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“It takes a village” to raise research productivity: Impact of a Trauma Interdisciplinary Group for Research (TIGR) at an urban, Level 1 trauma center

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Abstract

BACKGROUND—Few interdisciplinary research groups include basic scientists, pharmacists, therapists, nutritionists, lab technicians, as well as trauma patients and families, in addition to clinicians. Increasing interprofessional diversity within scientific teams working to improve trauma care is a goal of national organizations and federal funding agencies like the National Institutes of Health (NIH). This paper describes the design, implementation, and outcomes of a Trauma Interdisciplinary Group for Research (TIGR) at a Level 1 trauma center as it relates to increasing research productivity, with specific examples excerpted from an on-going NIH-funded study.

METHODS—We utilized a pre-test/post-test design with objectives aimed at measuring increases in research productivity following a targeted intervention. A SWOT (strengths, weaknesses,

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opportunities, threats) analysis was used to develop the intervention which included research skill-building activities, accomplished by adding multidisciplinary investigators to an existing NIH-funded project. The NIH project aimed to test the hypothesis that accelerated biologic aging from chronic stress increases baseline inflammation and reduces inflammatory response to trauma (projected N=150). Pre/Post-TIGR data related to participant screening, recruitment, consent, and research processes were compared. Research productivity was measured through abstracts, publications, and investigator-initiated projects.

RESULTS—Research products increased from N =12 to N=42; (~ 400%). Research proposals for federal funding increased from N=0 to N=3, with success rate of 66%. Participant screenings for the NIH-funded study increased from N=40 to N=313. Consents increased from N=14 to N=70. Lab service fees were reduced from \$300/participant to \$5/participant.

CONCLUSIONS—Adding diversity to our scientific team via TIGR was exponentially successful in 1) improving research productivity, 2) reducing research costs, and 3) increasing research products and mentoring activities that the team prior to TIGR had not entertained. The team is now well-positioned to apply for more federally funded projects and more trauma clinicians are considering research careers than before.

Keywords

research activity; interdisciplinary communication; trauma centers; wounds and injuries; multiple trauma

INTRODUCTION

Research productivity at verified trauma centers is required by the American College of Surgeons Committee on Trauma (ACSCOT) ¹ and is an expectation for clinical faculty at academic medical centers. Time to conduct research is associated with high job satisfaction for surgeons.² Despite this emphasis, federal funding for trauma research, one measure of research productivity,³ is significantly lower for trauma clinician-scientists at only \$200 per year of potential life lost (YPLL), compared to funding for HIV research (\$16,000/YPLL) and breast cancer (\$3,000/YPLL).⁴

According to the Multisociety Strategic Planning Task Force for Critical Care Research,⁵ significant barriers to research productivity exist, including the lack of an interdisciplinary approach. Increasing interdisciplinary research is a goal of the National Institutes of Health (NIH) and national specialty associations, including the Eastern Association for the Surgery of Trauma (EAST) the Society for Critical Care Medicine (SCCM), and the American Association of Critical Nurses (AACN).^{5,6}

Evidence supports that research groups increase research productivity by creating a culture of scholarly activity.^{7,8} Groups composed of interdisciplinary members are highly desired by federal funding agencies like the NIH.⁹ Interdisciplinary members are particularly relevant for trauma research, since trauma care is delivered within an interdisciplinary system that includes not only physicians and nurses, but also pharmacists, respiratory and rehabilitation therapists, nutritionists, and laboratory specialists.

Although interdisciplinary research teams are an important component of the NIH-roadmap,⁹ we found no references describing the development, implementation, and products of such teams in the trauma literature. We did find one report that described a similar process, but it was limited to interdisciplinary team building as it relates to trauma performance improvement and patient safety.¹⁰ Other reports were limited to non-acute care or academic settings.¹¹⁻¹⁴ Thus, the purpose of this paper is to describe the design,

implementation, and outcomes of a Trauma Interdisciplinary Group for Research (TIGR) at a Level 1 trauma center as it relates to increasing research productivity, with specific examples excerpted from an on-going NIH-funded study.

METHODS

Recently, the Georgia state legislature allocated \$59,000,000 to improve the state trauma system, of which, research activity is a vital component.¹⁵ Soon thereafter, representatives from the ACS Trauma System Consultation program conducted an assessment of the state system with recommendations for increasing research productivity.¹⁶ In response to these events, we assessed our programmatic research productivity and found it to be lower than that which we desired as an urban, Level 1 trauma center which treats ~1,800 patients/year. Consequently, we designed and implemented a division-level initiative to increase trauma research productivity at our institution.

Framework

We designed our intervention based on a S.W.O.T. (Strengths, Weaknesses, Opportunities, and Threats) analysis of our research program. Strengths included a highly motivated team, doctoral-level research training from nurse and basic science members, and fundable ideas for trauma studies. Weaknesses included a lack of consistent and sustained investigator-initiated research and scholarship; defined by numbers of abstracts, publications, and research projects. Opportunities included trauma-related requests for applications (RFAs) from NIH and other funding agencies and calls for interdisciplinary collaboration from national organizations. Threats were consistent with the literature,^{5,12} and included a lack of research capacity; defined as “the process of...development which leads to higher levels of skills and greater ability to perform useful research” and the very limited number of federally-funded trauma research programs after which our program could be modeled.

Interventions

Based on support for the effectiveness of research groups in generating a research-rich environment,⁷ we created the Trauma Interdisciplinary Group for Research (TIGR) in 2008. TIGR was the brainstorm of two trauma nurses who received terminal research (PhD) and evidence-based practice (DNP) degrees in 2007 and 2009. It connected individuals from multiple colleges across our campus, including clinical and basic scientists, nurses, respiratory and physical therapists, nutritionists, pharmacists, information service technicians, medical illustrators, and representatives from our Center for Patient and Family-Centered Care. Through TIGR, clinician and basic scientists helped create a culture of research and assisted others who had comparatively less research training to write and submit scholarly products.

TIGR also helped mitigate threats to productivity by building research capacity and increasing research-related skills. After several meetings to network, learn the respective professional cultures, and immerse ourselves in the group mission, members decided that, based on the principals of problem-based learning,^{17,18} we could best mentor research skills through a funded research project.

Funded clinician-scientists joined other TIGR members to develop a research idea from the SWOT analysis into an NIH-funded study that is currently in progress.¹⁹ The prospective design they developed capitalizes on the interests and prior publications of TIGR members. The aims test the hypothesis that accelerated biologic aging from chronic stress increases baseline inflammation and reduces inflammatory response to trauma, which increases susceptibility to sepsis and organ failure. TIGR members with Emergency Department (ED)

and ICU experience²⁰ identified a recruitment goal of N=300 within our Level 1 trauma ICU setting (later reduced to 150 per protocol amendment). Inclusion criteria were: 1) age 18-44 years; 2) transport to the ED directly from the scene of the injury. Exclusion criteria were 1) ICU admission >24 hours post-injury; 2) spinal cord injury; and 3) comorbidities effecting immune function (e.g. HIV, cancer). Consulting with basic scientists identified important independent variables, such as chronic stress measured by dihydroepiandrosterone sulfate (DHEA-S) and hair cortisol. Nurses located chronic stress questionnaires with reliability and validity for being answered by the patient or the next-of-kin. An MD/PhD geneticist with expertise in inflammatory biomarkers^{21,22} helped define accelerated biologic aging as reduced telomerase activity and identified baseline inflammatory markers. Dependent variables were susceptibility to sepsis defined by the rate of increase and peak magnitude of inflammatory cytokines and immature neutrophils collected from ED through ICU length of stay. Susceptibility to organ failure was defined in collaboration with physician TIGR members. With NIH-funding and institutional review board (IRB) approval secured, investigators began consenting participants and collecting data. In compliance with IRB protocols, we obtained informed consent from all participants to-date.

Measures

We measured outcomes at the end of a 5-year implementation period. Consistent with our SWOT framework, we measured research productivity based on the “weaknesses” and “threats” by comparing numbers of abstracts, publications, and investigator-initiated research proposals^{3,16} over 5 years pre- (2003-2007) and post- (2008-2012) TIGR. Research capacity was measured by successful mentored skill-building activities^{12,13} implemented via the funded grant. Activities included recruitment, screening, and consent, as well developing resource-efficient processes for data collection, preparation, and analysis. Research skill-building is needed for clinicians who lack experience in implementing scientific investigations.^{12,13,23} Recruitment and process activities were chosen because of well-documented difficulties in recruiting research participants from trauma/critical care populations.^{24,25}

RESULTS

We significantly increased our outcome measures post-TIGR. Abstracts, publications, and investigator-initiated proposals rose from a pre-TIGR N=12 (Table 1) to a post-TIGR N=42 [~400%] (Table 2). Submissions for federally-funded research proposals increased from N=0 to N=3, with a success rate of 66%. This trend has continued, with 6 new proposal submissions in 2012 alone. Reported gains were achieved with a relatively stable faculty. New collaborations with federally-funded interdisciplinary investigators via TIGR changed the culture of the program from less research-oriented to more research oriented. Consequently, the same faculty produced more research.

TIGR-initiated interventions to mitigate threats to the research program by building research skills have also been successful. During the implementation of the NIH-funded grant, early challenges in participant screening and consent were overcome through frequent and close collaboration with TIGR. Ideas generated through TIGR helped increase participant screenings from N=40 in the first year to N=313 in the second year; an 8-fold increase. Similarly, TIGR was responsible for increasing consents from N=14 in the first year to N=70 the second year; a 5-fold increase.

Improvements in our ability to develop resource-efficient processes for data collection, preparation, and analysis were also achieved. Initial estimates from clinical laboratory personnel for 24/7 assistance with biological sample preparation and storage were \$300/sample. This quote was based on charges to outside entities for similar services that were

strictly clinically-oriented, and not research-oriented. Consequently, TIGR members engaged institutional research leadership to negotiate a reduced, research-oriented fee of \$5/sample; a 98% cost reduction from the previous estimate. These activities combined to help make the research project a success so far. To date, we have consented and collected data from 70 participants. Early data analyses have shown significant findings for the project,²⁷ the details of which being prepared for another manuscript.

DISCUSSION

This is the first known report of the successful implementation of a trauma interdisciplinary group for research expressly to increase programmatic research productivity and capacity at a Level 1 trauma center in accordance with the ACSCOT guidelines.¹

Increasing research productivity in clinical programs is an ongoing challenge. The Multisociety Task Force for Critical Care Research (MTFCCR) recently published four primary barriers to conducting critical care (and trauma) research.⁵ This task force resulted from a consortium consisting of interdisciplinary representation from the American Association of Critical Care Nurses, the American College of Chest Physicians, the American Thoracic Society, and the Society for Critical Care Medicine brought together to identify an overarching critical care research agenda. We believe our approach to increasing research productivity within our trauma program addresses a majority of these challenges.

MTFCCR identified that the “traditional, silo-ed approach to research, defined as suboptimal collaboration or research between professionals who share a limited sphere of interest, must be altered.”⁵ Unlike many research groups, TIGR is not limited to physicians and nurses, or physicians and basic scientists. Like MTFCCR,⁵ we consider this a continuation of the “silo-ed” approach to research because the professional environments of these individuals is the same (e.g. trauma nurse and trauma physician), or because research interests are limited to the same physiologic system (e.g. physicians and basic scientists). Such commonalities may begin as an advantage, but the “suboptimal collaboration” that occurs without outside members or those peripheral to healthcare creates a disadvantage that teams may not be acutely aware of. In simpler terms, “you don’t know - what you don’t know” and teams will never know the true advantages of diversity of thought without purposefully inviting it.

In contrast to most research groups we found, TIGR includes the entire health care team, including respiratory therapists, nutritionists, rehabilitation specialists, and laboratory technicians in addition to physicians and nurses. Consistent with MTFCCR recommendations⁵ TIGR also includes basic scientists, information technicians, medical illustrators, social scientists, and trauma patients and families themselves. Inviting trauma patients and families to participate as sub-investigators on grant submissions follows the principals of community-based participatory research methodology in which members of the community of interest participate fully in the research that affects them most directly.²⁸ Importantly, the practice is also supported by the mission and vision of federal funding agencies like the Patient Centered Outcomes Research Institute.

These successes are a direct result of our conscious choice to invite these individuals to join TIGR. Many members had not met one another before TIGR, but because the research interests of the group co-founder focused on clinical and translational research, she was aware of the common interests among the diverse group invitees. Networking meetings were held away from the academic medical campus which housed the trauma center and focused on identifying mutually beneficial relationships. Common research efforts previously unknown to individuals were brought forth and extended through new collaborations. Senior investigators from multiple colleges provided training to individuals with a passion for

trauma research, but comparatively less exposure to it. These actions were instrumental in making professionals from different research and clinical cultures, as well as trauma patient/family TIGR members, feel welcomed and valued.

Through this investment in relationship-building, we improved our communication, understanding, and respect for one another, which translated into measurable increases in research products. While implementing the NIH-funded study, we improved our research skills by learning techniques from nurses and other bedside clinicians that helped build trust in patients and families who were potential research participants. Applying these skills improved our success for participant screening and consent. Directly involving bedside clinicians in the study helped them answer study-related patient questions. We also developed resource-efficient processes for data collection, preparation, and analysis by consulting with TIGR members from the clinical laboratory. This resulted in a successful collaboration for 24/7 coverage for biological sample preparation and storage. Basic scientists also suggested better processes for preserving participant samples and efficiently completing biological assays.

The second challenge to research identified by MTFCCR was the need to link research from different areas more effectively to improve patient outcomes.⁵ MTFCCR explained that greater collaboration is needed between basic and clinical scientists to move research from the bench to the bedside more quickly and to incorporate suggestions learned from community involvement into the critical care arena. By working through our study, TIGR clinical scientists have had exposure to bench laboratory work in ways they would not otherwise have pursued. Similarly, TIGR bench scientists who study sepsis at the cellular-level requested to observe patient symptoms in action, and have visited the trauma ICU unlike many their bench-science colleagues. Bedside observations by TIGR nurses, respiratory therapists, and others provided the idea for the study, and clinical processes identified by laboratory technician members and clerical personnel improved the study procedures.

TIGR is also linking research between the bench, bedside, and community through our future research agenda. Community scientists who usually investigate the effects of stress on the inflammatory and vascular response system of African American youths^{22,29,30} were consulted to apply this work in our study investigating the effects of chronic stress prior to trauma on the inflammatory response after trauma.¹⁹ Interestingly, early analyses have shown significant differences in baseline white blood cell counts for African-American trauma patients.²⁷ These findings support earlier published work by members of the same group.³¹ In another example, TIGR members from nursing, information services and medical illustration have joined with clinician scientists to test computer-based patient education software developed in collaboration with patient and family advisors.³² Patients and families helped TIGR members create this mini-clinical trial using their experience, which we hope will help make it easier to implement the findings into practice.

The third challenge MTFCCR identified is that “future approaches to human research must account for the complexity of critical illness.”⁵ This includes accounting for “factors that provoke dysfunction in multiple organ systems.” While developing ideas into grants, TIGR identified deviations from the normal inflammatory response to trauma as one such factor. The systemic inflammatory response syndrome and its counterpart, the compensatory anti-inflammatory response syndrome, are well-established precursors to sepsis and multiple organ dysfunction and failure following trauma.³³ Significantly, chronic stress has also been correlated to inflammatory changes unrelated to trauma.³⁴ TIGR is testing these relationships to help us understand common mechanisms in the genesis of inflammatory-related complications of trauma. TIGR’s future research productivity is secured by applying

these findings to develop prognostic biomarkers and therapeutic interventions which we believe will improve outcomes and increase the cost-effectiveness of care – another NIH funding priority.

The national research group known as the Inflammation and Host Response to Injury Collaborative Research Program,³⁵ studies similar concepts and is one of a limited number of federally-funded trauma research groups after which TIGR could be modeled. This highly productive group also addresses the research challenges published by MTFCCR⁵ and features diverse representation from trauma surgery, infectious disease, pathology, public health, cell biology, and molecular medicine. While the mission of TIGR differs slightly from that of this group by appealing to individual trauma programs vs. national research collaboratives, this national group appears limited to representatives from clinical medicine as opposed to representatives from all of the health professionals who care for and investigate mechanisms of pathology for trauma patients. We believe that the organization of this group, which includes 1) a core advisory committee to set individual research priorities; 2) a steering committee to advise the direction of the entire research program; and 3) an external advisory committee to assist principal investigators,³⁵ is an excellent example of a successful trauma research program framework.

TIGR's success at increasing programmatic research productivity has nationally-relevant applications. In presenting the NIH 2012 budget, NIH Director Francis Collins emphasized targeted investments in "areas of promise for biomedical science to advance public health".³⁶ This is exactly what research groups like TIGR aim to do. With more than 42 million trauma-related ED visits per year, and responsibility for 30% of all life-years lost in the United States (more than cancer, heart disease, and HIV combined),³⁷ trauma is a significant public health problem. Direct collaboration between diverse individuals who can apply biomedical sciences to develop new prognostic and therapeutic tools for trauma care creates very fundable research teams. Research products from these teams also places them in great position for funding nods from the newly proposed NIH National Center for Advancing Translational Sciences.³⁶ In this way, interdisciplinary teams like TIGR could be a model for the continuum of translational research within an otherwise very challenging funding environment.

There are important limitations to this work that should be noted. TIGR's results are best applied by trauma clinical scientists with a mandate (self-imposed or otherwise) to improve research productivity in accordance with ACSCOT verification guidelines at their own institutions. Our results are further limited to Level 1 trauma centers at academic medical centers with access to independently-funded clinical, basic, and/or social scientists, in addition to clinicians interested in research and individuals outside of healthcare who have a desire to help improve outcomes for trauma patients. We do not believe our results were due to a Hawthorn effect because research productivity was motivated by ASCOT verification guidelines and NIH grant deadlines and investigators did not know that research productivity results would be measured and disseminated as part of an independent project.

In conclusion, adding professional diversity to our scientific team was exponentially successful in improving research productivity and reducing research costs. The team is now well-positioned to apply for more federally funded projects. Future initiatives will offer trauma research training opportunities to graduate students and fellows through collaborative scholarship, from idea to publication.

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Authorship. EGN and RSM are co-founders of the TIGR. All authors are active TIGR participants and investigators on the referenced NIH-study (Grant #5K01NR011471). EGN and RSM are Co-Principal Investigators for the TIGR research productivity study. EGN is the Principal Investigator for the NIH study. EGN drafted the manuscript and all co-authors reviewed and assisted with revisions of the manuscript. All co-authors contributed to the study designs of both the TIGR-research productivity study and the NIH study during the development and revision phases, and participated the implementation of both studies as sub-investigators.

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Figure 1. Defining framework for building research productivity

Table 1

Pre-TIGR research productivity

PRE-TIGR YEAR	ABSTRACTS	PUBLICATIONS	RESEARCH*	RESEARCH PRODUCTS
2003	0	0	0	0
2004	0	3	0	3
2005	0	2	0	2
2006	1	1	0	2
2007	4	1	0	5
TOTAL	5	7	0	12

* Investigator-initiated (i.e. not industry-sponsored protocol or multi-center trial)

Table 2

Post-TIGR research productivity

POST-TIGR YEAR	ABSTRACTS	PUBLICATIONS	RESEARCH*	RESEARCH PRODUCTS
2008	0	1	4	5
2009	8	2	0	10
2010	1	2	2	5
2011	12	1	1	14
2012	5	3	0	8
TOTAL	26	9	7	42

* Investigator-initiated (i.e. not industry-sponsored protocol or multi-center trial)