

Conducting Interdisciplinary Research to Promote Healthy and Safe Employment in Health Care: Promises and Pitfalls

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SYNOPSIS

Due to the complexity of human health, emphasis is increasingly being placed on the need for and conduct of multidisciplinary and/or interdisciplinary health research. Yet many academic and research organizations—and the discipline-specific associations and journals—may not yet be prepared to adopt changes necessary to optimally support interdisciplinary work. This article presents an ongoing interdisciplinary research project's efforts to investigate mechanisms and pathways that lead to occupational health disparities among healthcare workers. It describes the promises and pitfalls encountered during the research, and outlines effective strategies that emerged as a result. Lessons learned include: conflict resolution regarding theoretical and methodological differences; establishing a sense of intellectual ownership of the research, as well as guidelines for multiple authorship; and development and utilization of protocols, communication systems, and tools. This experience suggests a need for the establishment of supportive structures and processes to promote successful interdisciplinary research.

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Given the complexity of human health, emphasis is increasingly being placed on health research conducted by groups consisting of more than a single discipline. Funding agencies call for research that is multidisciplinary or interdisciplinary. Universities are establishing interdisciplinary departments and programs. What remains uncertain, however, is the degree to which academic and research organizations, and the associations and journals of the disciplines themselves, are prepared to change in order to support interdisciplinary work. The structures for credentialing, advancement, and promotion within academic and scientific institutions remain discipline-based. It is one thing to acknowledge the complexity of health issues, and quite another to commit to a restructuring of health sciences that will develop the next generation of researchers prepared to make the transition from multidisciplinary to interdisciplinary research, and hopefully to transdisciplinary research.

In late 1999, a diverse team of researchers from three University of Massachusetts Lowell (UML) colleges (health professions, engineering, and arts and sciences) began meeting to consider a response to a National Institutes of Health (NIH) request for application (RFA) that addressed the mechanisms resulting in health disparities. The RFAs had a stated purpose to “. . . foster multidisciplinary research . . .” and indicated NIH’s belief that the “. . . integration of qualitative and quantitative research methodologies . . .”¹ would be needed to meet programmatic goals. The UML team’s proposal to study occupational injury and general health disparities among health care workers was accepted and the team was awarded a grant to support research entitled, “Health Disparities among Health Care Workers.” The research effort was viewed as an opportunity to enhance the UML mission to study and support sustainable regional development by demonstrating the critical importance of health and health care as criteria for social and economic sustainability. The proposal built on UML’s recent emphasis on multi- and interdisciplinary research and relationships the university had established with area health care provider organizations and labor unions that represent health care workers. This article presents the ongoing interdisciplinary research project as an example of the promises and pitfalls of integrating diverse disciplines and methodological approaches to more comprehensively investigate and understand health disparities.

HISTORY OF SUPPORT FOR INTERDISCIPLINARY RESEARCH AND TEACHING

Since the mid-1980s, the UML faculty and administration have taken many steps to promote and support multidisciplinary academic, research, and service efforts. Collaboration among natural scientists and engineers has been strongly encouraged, and several research centers have supported these efforts. A new interdisciplinary department, the Department of Work Environment (DWE), was established in 1987 to address occupational and environmental health issues. Steadily, DWE faculty and staff developed integrated curriculum, collaborated on research and service projects, and spawned two institutes and a center that support multidisciplinary efforts.

In the early 1990s, UML Chancellor William Hogan presented and promoted a new university mission: to support sustainable regional social and economic development through teaching, research, and public service. In doing so, he set a direction to integrate the breadth of university expertise to address and support the academic and research needs of the Merrimack Valley region of Massachusetts. In the mid-1990s, another interdisciplinary department—the Department of Regional Economic and Social Development (RESO)—was created, establishing major study areas directly related to the UML mission. RESO brought together faculty from the disciplines of community psychology, economics, history, labor history, management policy, political science, and sociology.

UML strongly supports faculty involvement in setting directions for academic, research, and service efforts. Throughout this period of mission-related expansion, several councils were established to advance interdisciplinary integration throughout university activities. These included councils for Teaching, Learning, and Research as Scholarship; Diversity and Pluralism; and Regional Development. The Council for Regional Development oversees two committees established to promote and further the university’s mission:

- The Committee for Industrial Theory and Assessment (CITA). This group facilitates research and service projects with the aim of engaging the university community through study of the region and of regional development to assess the contributions of enterprises, organizations, communities, and institutions to the innovative performance of the regional economy. This committee has encouraged a multi- and interdisciplinary approach, providing annual seed grants and commissioning papers for annual conferences, and bringing together faculty and staff, and sometimes

community partners, to discuss a wide range of regional development issues.

- The Committee of Federated Centers and Institutes (CFCI), a faculty group composed of center and institute directors.² CFCI “. . . coordinates and supports the research centers and institutes at UML . . . [which] . . . provide focus for innovative, multidisciplinary work that connects research to real-world problems.” CFCI’s January 1998 “Policy Statement on Innovation” lists “promote collaboration” and “involve multiple disciplines” as the first two of six aspects of innovation.

Two additional supports for cross-disciplinary efforts were established at UML: an Office for Collaborative Research and a university-wide Public Health Initiative (PHI). The PHI has the goal of fostering inter- and multidisciplinary research and service projects with a health focus through collaboration among departments, centers, and institutes.^{3,4}

THE HEALTH DISPARITIES PROPOSAL

In late 1999, a diverse team of researchers from three UML colleges (health professions, engineering, and arts and sciences) began meeting to consider a response to a National Institutes of Health (NIH) request for application (RFA) that addressed the mechanisms resulting in health disparities. The RFA’s stated purpose was to “. . . foster multidisciplinary research . . .”¹ It indicated NIH’s belief that the “. . . integration of qualitative and quantitative research methodologies . . .”¹ would be needed to meet programmatic goals.

The opportunity to compete for a sizeable grant that would support multidisciplinary research to address an issue of social justice was initially attractive to a small group of UML researchers. Using networks established through the university’s existing interdisciplinary organizations, others were invited to join a process to determine the possibility of developing and submitting a proposal. The group consisted of researchers from the following disciplines: biology and nutrition, biostatistics, community psychology, economics, epidemiology, ergonomics, health education, health policy, health care administration, industrial hygiene, industrial policy, medicine, nursing, political science, public health, sociology, women’s studies, and work environment policy.

After several meetings, the group decided to address occupational illness and injury disparities within one of three employment sectors: retail, higher education, or health care. Partially due to strong relationships with Merrimack Valley region health care pro-

vider organizations that had been fostered over time by faculty from the UML College of Health Professions, the team decided to study the health care industry. The UML Office of Collaborative Research committed funding to support the proposal development work. Some members of the team withdrew from the process, for a variety of reasons, but many remained to develop a successful proposal. The proposal was accepted with a grant to support a research project entitled “Health Disparities among Health Care Workers.” To give the project—which includes a community outreach and education program—a recognizable public face, we chose the name PHASE (Promoting Healthy and Safe Employment) In Healthcare. Our team became known as the PHASE In Healthcare Research Team. To provide information to the public, we established a web site at <http://www.uml.edu/phase/>.

WHAT KIND OF RESEARCH? WAYS OF WORKING WITH OTHERS

Although the academic community may feel quite comfortable with the use of the terms “multidisciplinary” and “interdisciplinary” regarding research, the meanings of these terms, this type of research, and some of its intrinsic challenges are understood differently by researchers across different disciplines. The need for clarity and consistency led us to review operational definitions for multidisciplinary, interdisciplinary, and transdisciplinary research that could potentially serve as a framework for the team’s efforts. Analysis of the literature from different disciplines led us to choose the following definitions:

- Multidisciplinary research teams work in parallel or sequentially from their specific disciplinary base to address a common problem.
- Interdisciplinary research teams work jointly but still from a discipline-specific base to address a common problem.
- Transdisciplinary research teams work using a shared conceptual framework, drawing together discipline-specific theories, concepts, and approaches to address a common problem.⁵

Literature on the topic often concludes that interdisciplinary research is likely to be much more challenging than multidisciplinary research, given the more significant obstacles implied in an interdisciplinary effort. Despite these challenges, the work of our team soon took the shape of an interdisciplinary effort. This was probably due to researchers having met since the beginning of the proposal development process to shape a proposal and learn from each other about different approaches and research methodologies.

CONCEPTUAL CHALLENGES OF INTERDISCIPLINARY RESEARCH

Fuchs identifies three major factors that are likely to challenge the development of interdisciplinary research. Disciplines differ (1) in the concepts that are considered foundations of their analyses, (2) in the questions they seek to answer, and (3) in their research methods.⁶ The PHASE In Healthcare Research Team has experienced such differences in the application of its research. In this article, we report how these differences have impacted our research effort and describe the steps we took to address these challenges.

Differences in concept

Our research team included disciplines in the natural and medical sciences, as well as the social sciences. Each discipline may have a stronger preference for, and expectation toward, the use of more qualitative vs. quantitative methods. In contrast to the natural and medical sciences, Walker asserts that “. . . the social sciences do not seek to limit experience to the conditions of systematic observation, the requirements of measurement, but rather to open boundaries of the experiences that may be inquired into.”⁷ Within some of the social sciences, qualitative methods may be employed more commonly than in the medical sciences. Yet social science researchers may approach research similarly to natural and medical science researchers because of the dominance of a positivist orientation to scientific practice, regardless of their methodology.⁸

Our research team quickly realized that its members are limited to some extent by their discipline-based education and research training, which, as Walker suggests, “. . . induct researchers into one or other perspective but rarely into both.”⁷ The difficulties encountered by various researchers attempting to understand one another are substantial, as each may be so fundamentally different in philosophy, theory, and method.

Rosenfield offers the following advice about how to sustain and extend linkages between the health and social sciences:

While a disciplinary basis must be the natural starting point for each team member, the starting point rapidly becomes the limiting factor in problem definition, collection and analysis of data, and interpretation of findings. Each team member needs to become sufficiently familiar with the concepts and approaches of his or her colleagues as to blur the disciplinary bounds and enable them to focus on the problem as part of broader phenomena; as this happens, discipline authorization fades in importance, and the prob-

lem and its context guide an appropriately broader and deeper analysis.⁵

Consistent with this recommendation, at an early stage of our project we planned a series of seminars to educate participating researchers about their team members' various disciplines. During the first of such meetings, each investigator was asked to take five minutes to write a sentence about their individual understanding of the main content of each discipline represented on the project. The intent was to begin a dialogue for future activities in which we would learn about each discipline's language and conceptual framework.

Over a six-month period, five two-hour sessions were held to provide each researcher the opportunity to brief the team about the main concepts and issues covered in the individual's discipline. These conversations were extremely useful because they highlighted misunderstandings about each other's conceptual framework, similarities in research questions, and difficulties in agreeing about priorities, methodologies, and terminologies.

Through this process, we were able to dispel some myths and misunderstandings about each other's disciplines. Interestingly, we learned that our political perspectives could also unite or divide us—that is, our understandings about the processes of individual and social change and of the ways that social power relationships frame the context for health. In fact, as challenging as working across disciplines may be, some of us have come to wonder if the more difficult challenge is working on teams where members have differing or even opposing political orientations to their work. In health research, two tendencies (which are not mutually exclusive) exist: focus on individuals and their behavior (medical/specific etiology model), and focus on structural/contextual roots of health problems (public health/social determinants model). Our discussions of occupational injuries resulting from assaults and interpersonal violence provide an example of this. Some team members believed strongly that prevention of these injuries required the establishment of effective violence prevention systems—and that failure to do so indicated employer irresponsibility to provide a safe workplace. Other team members believed that individual perpetrators were to blame for these injuries and that they needed to be held individually accountable for their hostile behavior—and found it difficult to see this problem systemically. In this case, the discipline differences were not as wide as the political differences. This is not to deny the discipline-rooted differences, but to note that we should

not attribute all communication challenges to discipline-based misunderstanding.

Differences in questions

The different conceptualization implicit in each discipline creates challenges, not only because of the difficulty in understanding each other's backgrounds, but also because it has an immediate impact on the questions that each discipline addresses on a specific topic. Any researchers who decide to join an interdisciplinary team are likely to bring their personal histories, reflecting their own research expertise and priorities. It is not enough, therefore, for an interdisciplinary research team to educate itself about the conceptual framework of each discipline. From the outset of any interdisciplinary project, team members need to present and discuss the research questions they seek to answer. In our case, the researchers who had participated in developing the proposal decided to study whether the socioeconomic gradient in health could be explained by different working conditions. Despite this common focus, disciplines could have interpreted this question in significantly different ways.

To understand these differences and to address potential conflicts in research priorities from the outset, the team scheduled a retreat wherein four members were asked to describe how their disciplines (community psychology, economics, epidemiology, and political science) would approach this research topic. These four disciplines were selected because they were the least familiar to the majority of the research team. Our discussions indeed revealed deep differences, as well as similarities across disciplines.

Epidemiology can probably claim the largest body of research on the relationship between socioeconomic status and health. Indeed, thanks to the analyses conducted by epidemiologists, there is virtually an international consensus about the existence of a clear relationship between socioeconomic and health status. Now epidemiologists seek to go beyond this finding and explore the causal mechanism(s). In our study, this means characterizing job and workplace features that might help to explain the relationship between socioeconomic status and health. Epidemiologists aim to increase the methodological validity of their studies by addressing issues of selection biases, validity of measurement variables, and the role of confounding variables in order to ensure that the association is not an artifact of these.

Economists are interested in using data and econometric techniques to produce more precise estimates of such relationships. For example, they discuss the role played by additional variables that can simulta-

neously affect both income and health, such as differences in individuals' ability and willingness to make choices that will bring positive rewards only in the future. Also, because of their interest in behavioral economics, economists want to go beyond the analysis of the role played by absolute levels of income. In our study, this leads to exploring whether issues of relative wages, job status, and fairness in promotion practices or task assignments shape the relationship between socioeconomic status and health. However, economists also look at health as an economic resource. Therefore, they still question the direction of causality between economic status and health by modeling and testing whether poor health can actually lead to lower economic status. For example, economists would examine whether work-related health problems jeopardize individuals' abilities to keep their jobs or maintain stable employment.

Political science shifts the focus of the discussion by asking how the phenomenon can be explained by looking at who has control over the distribution of economic and other resources, and, therefore, who has the power to determine health outcomes. Political scientists look at how economic factors, together with institutions such as government, unions, and professional associations, may alter the balance of power within the workplace. When it comes to occupational health and safety regulations, for example, power may imply control over individual workers' health and control over the design of the workplace and work processes.

Finally, community psychologists adopt a "social ecological paradigm" for understanding individual outcomes. This discipline works from the assumption that individual behavior is "nested" within several levels of analysis that range from the individual, to the small group, to the institutional, and to societal levels. (In our study, such levels could be workers' families, coworkers, hospitals, the health care system, and the set of society's values regarding work and income distribution.) Further, when analyzing individual contributions, community psychology stresses the need to explore the internal experience of the individuals under study, not just externally observable phenomena. For example, community psychology will explore not just whether policies are available, but rather whether people are aware of them and/or consider them accessible. Therefore, for this discipline, it becomes important to study how individual experiences interact with the relevant environmental variables, and how such interactions may vary over time because of reciprocal influences.

To conclude, the same research topic can actually imply very different sets of questions depending on

the researchers' backgrounds and disciplinary training. At the same time, disciplines may share methodological concerns and challenges when it comes to identifying relations of causality or factors that may affect outcomes of interest. A dialogue between researchers is often extremely useful in understanding both the limits of each analysis and the potential gains that can be achieved when researchers, working collaboratively, have a better general understanding of the phenomenon they want to study.

This shows that the same research topic can actually result in very different sets of goals and strategies depending on researchers' backgrounds. A dialogue across disciplines can strengthen the understanding of both the limits of each approach and the potential gains that can be achieved when researchers have a better general understanding of the phenomenon they want to study.

Differences in methods

After our team began to learn to recognize each discipline's conceptual background and the legitimacy of their colleagues' research questions, they were faced with a new research challenge: agreement about research methods. Disciplines tend to use specific methodologies for a variety of reasons. Graduate studies rarely expose future researchers to research methods outside their disciplines. In addition, each discipline's research methods evolve quickly, and even senior researchers may struggle to remain updated about their field's developing approaches and techniques. Finally, the challenges and urgency to publish in journals recognized by each profession further limit the opportunity to explore different research methods. Therefore, lack of knowledge about other methods, as well as pride in one's own choice of methodologies, can be significant obstacles for a team that aims to develop a study across different disciplines. Although some disciplines tend to use either quantitative or qualitative methods, the choice of methods usually depends on study goals. Research goals are also likely to be discipline-based, so an interdisciplinary team needs to meet the challenge of asserting goals that reflect the team's disciplinary diversity.

Ragin argues that what are often framed as quantitative vs. qualitative research differences are actually the differences between case vs. variable orientations.⁹ These orientations present contrasting goals, which require different strategies. He notes that correlational studies (variable-oriented) "... are centrally concerned with the question of 'why' (as in: Why some more than others?), [while] comparative case studies are centrally concerned with the question of 'how' (as in:

How does it happen?)."⁹ Following a discussion of strategies used for each orientation, Ragin concludes "... the two dominant goals—making facts understandable and making causalmechanistic predictions—lead to different research strategies. Social scientists should never lose sight of the tight coupling of goals and strategies in social research."⁹

We have found that communication is indeed strained by differences in members' methodological expertise. As part of our work, we have established two core research designs/directions and three research sub-teams. One team is case-oriented and the other two are variable-oriented. Within each, we are combining quantitative and qualitative methods—integrating both methodologies, but maintaining an emphasis on one over the other.

This division supports the interdisciplinary nature of the research project in different ways. First, some individuals volunteered or were asked to serve as members of more than one sub-team, with the anticipation that they could facilitate communication and interaction across teams, and thereby facilitate integration of the designs. Second, each member of the entire team was asked to give feedback on research tools that were prepared by the sub-teams. Research tools—primarily including two survey instruments and a case study data collection matrix (described below)—are indeed diverse. Other tools include occupational health and safety risk exposure assessment methodologies, demographic and administrative data collection templates, and interview and focus group scripts. Finally, in specific instances, the sub-teams have recognized the limits inherent in each research method and have worked to design a combined approach to analyze individual topics. For example, given the potential importance that the phenomenon of "underreporting" job-related accidents could play in our study, we decided to collect data on this problem in different ways. We will review the relevant polices in each workplace under study. A survey questionnaire includes questions to generate responses about the frequency of and reasons for underreporting cases. This will permit statistical multivariate analysis. Also, through interviews and focus groups, we will provide managers and workers the opportunity to express their perceptions of the severity, causes, and consequences of the problem. Our intent is to support interdisciplinary analysis of occupational injury underreporting, leading to a better understanding of how this phenomenon takes shape and an ability to predict its likelihood to occur and resultant harm/costs.

We faced significant challenges in developing the epidemiological survey instrument. We first identified

a set of dependent and independent variables. Various members reviewed the literature related to these constructs, as well as existing related validated survey instruments. The draft instrument very soon became quite long and unwieldy. This necessitated a streamlining of indices for various concepts/variables to be included in the study. Much discussion time was required to iron out some of the philosophical as well as pragmatic differences related to variable measurement. Ultimately, the team agreed on an abbreviated draft questionnaire that was pilot tested. Negotiations were heated as to which concepts/variables could be eliminated from the survey tool and emphasized instead in the other study design components. We relied on our proposed specific aims as guides for making these decisions.

THE PROBLEMATIC RECOGNITION OF INTERDISCIPLINARY RESEARCH

Even as the team struggled to overcome the challenges identified above, additional pressures relating to recognition from publications and making presentations emerged early in the process. The team addressed the following questions: Is there an audience for reports on interdisciplinary research? How will the team's selection of publication and presentation venue affect decisions regarding individual team members' tenure and promotion?

To obtain a general picture of the popularity of this type of research among disciplines, we searched online bibliographical databases commonly used by each discipline represented on our team. The [Table](#) presents how often a term such as "interdisciplinary" or "multidisciplinary research" appeared in abstracts of studies published during the last 12 years, by specific disciplines. The interpretation of our findings is clearly limited because interdisciplinary studies do not necessarily define themselves as such in their abstracts. Also, online databases differ widely in terms of the number of journals they cover. However, we still believe that the [Table](#) indicates the limited reporting (and probably conduct) of interdisciplinary research. (It is possible, however, that the small numbers we found for disciplines such as health policy simply indicate the predominant interdisciplinary nature of research conducted in such fields, and therefore the much more limited need to label a study as interdisciplinary.) Indeed, in a recent study, Pieters and Baumgartner explored, for example, how the economic profession makes use of five economic journals that specifically aim at interdisciplinary research.¹⁰ They found that such journals are only rarely cited by economics jour-

nals and only in a minority of cases were citations found in economic journals that had been selected because of their high impact score in the Social Sciences Citation Index (SSCI).

Obstacles encountered within each discipline

The scarcity of interdisciplinary research is not a surprise given the general lack of interest that disciplines often show toward each other. Citation analysis, the study of the flow of citations between journals among and across disciplines, highlights the limited frequency with which authors in different disciplines build on the work of researchers from other disciplines. Pieters and Baumgartner reviewed five influential professional journals from the disciplines of anthropology, different fields of business, economics, political science, psychology, and sociology.¹⁰ They found low percentages of interdisciplinary citations within almost all these disciplines (0% in anthropology, 6% in psychology, 10% in economics, 13% in political science, and 15% in sociology), with the highest rates in the business fields (for example, 38% in management). These data suggest how hesitant researchers may feel about working and writing with an interdisciplinary team, given the potential scarce interest, if not suspicion, that the individual's work may face within the typical review process of some discipline-specific journals.

Obstacles encountered within academic institutions

Academic institutions may consider interdisciplinary efforts favorably because of the recent interest shown by major national granting institutions. At the same time, internal policies and practices of academia may discourage faculty members who have an interest in interdisciplinary efforts. Decisions about tenure, promotions, merit pay, course releases, and sabbatical leaves usually depend on academic departments' and university committees' assessments of individuals' productivity. Measures of individual and departmental productivity become even more crucial when a university is faced with a budget crisis and departments need to compete for shrinking available resources.

While the ability to generate grants is regarded as an important index of faculty performance, the most common measure of productivity across all disciplines is the quantity and quality of publications. As far as quality considerations are concerned, interdisciplinary efforts are likely to be undermined if researchers are part of departments that do not value publications in interdisciplinary journals or in journals that do not represent their fields. With regard to "quantity," additional features of the publication process may challenge the work of an interdisciplinary team. For ex-

Table. Number of occurrences of search terms (1990 through 2002)

| <i>Disciplines</i> | <i>Interdisciplinary research</i> | <i>Multidisciplinary research</i> | <i>Transdisciplinary research</i> | <i>Interdisciplinary research and health</i> |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|----------------------------------------------|
| Economics | | | | |
| <i>Econlit</i> | 53 | 5 | 1 | 3 |
| EBSCO ^a | | | | |
| Epidemiology | | | | |
| <i>Medline&CINAHL</i> | 31 & 3 | 24 & 0 | 1 & 0 | 12 & 0 |
| EBSCO ^a | | | | |
| Including "Epidemiology" in term | | | | |
| Health Policy | | | | |
| <i>CINAHL</i> | 2 | 0 | 0 | 2 |
| EBSCO ^a | | | | |
| Including "health policy" in term | | | | |
| Nursing | | | | |
| <i>CINAHL</i> | 31 | 22 | 0 | 18 |
| EBSCO | | | | |
| Journal subset "nursing" | | | | |
| Occupational Health & Safety | | | | |
| <i>NIOSH</i> | 5 | 5 | 0 | 6 |
| DIALOG @ CARL ^b | | | | |
| Political Science | | | | |
| <i>Pol. Sci. Abstracts</i> | 7 | 2 | 0 | 0 |
| Silverplatter ^c | | | | |
| Psychology | | | | |
| <i>Psychinfo</i> | 636 | 82 | 9 | 144 |
| EBSCO ^a | | | | |

^aEBSCO is an online reference system that can be accessed through the library's multidisciplinary index Academic Search Premiere. *Econlit*, *CINAHL*, *Medline*, *Psychinfo*, *Sociological Abstracts*, and *Social Science Abstracts* are some of the databases that can be searched using EBSCO.

^bDialog@Carl is another online reference system. *NIOSH* is one of the databases that can be searched using Dialog@Carl and can be accessed through the library's Occupational Health & Safety index found under "Health Resources."

^cSilverplatter or WebSPIRS is an online reference system. *Political Science Abstracts* is one of the databases that can be searched using Silverplatter. It can be accessed through the library's Political Science index under "Political Science Resources."

NOTE: The disciplines epidemiology and social policy do not have databases specific to them, so we have used the most logical databases for the search, then included "epidemiology" or "social policy" in the search term (for example: interdisciplinary research AND epidemiology). The search was conducted within the reference systems subscribed to by UML in August 2002.

ample, as we will further discuss, even when researchers agree to co-author a paper, conflicts could arise because of what is considered the "norm" in ordering the author's names within each discipline. Furthermore, disciplines differ dramatically in the typical acceptance rate of articles in their professional journals and in the average length between submission and acceptance of a study for publication. For example, Huettner and Clark present very different acceptance rates in the top five journals of different disciplines: 9% in economics, 22% in psychology, and 69% in

physics.¹¹ A survey of 75 health-related journals produced an average acceptance rate of 42%.¹²

These differences are likely to create challenges for authors who want to engage in interdisciplinary research but also want recognition within their own profession. Indeed, they could jeopardize the spirit of cooperation that is needed in interdisciplinary endeavors. Universities that are interested in interdisciplinary research—either because of their mission or because of their desire for grant funding—need to explicitly recognize such obstacles and actively support

interdisciplinary teams with appropriate personnel decisions.

ESTABLISHING A SUPPORTIVE STRUCTURE AND PROCESS FOR INTERDISCIPLINARY RESEARCH

Administrative resources are required to support an interdisciplinary research project. In order to accommodate a large number of researchers' schedules and facilitate communication, we added a project manager and a project administrator to our team and established a coordinating committee. Members include the leaders of the research sub-teams, the co-principal investigators, the project manager, and the project administrator. This has helped to facilitate process-oriented issues and communication across teams for the overall research aim achievement.

Full-project meetings have been valuable for sustaining this interdisciplinary team effort. Agenda for these meetings alternate between professional speakers from various disciplines and meetings organized to facilitate discussion of the project progress and concerns. Early on, team discussions at these meetings addressed the need to face and formalize two specific points: the issue of authorship and the need for research protocols.

Authorship and intellectual property rights

Authorship or "intellectual property rights" was a concern identified by team members early in the project.¹³ The team identified the potential for conflict related to authorship of papers, abstracts, posters, and presentations. During the project's first year, several discussions focused on how authorship would be determined; what convention would be used in the determination of the order of author names; and how—with the large number of faculty, research staff, and students involved—each contribution to a paper would be measured and rewarded. Over the course of several discussions, the team realized that various disciplines across the [table](#) followed their own conventions for authorship order, lead authorship order, and rules for acknowledgement vs. assigned authorship.

Bruhn has suggested that the future of interdisciplinary research will ultimately be based on "social trust."¹⁴ With this term he referred to the need for respect across various disciplines for the integrity and validity of other disciplines' work. The sticky issue of authorship across disciplines goes beyond the acknowledgement of the quality of other disciplines' methods. Rather, it speaks to the pressures on academics to publish within their discipline's accepted tradition.

The team recognized that the prestige of author-

ship position varied across and within disciplines. For example, although there are no specific guidelines, most nursing journals identify lead authorship by first authorship.¹⁵ In the field of nursing, first authorship is generally the most valued status for academic credentialing (tenure and promotion process). Others noted that in medicine, the final author is often the principal investigator and thus this position is highly valued. In the field of economics, Laband identified the irony of significant differences between two types of related disciplines in terms of authorship convention.¹³ He noted that agricultural economics highly values author order, while the broader field of economics does not emphasize author order as important and authors are more likely to be listed alphabetically.¹⁶

Due to the differing values applied to authorship placement and convention, the tendency toward multiple authorship varies widely. For example, multiple authorship is less common among economic researchers because there is no distinction among authors and all are considered to have equally contributed to the paper. In contrast, Laband suggests that disciplines that value lead authorship are more likely to include multiple authors, with the caveat that less prestige goes to those following the lead author.¹³ Friedman and Friedman suggest that by definition, interdisciplinary research teams and organizations tend to value multiple authorship as opposed to research within a disciplinary department, which tends to value single authorship.¹⁷

UML's mission and goals generally support collaborative research across disciplines. However, our team members identified the concern that the university's tenure committee members might unfairly evaluate project-related authorship due to disciplinary biases of the reviewers. In the past, the emphasis on first and solo authorship as a criterion for promotion was acknowledged as a disincentive to multiple authorship. This pressure for solo authorship has been cited in the literature and is a lingering perception among many academics.^{14,15,18} Indeed, Hollis examined the relationship between co-authorship and research output in the field of economics.¹⁹ As in previous research, he found that co-authorship leads to higher quality research as indicated by "more frequent, longer and better publications."²⁰ However, he also noted that despite the increased tendency for co-authorship among academic economists, co-authorship has a negative impact on a measure of individual research output that discounts for the number of authors.

At the project's outset, we sought to minimize confusion and ambiguity about authorship issues by holding a full-team discussion to facilitate development of

project protocols. As guides, the team relied on the recommendations suggested by Erlen et al.,¹⁵ the American Public Health Association's (APHA's) instructions for authors,²¹ and the International Committee of Medical Journal Editors (ICMJE) requirements for manuscripts.²² All three of these sources recommend that each author listed on a paper should contribute substantially to the paper. The APHA mandates that listing more than six authors requires justification. (Another reviewed source, the American Psychological Association, suggests that generally ". . . the name of the principal contributor should appear first with subsequent names in order of decreasing contribution."²³) According to the ICMJE's requirements, the order of authorship should be a group decision by the authors. All three sources suggest that for multiple author listings, each individual's contribution should be readily available, if not explicitly published in the journal. Erlen and colleagues identified general principles, first-author responsibilities, and specific responsibilities for all authors.¹⁵

Our research team discussed the various issues and recommendations. We produced guidelines that established the appropriateness of multiple authorship for every publication derived from the project but defined no formal policy about the sequence of authorship. We agreed that project authors should address the issues within the respective disciplines at the outset of each writing effort. We decided, however, that all author listings should end with "PHASE In Healthcare Research Team."

Developing protocols and communication tools and systems

In clinical medical practice, the process of protocol development provides an ideal opportunity for various team members to discuss approaches and share philosophies and strategies.²⁴ According to Yin, case study protocols contain the procedures and general rules that should be followed in carrying out case study research²⁵ and ". . . represent the investigator's own agenda in pursuing the line of inquiry for the case study."²⁶ Not surprisingly, the case-oriented researchers on our team moved the project to develop and adopt research protocols. These researchers had been trained to understand that ". . . the protocol is a major tactic in increasing the reliability . . ." of research.²⁵

The PHASE In Healthcare Research Team's interdisciplinary perspective and approaches required ample forethought to assure a systematic framework for consistency and scientific integrity in the research process. The protocols or guidelines were an attempt

to avoid potential pitfalls by assuring a clear and comprehensive understanding by the entire team in carrying out the process. Given the large number of researchers and the varied settings in which the research has taken and will take place, development of these protocols allowed the team to reduce inappropriate variations in the research process and to ensure high quality data collection techniques. This effort was deemed highly relevant and involved many team members, and required approval by all team members. The protocols were compiled into a "protocol notebook" distributed to all members of the PHASE In Healthcare Research Team. Bowman, Wyman, and Peters wrote that a protocol notebook can ". . . reduce variability in staff interpretation of how and in what order to carry out procedures and collect data."²⁷

Key to the successful application of these protocols—which are living documents amenable to change—is the need to assess and evaluate their effectiveness once used so that their relevance for this and other projects can be determined. A web board, e-mail distribution lists, and other communication tools developed for the project have been useful in making draft protocol elements readily available to the team.

Research tools were developed through a participatory interdisciplinary process. For example, the team developed a case study research data collection matrix that is categorically divided into those aspects of the health care work environment's political economy that we have selected as most relevant to our study of occupational injury disparities. Each category lists key indicators of processes and organizational attributes that can shape occupational injury disparities. Anticipated data sources for locating these indicators are also listed. Finally, the matrix includes a listing of research questions pertinent to each set of indicators. This instrument has been shared with the variable-oriented teams for input and feedback to assure consistent communication across teams about needed data. The coordinating committee has met to develop agreement about data collection priorities, needs, and data management protocols.

LESSONS FROM OUR EXPERIENCE

Toward the end of the first full year of effort, a full project meeting was organized to include small-group discussions to explore team members' sense of commitment and levels of effort. Some responses from team members were similar to benefits and problems described by Mellor and Solomon in their discussion of interdisciplinary teaching teams.²⁸ More specifically, in the case of our project, most team members appre-

ciated the following aspects of interdisciplinary research: learning and combining new research techniques/methodologies (such as qualitative and quantitative analyses); opportunities to combine research questions driven by different disciplines' interests; and application of one's discipline to a social issue that ordinarily would not be considered.

However, team members also identified challenging aspects of the project that sometimes had brought them to consider decreasing their effort and participation. Time constraints was one general category that included concerns about (1) participation on multiple sub-teams and the number of meetings required; (2) balancing the work requirements of this effort with other aspects of their work and lives; and (3) the time commitments needed to foster adequate communication. For many team members, communication difficulties arose from the lack of familiarity with each other's disciplinary language, thereby straining working relationships. Team members also raised concerns about actual or perceived interference with promotion and tenure goals, primarily due to concerns that other academicians felt general disregard for the researcher's interdisciplinary efforts. These concerns also resulted from the slower progress of a research project that requires complex compromises to combine methods and goals of different disciplines.

A specific set of concerns was raised by team members who had assumed leadership roles. The process of interdisciplinary research requires the ability to lead by facilitating a relatively democratic process that provides space for each researcher to present his or her individual approach to the team. Most of us, however, including team leaders, have had little training or experience to develop such management skills. Therefore, the burden of leadership is increased by the frustration of not being able to effectively lead an interdisciplinary team, and/or having to extend one's commitment in order to effectively provide such facilitation.

Finally, there were issues of trust, which place a great strain on interpersonal relations. Specifically, many did not trust that all disciplines within the project were regarded equally and believed that a hierarchy of values had been established, placing greater emphasis on the values and methods of some disciplines over others. This led to concerns about whether the research team would be able to collectively take ownership of the completed project, or if some would either distance themselves from the project or claim more credit than was due.

At this stage of our research project, we have learned that interdisciplinary work is indeed a very powerful

venue to expose us to new and more complex research questions and techniques. At the same time, we have realized that interdisciplinary research will likely result in clashes over values, goals, and methods. Researchers need to be aware of the heavy time commitment that is likely to be required given the need to learn and coordinate research strategies with researchers from other disciplines. Interdisciplinary research also requires team members to be comfortable in presenting their goals. Finally, strong interpersonal relationship skills are needed, and these skills will likely be challenged.

CONCLUSION

Both the promises and pitfalls of interdisciplinary research have been experienced by the PHASE In Healthcare Research Team. We have cited some literature that presents similar experiences. Our effort is not unique, and noticeably, a growing emphasis is being placed on interdisciplinary approaches to both the study of, and interventions to address, increasingly complex modern societal problems. While some of the major funding agencies—such as NIH and the National Science Foundation in the United States—are increasingly supporting this approach, academic institutions and departmental policies have lagged behind in some respects. Productivity in academia is primarily measured in terms of publication records, and pressures to publish include demands for solo authorship, hierarchical ordering of multiple authorship, and the choice of select journals within elite disciplines. Such requirements will likely complicate interdisciplinary efforts.

One of the advantages for researchers participating in interdisciplinary projects is that their available funding sources are expanded to include resources not previously explored when they had proposed discipline-specific research. Some significant funding issues exist, however, not the least of which is the lack of planning grants. As has been discussed in the literature regarding community-based research and community-university partnerships,^{29–33} we believe planning grant funding would greatly enhance any interdisciplinary research team's ability to build the foundation of consensus and trust needed to sustain a project through its completion.

In this article, we have presented measures that one university has taken to enhance its capacity to support interdisciplinary approaches to the study of regional economic and social development. We have also described our experience to date in developing an interdisciplinary research project. Our work suggests a need

for the establishment of supportive structures and processes to promote the interdisciplinary research team's success. These would enhance communication among a diverse group through, for example, the development of clear protocols and establishment of authorship guidelines at the outset. In addition, project meetings and retreats must be facilitated to support open and ongoing discussions. These can enhance the process of communicating about each of the disciplines' perspectives, as well as the sharing of expertise.

Certainly, powerful outcomes experienced by our team to date include the intellectual stimulation and creativity that have emerged during the process. Team members are learning about other disciplines' research methods and approaches, as well as their own, in the process. This approach to research supports increased networking opportunities for team members. Each team member is engaged in a long-term commitment with faculty and students from other disciplines that can expand the types of, as well as our conceptual view of, the social problems that we examine. The process of our interdisciplinary research has been challenging and demanding.

UML's commitment to interdisciplinary research supported our ability to develop a successful proposal. We hope this commitment can be extended to build the capacity for making a transition to transdisciplinary approaches to research, teaching, and interventions that will further promote this institutions's support for sustainable regional development.

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