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Moving evidence from the literature to the bedside: Report from the APIC Research Task Force

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Research is an integral component of the mission of the Association for Professionals in Infection Control and Epidemiology (APIC). In January 2010, APIC 's Board of Directors decided to update and clarify the Association's approach to research. The purpose of this paper is to briefly review the history of APIC's role in research and to report on the recent vision and direction developed by a research task force regarding appropriate roles and contributions for APIC and its members in regards to research. APIC and its membership play critical roles in the research process, especially in terms of setting the research agenda so that research resources can be directed to important areas. Additionally, dissemination and implementation are areas in which APIC members can utilize their unique talents to ensure that patients receive the most up-to-date and evidence-based infection prevention practices possible.

Key Words: Comparative effectiveness research; dissemination and implementation science; practice-based research networks; APIC research task force; infection control.

"Knowing is not enough; we must apply. Willing is not enough; we must do."

Johann Wolfgang von Goethe

Infection preventionists (IPs) are major consumers of research; and as such, research is an integral component of the Association for Professionals in Infection Control and Epidemiology (APIC).[1] Indeed, in 2006, the creation of new knowledge through research became one of the Association's 5 strategic goals. Consequently, APIC's research efforts have been more fully integrated into the organization's educational conferences, products, services, publications, communications, and government relations. The "APIC Vision 2012" Strategic Plan states that APIC will serve as a catalyst for leading edge research for the prevention of infection and associated adverse outcomes. While there were formerly 6 clear objectives associated with this goal, in January 2010 APIC's Board of Directors determined that it was time to update and clarify the Association's approach to research, consistent with the membership's interests and needs; financial capacity; and the evolving political, biologic, and professional landscapes. As a result, a multidisciplinary research task force was formed representing IPs with the primary role in the clinical setting, APIC members whose primary role is research, members of the *American Journal of Infection Control* editorial board and the Editor, a hospital epidemiologist, a hospital intensivist, an IP from the World Health Organization (WHO), the current President, and the President elect of APIC as well as APIC's Chief Executive Officer and Executive Vice President. These categories are not mutually exclusive, and, often, one person brought multiple perspectives. (See authorship list for the names of the task force members.) The purpose of this paper is to outline the vision and direction developed by this APIC research task force regarding appropriate roles and contributions for the Association in creating new knowledge.

In preparation for an in-person meeting in March 2010, APIC distributed to the task force a number of documents including (1) a cross walk of research topics

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from the 2007 APIC annual conference research abstract categories, the 2007 Society for Healthcare Epidemiology of America (SHEA) annual conference research abstract categories, and the Centers for Disease Prevention and Control (CDC) research themes (Hanchett and Ryder, Research topic cross walk: APIC, SHEA, and the CDC 2007. The Institute for Vascular Access Advanced Practice. 2010. Unpublished Work); (2) the Health and Human Services (HHS) Action Plan to Prevent Healthcare-Associated Infections Research agenda;[2] (3) a SHEA position paper outlining a research agenda related to health care-associated infections (HAI);[3] (4) a published research agenda related to the recent federal changes in reimbursement for HAI;[4] and (5) a published report on US funding for biomedical research.[5] Additionally, at the meeting an oral history of APIC's past and current research efforts was presented.

HISTORY OF APIC RESEARCH EFFORTS

In 1992, a separate 501(c)3 Research Foundation was created by APIC as an independently operated subsidiary to support research relevant to the practice of infection prevention and control. The APIC Research Foundation's primary activity was the award of small grants to conduct infection prevention-related research. More than 15 small awards were made. Recently, a larger research award was provided to researchers at Ohio State University Medical Center to compare HAIs identified by administrative coding compared with those identified using CDC criterea.[6]

Another important role the Foundation played was setting the research agenda related to infection prevention. In 2000, the APIC Research Foundation funded and conducted a Delphi process with experts to identify research priorities. As a result, 21 priorities were identified providing a valuable guide to researchers, who used them as rationale and supporting evidence for the need for research funded by other organizations or agencies.[7] At that time the highest ranked research priorities were related to obtaining evidence on how best to improve compliance with best practices, use antimicrobials appropriately and decrease resistance, measure the financial impact of complications of HAI and value of interventions aimed at preventing HAI, perform surveillance of infectious and noninfectious complications across the spectrum of care delivery, and prevent complications at specific sites (eg, ventilator-associated pneumonia). Among non-US respondents, occupational health issues were also highly ranked.

In 2005, to provide members interested in research increased access to APIC's support and resources and to coordinate research on behalf of the collective membership, the administrative and practical functions of the APIC Research Foundation were integrated into the Association Headquarters and evolved into the Scientific Research Council. Members of the former APIC Research Foundation Board of Trustees then became members of the Scientific Research Council. Consistent with other APIC committees, task forces, and councils, the legal terms of this merger specified that the Scientific Research Council would be accountable to the APIC Board of Directors. The Council would establish research priorities, solicit research proposals, and recommend projects appropriate for funding to the Board of Directors. At the time of the merger, it was agreed that existing funds would be used to support research projects, as well as a committee or council to guide the work and staff and other expenses associated with these functions. For the purpose of transparency, the Council funds continued to be separately invested and segregated within APIC's financial system.

The next structural iteration of APIC's research enterprise was the reconfiguration of the standing Scientific Research Council to a more nimble task force structure. The rationale for a task force structure versus a standing council was that the membership could readily change as various research priorities emerged and various types of expertise were needed. APIC's Board made this decision in response to the increasing need for APIC to be more flexible and competitive in responding to a rapidly changing clinical and research environment. For example, the tasks given this task force were to develop a vision and direction regarding appropriate roles and contributions for APIC in regards to research.

RECENT AND CURRENT RESEARCH EFFORTS

Recently, APIC has undertaken 2 successful major research studies including the 2006 MRSA Prevalence Study and the 2008 *Clostridium difficile* Prevalence Study.[8,9] A follow-up to the MRSA Prevalence Study is in process for the Northern Hemisphere. More recently, APIC has partnered with several academic research teams, including separate projects with faculty from both Columbia University and Harvard University (see: http://www.apic.org/AM/Template.cfm?Section=Collaborative_Studies&Template=/CM/HTMLDisplay.cfm&ContentID=15407). In these collaborations, APIC staff and interested members have substantive roles including input into developing the research design, recruitment, and/or dissemination of results. Results and products of these partnerships are beginning to be disseminated in the form of peer-reviewed papers as well as poster and podium presentations at the

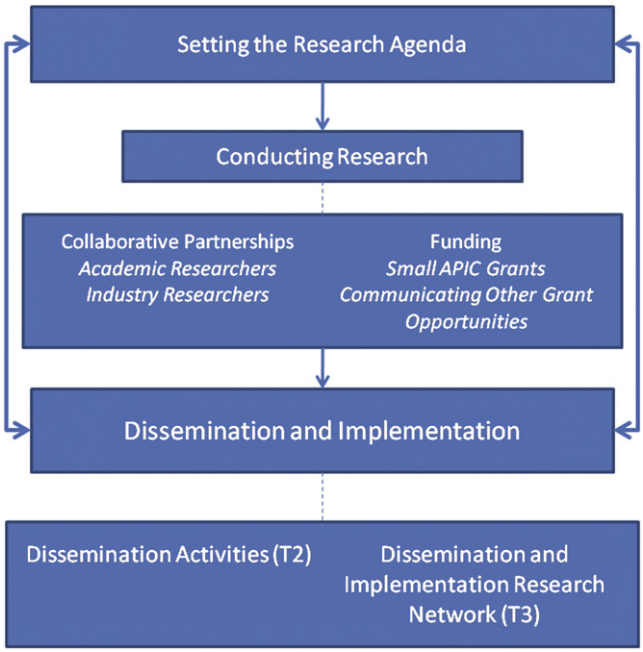

Fig 1. APIC's multifaceted roles in research.

APIC annual conference.[10,11] Additionally, APIC staff have had preliminary conversations/negotiations about other possible partnerships with academic research teams.

DIVERSE ROLES IN RESEARCH

APIC is uniquely and strongly positioned to be active in research that will serve its membership, who, in turn, use evidence to improve safety and quality of health care in several ways. Figure 1 outlines these primary areas and roles for APIC and its membership, which include identifying research gaps and setting research agendas, conducting research through collaborative partnerships and funding, and disseminating and implementing research into practice. Each of these areas is discussed below. It is important to note that this is a dynamic and iterative process.

SETTING THE RESEARCH AGENDA

APIC and its membership should continue to inform and guide the type of research that is conducted by developing an up-to-date research agenda that is regularly reviewed to ensure its ongoing value and fit with member needs and the external public policy, practice, scientific, and biologic environments. Although the previous research agenda developed by APIC membership a decade ago is in need of updating, it continues to be surprisingly relevant today. A decade later, it is time to build on the Research Priorities Project and update the research agenda.[7] To meet this goal, the task force will develop a survey for members to rank research priorities. This survey will be available on-line. We encourage all members to contribute to this important initiative. A report on the findings from this survey on the research agenda will be published separately.

Other organizations and institutions such as the Agency for Healthcare Research and Quality (AHRQ), the CDC, the Department of Health and Human Services (HHS), the National Institutes of Health (NIH), SHEA, and WHO also play important roles in identifying knowledge gaps and setting the research agenda. Active engagement by APIC to relate to the international research agenda is being explored by the research task force through the WHO, including in the area of patient safety. While setting the research agenda related to infection prevention and control is not a role that solely belongs to APIC, it is vital for APIC and its members as frontline providers to contribute to this important endeavor.

CONDUCTING RESEARCH

The primary role of most of APIC's members is in the clinical setting as IPs. It is likely their major contribution to research may be participating in research led by others and implementing research findings as well as identifying gaps in knowledge and setting research priorities. However, APIC also has important roles in the conduct and funding of research. Partnering with academic researchers, other professional organizations, such as the SHEA, as well as industry in prioritized areas is important. Partnerships with academic institutions as described above are templates for success when researchers obtained competitive external funding (ie, external to the researchers' institutions and APIC) in an area relevant to the practice of infection prevention and control. The fact that the research has undergone competitive peer review provides assurance that the research is well designed and likely to provide valid, reliable, and generalizable results. As such partnerships are developed, APIC serves an important coordinating and priority-setting function, while remaining mindful of content, rigor, and potential overlap of studies so as to avoid members being inundated with requests for data collection.

Industry is also often interested in partnering with APIC and supporting research initiatives. This interest presents in multiple ways. First, industry sometimes funds specific research (such as a study aimed at examining the efficacy of a particular prototype, product, or medical device). APIC can serve as a facilitator of research by helping industry funders identify suitable researchers and sites to conduct the studies. Second, industry sometimes seeks access to the membership to assist in data collection for clinical, market, or

product development research they are conducting. In these instances, APIC's role may be to vet the research and determine its value and fit with membership needs and the organization's strategic intent. Finally, industry often invests in clinical and professional societies by offering nonrestricted research or educational funds. In these cases, APIC may serve their membership as the communicator of these opportunities.

The task force discussed the role of APIC as a funder of research. While in principal it was not deemed a judicious use of APIC's monies to fund large scale research, it was agreed that there may be mutual benefit by APIC serving its members through awarding smaller grants to fellows, students, and junior researchers. Funding these types of small projects facilitates the development of the members interested in research, obtaining pilot data for larger projects, as well as potentially promoting loyalty among those who obtain these funds.

DISSEMINATION AND IMPLEMENTATION

According to Lomas,[12] dissemination is the targeted distribution of information and intervention materials to a specific audience. Implementation implies that the goal of the communication is, however, to do more than increase awareness; it is the use of strategies to adopt and integrate evidence-based health interventions and change practice patterns within specific settings. Dissemination and implementation science has been defined as research that creates new knowledge about how best to design, implement, and evaluate quality improvement initiatives.[13]

Often, IPs must set and recommend policies and procedures in relation to prevention and control of infections based on the best evidence available. As the organization for IPs, APIC is uniquely qualified to help facilitate dissemination of new knowledge about the efficacy of clinical practices. For example, APIC's Elimination Guides (see http://www.apic.org/Content/NavigationMenu/PracticeGuidance/APICEliminationGuides/APIC_Elimination_Gui.htm) are examples of the Association's broad-based dissemination activities. Other obvious venues related to APIC's dissemination activities include chapter meetings, the annual conference, Webinars, and publication of studies in the Association's premier venue for disseminating peer-reviewed evidence, the *American Journal of Infection Control*. Additionally, dissemination and implementation can be supported through collaborations with other agencies such as the WHO.

These activities serve as important forums for the membership to keep up with emerging science, including that generated by key partners (eg, the researchers and industry described above as well as direct recipients of research funds through APIC). However, the responsibility to disseminate research does not belong solely to APIC. Dissemination is also an important function for other organizations; the Healthcare Infection Control Practices Advisory Committee (HICPAC) Guidelines[14-20] and the SHEA Compendium[21] serve as examples of broad-based dissemination activities of partner organizations. Importantly, HICPAC is the primary source of evidence-based recommendations that are used to improve patient care and prevent HAIs. IPs are integral, along with health care epidemiologists, to applying these recommendations at their affiliates. There have been several notable gains in prevention when IPs apply well-supported infection prevention interventions.[22-24]

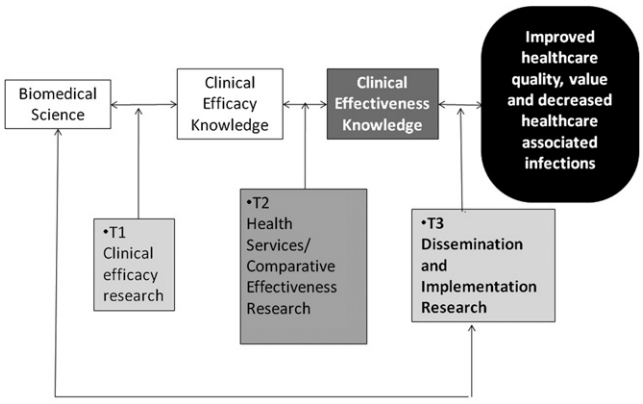

Fig 2. Illustration of 3 types of translational research.

An important role that APIC must fulfill is enhancing the skills of IPs in critical appraisal of the methodologic rigor and quality of published studies. An example of such assessment and its use by HICPAC has recently been described.[25] Other tangential skills include formulation of key clinical questions, searching the literature and applying findings to improve safety and quality of care. There is evidence that these skills along with certification in infection control and epidemiology correlate with more efficient and effective use of evidence to improve practice and prevent HAIs.[26,27]

''Dissemination and implementation science,'' a type of translational research, is a relatively new field of research, its overall purpose being to understand how best to translate research evidence into practice. The need for this emerging science grew out of the reality that, even when new knowledge is discovered and adequate research is available, there are many barriers to translating research into practice.[13,28,29] In the absence of effective implementation and evaluation, even the best research findings are only theoretical. Dissemination and implementation science must

Table 1. Three types of translational research

Translational level	Definition	Example
T1: Clinical efficacy research	Studies to translate basic biomedical science discoveries into knowledge needed for clinical efficacy	A comparison of the efficacy of hand hygiene agents in the reduction of bacteria and viruses[42]
T2: Health services/comparative effectiveness research	Studies to examine how these efficacious interventions actually work in everyday practice with different subgroups of patients/clinicians, ie, to determine whether they are effective and their value in "the real world"	A cost-effectiveness analysis of commercially available antimicrobial-coated central venous catheters[32]
T3: Dissemination and implementation research	Studies that "address the 'how' of high-quality health care delivery"[29] and assess how best to disseminate and implement best evidence into actual practice	A pragmatic cluster randomized active control trial in which settings are randomized to receive various quality improvement interventions[34]

increasingly become one of APIC's core areas of expertise.

To better understand dissemination and implementation science, it is helpful to review how research is typically translated into practice. Figure 2 displays the various ways in which research needs to be translated to improve patient outcomes, and Table 1 lists the definitions and provides examples.

The first step in translation (termed *T1*) is translating biomedical science into clinical efficacy knowledge. An example of this type of research is the experiment conducted by Sickbert-Bennett et al in which healthy individuals served as their own controls as the efficacy of various hand hygiene products were tested.[30]

In the past it has been recognized that we need to move beyond testing for efficacy of interventions (clinical efficacy research) to understanding how these interventions are implemented and how effective they are in actual practice. This type of translational science has often been called *health services and/or comparative effectiveness research* (termed *T2*). An example of T2 health services research is a study conducted Halton et al, in which the cost-effectiveness of commercially available antimicrobial-coated central venous catheters in the prevention of central line-associated bloodstream infections.[31]

Recognizing the distinction between clinical efficacy and clinical effectiveness is a critical first step to reduce infections and establish evidence-based practice. In addition, however, we must also better understand how to close the gap between research evidence and clinical (and public health) practice. This is the purpose of the relatively new field of research called *dissemination and implementation science*, which is the evaluation of translation of evidence into practice, sometimes referred to as *T3*.[13,28] Studies of this type test the effectiveness of various dissemination and implementation techniques. These studies are multidisciplinary and are often guided by theory and expertise in behavioral change, marketing, and/or organizational management.[32] While it may not be feasible to randomize patients to different settings with different implementation strategies, rigorous but pragmatic cluster-randomized approaches have been described.[33] Additionally, use of mixed methods and/or qualitative designs may be helpful.[34]

The HHS Action Plan's domestic research agenda made recommendations consistent with the need for dissemination and implementation research related to the prevention of HAI.[2] Table 2 outlines some of these recommendations. On a global scale, the WHO Guidelines on Hand Hygiene in Health Care similarly proposes a global hand hygiene research agenda for developed and developing countries.[35] It also poses a series of unanswered questions that define hand hygiene related issues for research and field testing.[35]

Several researchers have examined the effectiveness of single dissemination or implementation strategies.[23,36-38] More recently a composite of simultaneous implementation of evidenced-base interventions, also known as *bundles*, have resulted in significant reduction in incidence of HAIs.[23,39] However, much work remains. There is a paucity of well-designed T3 studies specifically designed to inform how best to disseminate and implement HAI prevention practices. These types of studies should test various implementation and dissemination practices to see what is most effective. An example of such a study is currently being conducted in Canada, which is designed to examine the effectiveness of various novel knowledge translation strategies related to improving the quality of care in intensive care units to decrease HAIs as well as other adverse patient safety outcomes.[33] In addition, there is a need to identify the subset of interventions that are the most effective to optimize efficient use of resources. In a review of dissemination and implementation research related to community-based cancer prevention, the authors found that more active and multimodal processes were more likely to be effective than passive processes and that not all strategies work for all people and in all

Table 2. Recommendations from the HHS action plan that are congruent with dissemination and implementation science*

Adherence to current prevention recommendations has been suboptimal
Adherence to current prevention recommendations in health care settings has been generally suboptimal, even when knowledge of recommended practices is sufficient. Several lines of evidence suggest that merely increasing adherence to currently recommended practices can result in a dramatic reduction in infection rates, at least for some infection types. A better understanding of the barriers to adherence, and strategies to overcome those barriers, are needed to promote improvements such as the following: 1. The use of technology to improve adherence 2. Better understanding of human and organizational factors that affect adoption and implementation of effective strategies 3. Standardized methods (ie, performance methods) that are feasible, valid, and reliable for measuring and reporting compliance with broad-based HAI prevention practices that must be practiced consistently by a large number of health care personnel (eg, compliance hand hygiene, isolation precautions, environmental cleaning practices) to prevent infections

*Based on data from reference 2.
HAI, health care-associated infections; *HHS*, Department of Health and Human Services.

settings.[40] These lessons learned in community-based cancer prevention are likely to apply to the prevention of HAI. In turn, understanding dissemination and implementation within infection prevention and hospital epidemiology can serve as a model to the broader health care community, similar to what we have seen with patient safety.[41]

There is a pressing need for these more real-world knowledge translation studies in infection prevention and control. APIC's approximately 13,000 members, many of whom are responsible for managing infection prevention programs, have an opportunity to assume a key role in translating science into practice and speed adoption of effective strategies. The diversity, collective skill, and broad and geographic representation of APIC's members, as well as the capacity of staff to facilitate research, uniquely positions APIC to play a key role in dissemination as well as dissemination and implementation research. This might be best facilitated by developing a network in which various implementation activities related to prevention of HAI could be tested. Such a network would link interested members and health care sites with appropriate researchers to facilitate the movement of innovative infection control and prevention strategies rapidly and effectively. Because this type of research is by necessity collaborative, it is more likely to succeed with a multidisciplinary team at each site. Therefore, APIC members should partner with hospital epidemiologists, infectious diseases physicians, intensivists, hospitalists, nursing personnel, and/or others in their organization when participating in these types of studies.

FUNDING SOURCES FOR DISSEMINATION AND IMPLEMENTATION SCIENCE

Dissemination and implementation science related to infection prevention is funded through a variety of mechanisms in the United States. These include federal sources such as the NIH, the AHRQ, the CDC, and the Centers for Medicaid and Medicare. By illustration, funding provided by AHRQ for HAI prevention research has grown to over $35 million in 2009. Additionally, the Veteran's Affairs Health Services Research and Development Service funds Veteran's Affairs-affiliated researchers to study topics related to improving the health (including infection prevention) in veterans. State and/or local funding is also sometimes available. Foundations, such as the Robert Wood Johnson Foundation, the Commonwealth Foundation, or the National Patient Safety Foundation are also sometimes interested in funding research related to infection prevention. Lastly, industry often supports research by offering both restricted and nonrestricted grants.

There are a number of federal funding opportunities relevant to infection prevention. For example, there was a recent AHRQ program announcement PA-10-089 entitled ''Prevention and Management of Healthcare Associated Infections.'' This funding mechanism is for health services research, demonstration, dissemination, and evaluation grants (see http://grants.nih.gov/grants/guide/pa-files/PA-10-089.html). While not specific to infection prevention, the NIH recognizes the need for dissemination and implementation research and has held an annual conference on the topic over the last 3 years (see http://obssr.od.nih.gov/scientific_areas/translation/dissemination_and_implementation/index.aspx). Additionally, on this Web page there are links to Funding Opportunity Announcements (PAR-10-038, PAR-06-520, PAR-06-521).

Information regarding the availability of infection prevention specific research funding outside of the United States is less readily available. However, many national professional associations routinely offer small sums of money for local research, as does the International Federation of Infection Control (see http://www.theific.org/scholarships.asp). Additionally, non-US-based device manufacturers and governments may periodically offer research funding to IPs and academics as do government. (see: http://www.aica.org.au/images/PDF_Files/Scholarships/WC_103_10_09_Scholorship_LR_(2).pdf, http://www.nhmrc.gov.au/media/media/rel09/091013-partnership-grants.htm). The newly formed APIC International Section has a task force on research, which should help

identify funding opportunities as well as collaborative opportunities. In recent years, international funding for patient safety research has expanded with WHO coordinating a Small Grants Research Programme (see: http://www.who.int/patientsafety/research/grants/en/index.html).

CONCLUSIONS AND VISION GOING FORWARD

Our vision builds on the strength of APIC's membership, which is the practicing IPs. As we know, many basic infection prevention processes (eg, hand hygiene) are not adhered to optimally, and it is the role of the IP to not only measure the rate of infections but develop tools and provide education that will help other clinicians increase their adherence to these basic processes. To do this, IPs must be active consumers of research. IPs everywhere should be proficient in the skills needed to critically appraise science, keep up with the rapid generation of new knowledge, and apply wisdom to establish evidence-based practices to improve patient care delivery. With these skills, IPs may act as an accelerant for the application and translation of evidence reducing the time lag that currently exists between the generation and adoption of knowledge.

As advanced clinicians, IPs should be participating in the research process, setting the research agenda for themselves (not having others do this) and using the best level of evidence. We believe that APIC's authority and the authority of the IP comes through working together to study how best to apply what is known (ie, dissemination and implementation networks that will rigorously test how best to achieve success). It is through networking that evidence-based solutions can be shared on a broad basis (between settings as well as across continents). One mechanism to facilitate this would be the formation of an APIC's Science, Knowledge, and Implementation Network (ASK-IN).

Specifically, we believe that APIC and its members have the power to create success. We believe that this process should be rigorous, open, and transparent for the good of all IPs and of course for the improvement in the safety of the patients. In the United States and across the globe, there is still much to learn about how best to prevent and control HAI. This will consistently be true with the emergence of new infections, changing and aging demographics, and health care reform that changes the setting in which care is given. APIC and its membership play critical roles in the research process, especially in terms of setting the research agenda so that research resources can be directed to important areas. Additionally, dissemination and implementation is an area in which APIC members can apply their unique skills and competencies to ensure that patients receive the most up-to-date and evidence-based infection prevention practices possible. We should do this together, and we should do this now.

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