, Gover M, Federman AD. Clinician Perspectives on the Use and Value of the Electronic Health Record (EHR) Generated Outpatient After-Visit Summary.

Presentations/ Abstracts

Sanchez Munoz, A. M., Chen, L., Gover, M., Deluca, J., Kannry, J., Jandorf, L., Federman, A.D. Provider use of the after visit summary in academic clinical practices. *Poster Presentation*. 2017 Society of General Internal Medicine Annual Meeting. Washington, DC. April 2017.

Federman AD, Sanchez-Munoz A, Jandorf L, Wolf MS, Kannry J. Patients' perceptions of and preferences for the outpatient after-visit summary: a qualitative study. *Poster Presentation.* 2016 Society of General Internal Medicine Annual Meeting. Hollywood, FL .January 2016.

Kannry JL. After The Visit: Developing An AVS Both Patients and Doctors Can Use. *Oral Presentation.* Epic Expert Group Meeting Physician Advisory Council. Verona, WI. April 2016.

Products

Prototype patient-centered AVS formatted in Microsoft Word (Figure 1).

Patient-centered AVS implemented in Epic electronic health record (Figure 2).

Figure 1. Pages 1-3 of the Optimized After Visit Summary (MS Word Version)

Harold Smith
Visit Date: 1/17/2016

Provider you saw today: Alex Federman, MD
Your Primary Care Doctor: Joseph Kannry, MD
Department: Internal Medicine Associates

For appointments, refills, or to speak with a doctor, call (212) 659-0000

For emergencies, call 911

Information about today's visit and your future visits

Your Vital Signs Today

Blood Pressure	Pulse	Temperature	Weight
120/80 mmHg	72 beats per minute	98.6 °F	128 lb

Reason for Today's Visit
Essential hypertension
Diabetes
UTI (lower urinary tract infection)
Needs flu shot

Self-Management Goals
- Lose 10lbs by June
- Take your medications every day

Special Instructions
- Stop taking metoprolol
- Start taking amlodipine for your high blood pressure

Follow-up Tasks
- Return to IMA in about 3 months (around 4/29/2016). Please call us to schedule this appointment: (212) 659-0000
- Cardiology (heart). Call to make an appointment: (212) 427-0000 to evaluate your heart murmur.

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Future Appointments that Are Already Scheduled

Date and Time	Specialty	Doctor	Reason for Visit	Location and Telephone
1/29/2016 10:30 AM	Otolaryngology	Dr. Smith	Difficulty swallowing	10 E. 102nd St. 3rd floor (212) 659-0000
2/2/2016 1:00 PM	Plastic Surgery	Dr. Gold	Hip wound	5 E. 98th St. 5th floor (212) 659-0000
3/22/2016 11:30 AM	Audiology	Audiologist	Hearing problem	5 E. 98th St. 11th floor (212) 659-0000

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Your Current Medications

Generic Name	Brand Name	For	Dose	How to Take It
Aspirin	Ecorin	Heart disease	81mg	Take 1 tablet with breakfast
Furosemide	Lasix	Heart disease	40mg	Take 1 tablet with breakfast
Simvastatin	Zocor	High cholesterol	20mg	Take 1 tablet at bedtime
Tramadol-acetaminophen	Ultracet	Pain	37.5-325mg	Take 1 tablet every 6 hours as needed
Amlodipine	Norvasc	High blood pressure	10mg	Take 1 tablet with breakfast
Polyethylene glycol	Miralax	Constipation	17grams	Take 1 capsule with lunch
Bisacodyl	Dulcolax	Constipation	5mg	Take 2 tablets at bedtime
Sodium polystyrene	Kayexalate	High potassium	60mLs	Take 60mLs at bedtime
Docusate sodium	Colace	Constipation	100mg	Take 1 tablet every 8 hours
Esomeprazole	Nexium	Acid reflux	40mg	Take 1 capsule with breakfast
Tamsulosin	Flomax	Regulate urination	0.4mg	Take 1 capsule with breakfast
Clonidine	Catapres	High blood pressure	0.3mg	Apply 1 patch to skin every Wednesday
Cetirizine	Zyrtec	Allergy symptoms	10mg	Take 1 tablet at bedtime

Your Pharmacy

CVS Pharmacy, 1500 Lexington Ave at the corner of 97th St. (212) 289-4565

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Figure 2. Revised After Visit Summary as Implemented in the Epic Outpatient Electronic

Jess Zztest
MRN: 7608961
Visit Date:

Provider you saw today: UNKNOWN PROVIDER
Your Primary Care Provider: Scot Niglio, MD
Department: INTERNAL MEDICINE ASSOCIATES

For appointments, refills, or to speak with a doctor, call (212) 659-8551

For emergencies, call 911

Information about today's visit and your future visits

Your Vital Signs Today

BP	Pulse	Weight	BMI (Normal: 18.5-24.9)
120/80	77	56.7 kg (125 lb)	20.18 kg/m2

Information & Instructions

Reason for This Visit
1. **Essential hypertension**
2. Mild persistent asthma with acute exacerbation
3. Type 2 diabetes mellitus with hyperosmolarity without coma, without long-term current use of insulin
4. Simple chronic bronchitis

Health Goals Discussed During this Visit

Provider added Goals will display here.

Your Current Medications

This list is accurate as of: 7/14/16 11:59 PM. Always use your most recent med list.

	Brand Name	For	Dose	How to Take
albuterol 2.5 mg /3 mL (0.083 %) solution for nebulization	PROVE NTIL	Simple chronic bronchitis	5 mg	Inhale 6 mLs by mouth every 4 hours as needed for Shortness of Breath/Wheezing.

Information & Instructions (continued)

aspirin 81 mg chewable tablet		Essential hypertension	81 mg	Take 1 tablet by mouth once daily.
atorvastatin 10 mg tablet	LIPITOR			Take 1 pill at bedtime.
benzonatate 100 mg capsule	TESSALON			Take 1 pill in the morning, 1 pill at noon, and 1 pill in the evening.
filgrastim 300 mcg/mL solution	NEUPOGEN	HIV (human immunodeficiency virus infection)	300 mcg	Inject 1 mL subcutaneously once daily.
Ibuprofen 100 mg tablet,chewable **What changed: Another medication with the same name was removed. Continue taking this medication, and follow the directions you see here.**			100 mg	
metFORMIN 1,000 mg tablet	GLUCOPHAGE	Type 2 diabetes mellitus with hyperosmolarity without coma, without long-term current use of insulin	1000 mg	Take 1 tablet by mouth 2 times a day.
tretinoin 0.01 % gel	RETIN-A			Apply topically at bedtime. as directed

VICTOZA 2-PAK SUBQ

Where to Get Your Medications

Information about where to get these medications is not yet available

I Ask your nurse or doctor about these medications

- albuterol 2.5 mg /3 mL (0.083 %) solution for nebulization
- atorvastatin 10 mg tablet
- benzonatate 100 mg capsule
- metFORMIN 1,000 mg tablet
- tretinoin 0.01 % gel

Table 1. Qualitative Analysis: Themes and Domains of the AVS, Patient Perspectives

Theme	Domain
AVS use and applications	Summary of the visit Summary of general health and healthcare Quick reference for specific aspects of healthcare Reminder of health-specific tasks to complete Review with physician to clarify health and healthcare issues Share health information with family Share health information with other clinicians (e.g., emergency department), pharmacists AVS disposition: disposed immediately, retained in a viewable area (e.g., on refrigerator door), filed, carried with person (e.g., purse, wallet)

Preferred AVS content	General Features of Content
	    Currently too much information; amount of content should be limited
	    The AVS should be customizable for each patient
	
	Specific Content Elements, Visit Summaries
	    Primary care physician contact information
	    Primary care follow-up appointment date and time
	    Appointment dates and times for specialty referrals and testing, and reasons for referrals
	    Specific instructions made by the clinician, including treatment plan
	    Goals of care
	    Vital signs from the current visit
	    Medication list that includes the purpose of the medications, excludes separate lists of discontinued or newly started medications
	
	Specific Content Elements, Health Summaries
	    Test results
	    Immunization history
	    Allergies (medication and other)
	    Medical history
	    Problem list
	    Challenges to patient care (e.g., language barriers, inability to swallow large pills)

Preferred AVS formatting	Use of lay language Larger font size Reduce density of the information, ensure white space Order of information: contact information, specific instructions, medications
Information on the AVS is often inaccurate	Medication list Problem list Referral contact information
Privacy concerns	Concern about exposure of personal information, e.g., history or diagnosis of depression, sexually transmitted diseases

Table 2. Qualitative Analysis: Themes and Domains of the AVS, Physician Perspectives

Theme	Domain

AVS use and applications	Physician use
	    Review information with patient to reinforce issues addressed during visit
	    Clarify health information; generate the AVS selectively for patients depending on their need
	Patient use
	    Reference tool
	    Share information with other clinicians
	    Prompt physician to clarify information; correct old or misleading information

Preferred AVS content	Follow-up appointment information, including the day of the week Specialty referral appointment information and reasons for referrals Specific goals of care Tasks assigned to patient to complete before next visit Reason for visit Listing of issues addressed during the visit Care plan, including treatments and instructions List of members of the care team Immunization history Pharmacy where patient should obtain their medications Problem list Vital signs Exclude certain items, including lab tests that were ordered, race and ethnicity Customization of content Up-to-date medication list, without separate lists of started or discontinued medications
Preferred AVS formatting	Brief AVS Simplified information for improved patient comprehension Use of larger font sizes, especially with older adults More white space More explicit section headings, including use of larger fonts and bold typeface Ability to easily highlight key text, using larger font or bold typeface First page should include items pertinent to the current visit (e.g., reason for visit, care plan, goals of care, recent vital signs, provider's name and contact information, follow-up appointment information, list of current medications, pharmacy to which prescriptions were sent)
Accuracy and other problems of AVS content	Inaccurate medication and problem lists Removing non-current medications from the medication list results in medications appearing in "stop taking" or "discontinue" medication lists and causing patient confusion Problem lists contain diagnosis names that are not intended for patients; lay language needed for diagnoses or problems Lack of availability of Spanish and other foreign language AVS
Interface	Need for drop down menus or other strategies that reduce free text (e.g., self-management tasks, diagnoses or problems that are the reasons for medications and referrals, goals of care, referrals; easy access to patient education materials associated with diagnoses) Preview window to review AVS before it is printed
Workflow concerns	Inadequate time to review AVS with patients (potential solutions discussed included placing the printer in the exam room or having a nurse review the AVS with the patient) Inadequate time to populate AVS with customized information for the patient, like instructions or goals (a potential solution discussed was engagement of other team members in this process, like nurses or medical assistants, as well as the patient, e.g., pre-review of the AVS to ensure accuracy of information about medications and diagnoses) Privacy concerns in practices that employ centralized printers (potential HIPAA violation if AVS content discussed in common areas) Some physicians unaware of AVS content because it is printed at the registration desk and given to the patient by a clerk at check-out

Table 3. Characteristics of Patients at Two Practices Sites, Pre- and Post-AVS Implementation

Site		Intervention Site			Control Site			Intervention vs. Control	
Variable	Total N=420 %	Pretest N=118 %	Posttest N=98 %	P	Pretest N=99 %	Posttest N=105 %	P	Pretest P-value	Posttest P-value
Age, *mean (SD)*	49.6 (15.0)	49.2 (15.3)	54.1 (12.7)	.01	46.3 (15.5)	49.1 (15.5)	.20	.17	.01
Male	34.0	34.7	26.5	.25	48.5	26.7	.002	.06	1.00
Race									
White, Non-Hispanic	6.2	8.5	6.1		5.1	4.8			
Black, Non-Hispanic	44.5	39.0	40.8	.78	49.5	49.5	.98	.42	.66
Hispanic	43.3	44.9	48.0		39.4	41.0			
Other	6.0	7.6	5.1		6.1	4.8			
Language									
English	92.4	89.8	91.8		90.9	97.1			
Spanish	6.2	9.3	5.1	.26	7.1	2.9	.12	.65	.13
Other	1.4	0.8	3.1		2.0	0.0			
Education									
High school or less	21.0	14.4	28.6		22.2	20.0			
High school graduate	31.9	32.2	24.5	.08	40.4	30.5	.31	.12	.47
Some college	28.6	33.9	28.6		23.2	27.6			
College graduate	18.6	19.5	18.4		14.1	21.9			
General health									
Excellent or very good	33.8	25.4	30.6		48.5	32.4			
Good	36.2	34.7	33.7	.68	35.4	41.0	.04	<.001	.35
Fair or poor	30.0	39.8	35.7		16.2	26.7			
Insurance									
Medicaid or Medicaid and Medicare	67.4	78.8	66.3		64.6	58.1			
Medicare	9.0	11.0	3.1	<.01	12.1	9.5	.33	.03	.14
Private or HMO	23.6	10.2	30.6		23.2	32.4			
Has a caregiver	97.1	98.3	96.9	.83	100.0	93.3	.03	.56	.39
Limited health literacy: somewhat to not at all confident in filling out a medical form	17.6	19.5	21.4	.86	17.2	12.4	.44	.79	.12

Table 4. Difference-in-Difference Analysis of Patient Ratings of After Visit Summary Characteristics, by Treatment Site and Time

Characteristic	Pre-Test Period		Post-Test Period		DiD	Adjusted Analysis[†]	
	Intervention	Control	Intervention	Control		β	P
Easy to understand medication information							
Intervention site	98.3%	100%	98.0%	99.0%	-	&	
Treatment period	-	-	-	-	-		
Site*Phase	-	-	-	-	-0.7%		
Too long							
Site 1 vs. Site 2	18.6%	13.1%	17.3%	2.9%**	-	0.29	.47
Posttest vs. Pretest	-	-	-	-	-	1.66	.01
Site*Phase	-	-	-	-	8.9%	1.58	.04
Includes all the information necessary for care							
Site 1 vs. Site 2	97.5%	97.0%	95.9%	96.2%	-	0.58	.50
Posttest vs. Pretest	-	-	-	-	-	0.06	.94
Site*Phase	-	-	-	-	-0.8%	-0.50	.66
Serves as a reminder to take medications							
Site 1 vs. Site 2	66.9%	94.9%**	63.3%	73.3%	-	-2.11	<.001
Posttest vs. Pretest	-	-	-	-	-	1.87	<.001
Site*Phase	-	-	-	-	18.0%	1.69	.004
Serves as a reminder of future appointments							
Site 1 vs. Site 2	89.8%	92.9%	82.7%	81.0%	-	-0.36	.49
Posttest vs. Pretest	-	-	-	-	-	0.97	.04
Site*Phase	-	-	-	-	4.8%	0.53	.40
Hard to understand							
Site 1 vs. Site 2	6.8%	8.1%	2.0%	2.9%	-	-0.32	.56
Posttest vs. Pretest	-	-	-	-	-	1.08	.13
Site*Phase	-	-	-	-	-0.4%	-0.11	.92
Wish AVS has more information about health							
Site 1 vs. Site 2	27.1%	30.3%	29.6%	20.0%	-	-0.37	.25
Posttest vs. Pretest	-	-	-	-	-	0.61	.08
Site*Phase	-	-	-	-	12.8%	0.79	.09
Process Outcomes							
Received an AVS after the visit							
Site 1 vs. Site 2	78.0%	33.3%**	86.7%	15.2%***	-	2.06	<.001
Posttest vs. Pretest	-	-	-	-	-	0.92	.01
Site*Phase	-	-	-	-	26.8%	1.63	.002
Clinician reviewed AVS with patient							
Site 1 vs. Site 2	80.4%	90.9%	84.7%	93.8%	-	-0.83	.23
Posttest vs. Pretest	-	-	-	-	-	-0.24	.84
Site*Phase	-	-	-	-	-1.4%	-0.003	1.00

[&]Model did not converge. *P<.05, **P<.01, ***P<.001

[†]Adjusted for all demographic variables significantly different in either pretest or posttest: age, gender, general health, and insurance.

Table 5. Difference-in-Difference Analysis of Patient Ratings of After Visit Summary Characteristics at 1 Week Follow Up, by Treatment Site and Time

Characteristic	Pre-Test Period		Post-Test Period		DiD	Adjusted Analysis[†]	
	Intervention	Control	Intervention	Control		β	P
Easy to understand medication information							
Intervention site	99.0%	98.5%	95.8%	95.0%	-	&	
Treatment period	-	-	-	-	-		
Site*Phase	-	-	-	-	0.3%		
Too long							
Intervention	77.8%	85.3%	75.0%	92.5%**	-	-0.41	.36
Posttest	-	-	-	-	-	-0.90	.11
Site*Phase	-	-	-	-	-10.0%	-0.93	.17
Includes all the information necessary for care							
Intervention	96.7%	95.6%	93.1%	95.0%	-	0.27	.76
Posttest	-	-	-	-	-	0.14	.86
Site*Phase	-	-	-	-	-3.0%	-0.60	.59
Serves as a reminder to take medications							
Intervention	70.0%	79.4%	72.2%	57.5%	-	-0.58	.14
Posttest	-	-	-	-	-	1.08	.01
Site*Phase	-	-	-	-	24.1%	1.22	.02
Serves as a reminder of future appointments							
Intervention	94.4%	88.2%	87.5%	78.7%	-	0.65	.29
Posttest	-	-	-	-	-	0.79	.10
Site*Phase	-	-	-	-	-16.4%	-0.07	.93
Hard to understand							
Intervention	92.2%	92.6%	84.7%	93.7%	-	-0.21	.74
Posttest	-	-	-	-	-	-0.03	.96
Site*Phase	-	-	-	-	-6.4%	-0.81	.34
Wish AVS has more information about health							
Intervention	65.6%	64.7%	73.6%	61.2%	-	0.05	.89
Posttest	-	-	-	-	-	0.20	.58
Site*Phase	-	-	-	-	11.5%	0.54	.28

[&]Model did not converge. *P<.05, **P<.01, ***P<.001
[†]Adjusted for all demographic variables significantly different in either pretest or posttest: age, gender, general health, and insurance.

Table 6. Difference-in-Difference Analysis of Provider Use of the AVS, by Treatment Site and Time

	Pre-Test Period		Post-Test Period			Adjusted Analysis[†]	
Action	Intervention	Control	Intervention	Control	DiD	β	P
Print out the AVS							
Intervention site	33.3%	94.4%***	30.6%	93.6%***	-	3.52	<.001
Treatment period	-	-	-	-	-	-0.13	.80
Site*Phase	-	-	-	-	1.9%	0.006	1.00
Give the patient a copy of the AVS							
Intervention	30.3%	91.2%***	27.8%	92.1%***	-	3.17	<.001
Posttest	-	-	-	-	-	-0.12	.82
Site*Phase	-	-	-	-	-3.4%	-0.24	.76
Review the AVS with the patient							
Intervention	30.3%	80.0%***	25.0%	77.8%***	-	2.22	<.001
Posttest	-	-	-	-	-	-0.27	.62
Site*Phase	-	-	-	-	-3.1%	-0.13	.84
Characteristic							
Overall rating of the AVS (Good-exceptional)							
Intervention	13.8%	39.3%*	11.1%	52.4%***	-	1.40	.01
Posttest	-	-	-	-	-	-0.25	.74
Site*Phase	-	-	-	-	-15.8%	-0.78	.74

*P<.05, **P<.01, ***P<.001
[†]Adjusted for clinician type.

Table 7. Association of Clinician's Ratings of the AVS with Providing It to Patients

Variable	Provides AVS for Patient (Usually or Always)	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Very good-Excellent Overall Rating of AVS	2.95 (1.04 – 8.35)	1.62 (0.41 – 6.51)
Site		
Hospital-based primary care practice	-	Ref
Community-based primary care practice	-	26.28 (8.10 – 85.30)
Male	-	0.70 (0.22 – 2.24)
Training level		
Nurse practitioner	-	Ref
Attending	-	0.16 (0.02 – 1.17)
Resident	-	0.08 (0.01 – 0.46)