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## Strategies for Success: Early-Stage Collaborating Biostatistics Faculty in an Academic Health Center

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### Abstract

Collaborative biostatistics faculties (CBF) are increasingly valued by academic health centers (AHCs) for their role in increasing success rates of grants and publications, and educating medical students and clinical researchers. Some AHCs have a biostatistics department that consists of only biostatisticians focused on methodological research, collaborative research, and education. Others may have a biostatistics unit within an interdisciplinary department, or statisticians recruited into clinical departments. Within each model, there is also variability in environment, influenced by the chair's background, research focus of colleagues, type of students taught, funding sources, and whether the department is in a medical school or school of public health. CBF appointments may be tenure track or non-tenure, and expectations for promotion may vary greatly depending on the type of department, track, and the AHC. In this article, the authors identify strategies for developing early-stage CBFs in four domains: 1) Influence of department/environment, 2) Skills to develop, 3) Ways to increase productivity, and 4) Ways to document accomplishments. Graduating students and postdoctoral fellows should consider the first domain when choosing a faculty position. Early-stage CBFs will benefit by understanding the requirements of their environment early in their appointment and by modifying the provided progression grid with their chair and

mentoring team as needed. Following this personalized grid will increase the chances of a satisfying career with appropriate recognition for academic accomplishments.

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## Introduction

Collaborative biostatistics faculty (CBF) are increasingly valued by academic health centers (AHCs) for their role in improving the success rate of grants (Zhang 2015; Wang 2015; Berg 2007; Inouye 2005), the acceptance rate of publications (Mazumdar 2010; Bordage 2001), and the education level of medical students, clinical researchers, and laboratory scientists. (Weissgerber 2016; Deutsch 2007; Ambrosius 2002)

A CBF can be defined as someone who provides expertise regarding statistical methods in collaborative projects. He/she may provide many services within a collaboration, including improved framing of hypotheses by stating them in measurable terms, developing study designs and computing optimal sample size, identifying data to be collected, advising on research database development and management, selecting and explaining optimal analytic methods, performing statistical computations, interpreting results from analyses, and helping develop presentations, manuscripts, and grants. (Biostatistics Collaborative Research Core, University of South Carolina (USC 2016)) A CBF also may develop statistical methods, provide didactic education in these methods, mentor, and serve as a reviewer and advisor. The combination of these responsibilities varies depending on the needs and demands of the department and environment where the CBF is appointed.

Some AHCs have a biostatistics department consisting of only biostatisticians who may be focused on methodology development, collaborative research, and education with varying degrees of emphasis (School of Public Health, University of Michigan (UMich 2016); College of Public Health, The University of Iowa (UIowa 2016)). Others may have a biostatistics unit within an interdisciplinary department such as 'Population Health.' (Departments of Population Health, New York University (NYU 2016); Department of Population Health Science and Policy, Icahn School of Medicine at Mount Sinai (ISMMS 2016); Department of Preventative Medicine, Northwestern University (NWU 2016)) In this setting, most faculties will be from other scientific disciplines, focused on research in their own field, as well as educating public health practitioners and epidemiologists. A third model is to recruit biostatisticians in various clinical departments (such as Psychiatry, Medicine, Anesthesiology, or Radiology) where most faculty are physicians focused on clinical services and educating medical students, residents, and fellows (Division of Biostatistics in Psychiatry, Department of Psychiatry, Columbia University Medical Center (CU 2016); Quantitative Sciences Unit, Department of Medicine, Stanford University (SU 2016); Biostatistics and Clinical Outcome Program, Department of Anesthesiology, Duke University (Duke 2016); Biostatistics and Outcomes Research Group, Department of Radiology, University of California at San Francisco (UCSF 2016)). Within each type of department, there is also variability in the environment, influenced primarily by the background of the chair, research focus of the colleagues, type of students educated, funding sources, and whether the department is in a medical school or school of public health. Another source of variability is whether the CBF is appointed in a tenure-track or non-tenure/

research track position. Tenure-track faculty may have to meet more or different requirements for promotion than research or non-tenure track faculty.

The purpose of this manuscript is to provide guidance to maximize the likelihood that a CBF develops a satisfying career with appropriate recognition in the promotion and tenure process regardless of the setting. We provide a progression grid for advancement towards promotion and tenure, which includes a recommended timeline by when certain milestones should be reached. The grid is conceived as an aid for thinking about and discussing promotion and tenure with department chairs and mentoring committees. Early-stage CBFs will benefit by understanding the requirements of their environment in the first 6 months of their appointment, and by modifying the progression grid with their departmental chair to suit the environment. Following this personalized grid will increase the chances of a satisfying career with appropriate recognition for academic accomplishments.

We begin with a discussion of different academic environments where a CBF member might be appointed. Graduating PhD statistics students and postdoctoral fellows might find this discussion useful in choosing a faculty position that is best suited to their interests. Next, we recommend skills that should be developed for success as a collaborative biostatistician. We then address ways to obtain the recognition necessary for promotion and tenure, and conclude with methods to help document accomplishments. Resources for skill development in networking, leadership, funding, awards and recognition, and team development also are provided. We envision these tools would be most useful to early-stage CBF and postdoctoral fellows interested in collaborative careers at an AHC.

## 1. Influence of Departmental Structure/Environment

The setting and environment of a CBF appointment is highly variable, and different expectations for promotion and/or tenure may exist depending on whether the appointment is on the tenure or non-tenure track. Another variation is whether an appointment is in a school of medicine or public health. In medical schools, physicians often make up the majority of leadership and tenure and promotion committees may have less experience evaluating a CBF. A school of public health almost always includes a biostatistical department of some type and is more likely to have awarded promotion and/or tenure to a CBF. In this section, we describe the varying departmental structures and environments that collaborative biostatisticians may commonly encounter, while pointing out the advantages and potential obstacles to promotion and tenure.

**a. Collaborative Biostatistician in a Biostatistics Department**—A biostatistics department, either in a medical school or a school of public health, typically consists of only biostatistics faculty and is chaired by a biostatistician. Expectations and promotion guidelines for this kind of department usually are formally laid out for all members, especially those in schools of public health. These departments generally provide masters' and PhD programs in biostatistics and faculty are focused on methodological research, collaborative research, and education. In general, collaborative biostatisticians within any biostatistics department are expected to devote a portion of their time to teaching and mentoring students, postdoctoral fellows, and other early-stage faculty members. In addition,

it is usually expected that a substantial amount of time be devoted to research, although the percentage required may vary by department or institution. The research endeavors of such faculty members are varied, but usually combine collaborative work and methodological work, often related to the individual's own research interests.

Advantages to working in such a department include having a department chair trained in biostatistics, who understands all aspects of the job and can effectively communicate the impact of accomplishments to the promotion and tenure committee. Since all faculty in such departments are biostatisticians, the CBF can network daily with other biostatisticians who are developing new methodologies, and thereby have opportunities to improve and diversify skills. In biostatistics departments, it is also likely to be easier to identify senior faculty collaborators for methodology development work and for service on a mentoring committee. Such departments also have a ready supply of graduate students for early-stage faculty to mentor and who can assist with research. Additionally, teaching opportunities aligned with one's own field of research are more likely to be available in biostatistics departments.

The main challenge of being a CBF working in a biostatistics department is that some departments may be primarily focused on methodological research. This can create a mismatch between collaborative responsibilities and departmental expectations, and may require convincing the department chair and the promotion and tenure committee of the value of collaborative efforts.

#### **b. Collaborative Biostatistician in an Interdisciplinary Department—**

Interdisciplinary departments to which a CBF may be appointed include those that combine biostatistics with epidemiology; these are typically found in schools of public health. These departments usually function similarly to a biostatistics department if they are chaired by a biostatistician. Another type of interdisciplinary department combines multiple public health disciplines such as 'Preventive Medicine,' 'Public Health' or 'Population Health Science and Policy.' Such a department typically has a limited number of other biostatistics faculty members as colleagues, but a larger proportion of faculty from other disciplines such as epidemiology, behavioral sciences, or public health. This model is often found in medical schools without an associated school of public health. In this setting, other faculties are primarily researchers.

One advantage to an interdisciplinary department is the potential for collaborative opportunities with departmental colleagues, which may result in more publications and co-investigator roles on grants. However, because interdisciplinary departments contain multiple fields, the chair may be from a discipline other than biostatistics and be less able to communicate the impact of CBF accomplishments to the promotion and tenure committee. The departmental chair may also have different expectations for a biostatistics faculty member compared to one in a different discipline. A CBF member might be seen as providing a service, rather than scholarship, to the department. This attitude might become an obstacle to promotion and tenure if it results in fewer publications or lack of co-investigator opportunities. Typically, these departments sponsor masters and PhD programs in public health and epidemiology; opportunities for mentoring biostatistics graduate students or finding statistical programming assistance may not be available to CBF in these

departments. As such, it can be more challenging to become a thesis advisor for a biostatistics graduate student in this environment. Another disadvantage of working in such a department is having fewer opportunities for direct mentoring by other senior biostatistical faculty.

**c. Collaborative Biostatistician in a Clinical Department**—A CBF member working in a clinical department is often the sole biostatistician or part of a small cohort of biostatisticians. An advantage of working in a clinical department is the close interaction and collaboration with clinical faculty, which can enable both the CBF and the clinician to jointly produce research that can directly impact patient care and improve clinical outcomes. One disadvantage is that in clinical departments, patient care always takes precedence over research, and therefore manuscript and grant submission may occur at a slower rate. CBFs working in this environment should realize that grant funding may be more occasional, resulting in a relatively sparse track record unless they are mature enough to write their own proposals and manuscripts based on the collaborative work.

Teaching responsibilities vary for CBFs in a clinical department, but usually are weighted more heavily to one-on-one interactions rather than formal classes. Graduate students in biostatistics are rare in a clinical department, but a collaborative biostatistician may be responsible for mentoring medical students, residents, and fellows. Since a clinical department will have a physician as a chair and usually lack other senior biostatistics faculty, each CBF will need to be primarily responsible for their own academic growth. A clinical department chair may have difficulty evaluating the work of a CBF member. Thus, meeting the expectations of a promotion and tenure committee may be more difficult for CBF in a clinical department. In such cases, the CBF might need to rely more heavily on outside letters of support to document achievements for their department chair and the promotion and tenure committee. Overall, appointment in such a position should be entered cautiously unless there is a well-established biostatistics group within the institution, and a clear and appropriate path for success determined within that entity.

**d. Ways to avoid mismatched expectations and to keep career growth on track**—Based on these variable settings and environments, it is extremely important for PhD graduating students and postdoctoral fellows in biostatistics to better define their aspirations and clearly understand their own weaknesses and strengths. A student primarily interested in developing methodology is not likely to be satisfied in a job as CBF in a clinical department. In general, since finding a perfectly-matched position is difficult, early-stage CBFs should take time early on in their career to understand their environment and plan proactively in matching their workload with institutional and departmental expectations. In Chart 1, we provide a progression grid for advancement towards promotion and tenure in six areas of importance: 1) Supporting network development, 2) Publication, 3) Grant Funding, 4) Teaching, 5) Mentoring, and 6) Service. This chart uses a framework developed and successfully used by nursing faculty (Garand 2010). We advise meeting the department chair or their designee within the first 6 months of appointment to determine milestones and expected timelines, and subsequently meeting at least yearly to review progress. CBFs should create a personalized grid by deleting the categories that do not fit

their environment and add any other duties that are valued in their setting. By organizing these activities within the timeline for promotion, CBFs can plan the sequence in which the activities need to be performed and allocate their time across different activities. Although not meant to be exhaustive or an exact fit for all settings, the chart can be a useful starting point to grasp what will be required for continued success in an AHC, and then be modified by the requirements of the track and/or the environment.

We strongly advise developing a mentoring committee of at least three members with one mid-career or senior faculty from the home department, one from the home institution but outside the department, and one external to the institution. Requesting a review of one's CV and soliciting advice from the mentoring committee members individually or jointly at least annually is a good way to become aware of gaps in growth and how to close them (Odueyungbo 2012; Thabane 2007).

## 2. Skills to Develop

CBF members should develop certain competencies early in their careers to demonstrate that they merit consideration for promotion and/or tenure. These competencies will likely be somewhat different for tenure-track vs non-tenure track faculty. Tenure-track faculties are often expected to demonstrate more or different competencies than non-tenure track colleagues (Appointment, Promotion, and Tenure Guidelines, The University of Texas Medical Branch (UTMB-APT 2016); Qualifications and Standards for Appointment, Promotion, and the Award of Tenure, Case Western Reserve University School of Medicine (CWRU-SOM-APT 2016). Some schools require only one area of excellence (such as either teaching or research) for non-tenure track/research faculty, but require excellence in two or more areas (such as both education and research) for their tenure-track faculty (Information Guide for Appointment, Promotion, and Tenure, Northwestern University Feinberg School of Medicine (NWU-SOM-APT 2016). Chart 1 can also be used as a guide for early-stage CBF to identify the importance of certain skills such as developing a support network, increasing productivity in publications and grant funding, creating a teaching and mentoring portfolio, and engaging in valued services.

Chart 2 lists resources for skill development important to collaboration, including writing, management and team building, time and stress management, communication, reporting, and conflict resolution, as well as teaching, mentoring, leadership, and networking. In the sections below, we discuss these topics in more detail.

**a. Developing and Maintaining Collaborations—**For biostatistical faculty members who work predominantly in collaborative teams, professional relationships with researchers in other disciplines should be fostered at a very early stage (Gehan 2000). To foster productive and long-term collaborative relationships, CBFs should learn to assist others in translating research questions into testable hypotheses. They should develop the ability to determine appropriate study designs relevant to the problem at hand, and know how to properly evaluate interventions and risk factors. In addition, they should be able to perform power analyses and sample size calculations necessary to plan both simple and complex research studies. Finally, they should be able to selectively apply existing hypothesis tests



for comparing treatment strategies and exposure groups appropriate to the outcome being measured and the study design being employed. (PhD in Biostatistics Competencies, New Orleans School of Public Health, Louisiana State University (LSU 2016)).

Critical to the success of these CBFs is their ability to communicate the assumptions, limitations, and (dis)advantages of statistical methods, and to help collaborators understand preferred methodological alternatives when statistical assumptions are not met (Jilliffe 2002). Equally important is the ability to clearly explain to collaborators the results and their appropriate interpretation. The entire team should gain an understanding of the statistical and experimental techniques used, how to interpret the data, and what the results mean (Weissgerber 2016). This can be accomplished by presenting oral and written reports of methods, results, and interpretations of the statistical analyses to both statisticians and non-statisticians. Imbedded in this competency is the ability to be an effective communicator and presenter; those skills are essential to becoming an effective collaborator in any discipline. Such skills are critically important to the success of biostatistics graduate students in the era of interdisciplinary research (Begg 2011).

Biostatistical faculty members can choose whether their collaborations should be within one medical discipline, or among many. CBFs can also choose to focus on certain types of data (e.g. proteomics, next-generation sequencing, imaging, institutional electronic medical record [EMR], or healthcare billing and claims-based). Doing so allows CBFs to learn more about the underlying disease or healthcare system, and possibly contribute more meaningfully to the scientific merit of new experiments being planned. As another benefit, biostatisticians can present their research findings at specialty-specific as well as biostatistics-specific conferences. Similarly, choosing to work with a certain type of data will allow learning experimental techniques specific to that platform, and being able to present those findings at relevant meetings.

The important thing to avoid is a lack of focus that precludes understanding the data for a given project. Deciding to work in multiple different diseases and in multiple different experimental types should be approached with trepidation. While having multiple collaborators is considered a good thing, having too many can lead to shallowness in work. Over time, early-stage faculty members can learn their limits. Consultations with mentors can be useful for making these decisions.

For biostatisticians looking to add more collaborative research to their portfolio, there are multiple ways to identify potential collaborators. Working with the university's statistical consulting lab or with core facilities (such as laboratories specializing in proteomics, genomics, functional magnetic resonance imaging, or a bioinformatics core) may help locate potential collaborators with funding available. Presenting at departmental Grand Rounds or other departmental seminars will help to educate other faculty about the value of working with a biostatistician.

**b. Developing Teaching and Mentoring Skills**—Many CBFs have teaching responsibilities at some level. But unlike the typical faculty member, a CBF may give only a few lectures in a course, or they may provide tutorial sessions instead. Additionally,

biostatistical faculty members should be involved in mentoring students, and become familiar with the qualifying exams and thesis process – not just within biostatistics, but other disciplines as well. They should develop the ability to question students during their oral exams (for qualifying exams or thesis proposals) and to guide master’s-level students as they design and conduct their thesis or capstone projects. As they progress in their careers, biostatistical faculty members should develop the skills to become thesis advisors for doctoral students in biostatistics.

Several teaching opportunities for team scientists also apply to collaborating biostatistician (Mazumdar 2015). Examples of these opportunities include giving one or more lectures in a non-biostatistics course, participating as a biostatistician in a basic science or clinical departmental journal club, or providing biostatistics workshops for basic science or clinical departments. Early-stage CBFs who lack teaching experience, or would like to improve their teaching skills, should seek out teaching seminars offered by their institution’s Office of Educational Development or consult statistics teaching specific websites (Center for Teaching, Vanderbilt University (VU-Stat Teaching 2016); Institute for Digital Research and Education, University of California at Los Angeles (UCLA-Stat Teaching 2016). Some universities may offer to have a senior faculty member observe an early-stage faculty member in the classroom, to provide advice and assistance to improve teaching skills. In addition, some universities have an academy of master teachers/educators, whose insights can be very useful for improving teaching skill. (Academy of Master Teachers, The University of Texas Medical Branch (UTMB-Teaching 2016), Academy of Master Educators, University of Pittsburgh (U Pitt-Teaching 2016)).

**c. Developing Leadership Skills**—Leadership is one quality that all promotion and tenure committees value; therefore, CBFs should develop the ability to lead (Begg 2011) and demonstrate and document this capability. There are several ways a collaborative biostatistician can work to increase his/her leadership skills and find opportunities to demonstrate leadership. When CBFs voice ideas effectively and assist collaborators in developing ideas for a new experiment or analyses’ resulting in an additional manuscript or grant proposal, their leadership skill is demonstrated. These new ideas may include applying different analytical techniques to existing data, or developing new experimental designs. Another example of leadership skills is helping researchers to translate research questions into testable hypotheses. Such activities can guide the research team in meaningful directions and provide objective evidence of leadership. Additional ways for a CBF to demonstrate leadership include (a) becoming a program manager for a research team, (b) serving on committees (especially as chair) within the university or within a professional organization, or (c) initiating a ‘work in progress’ seminar series or journal club.

For CBFs who work in a specific disease area, it may be advantageous to develop a reputation as a methodological expert. By doing so, they may be asked to serve on a study section for reviewing grants or to organize a conference session on biostatistical methods for a given disease at a disease-oriented conference. Both activities provide unique leadership opportunities for a collaborative biostatistician that might not be available to the personnel in the traditional principal investigator (PI) role.



Leadership skills for a CBF can also be enhanced by attending the Association of American of Medical Colleges (AAMC) leadership courses (see Chart 2). The American Statistical Association (ASA) also regularly offers several leadership skills workshops at the Joint Statistical Meetings each year, such as “Effective Collaboration”, “Preparing Statisticians for Leadership: How to See the Big Picture and Have More Influence”, and “Career Development: Power Careers in Statistics” (Buckingham 2014). Local chapters of the ASA also can host the leadership course, which would be an excellent opportunity for collaborative biostatisticians to get area-specific training in how to become a better leader. A book edited by Golbeck, Olkin, and Gel (2015) features contributions from leadership experts and statisticians at various career stages, and describes a variety of settings in which statisticians can develop and maintain leadership roles.

**d. Developing Networking Skills**—Networking creates new opportunities for collaboration and finding colleagues, mentors, and interesting datasets. Networking is even more important for CBFs, especially those working in interdisciplinary or clinical departments, if they have limited daily interactions with other biostatisticians. Many resources are available regarding effective networking skills for academics that are also applicable to CBFs (Streeter 2014, Grace 2016, Ansmann 2014). Specifically, CBFs need to network at four levels: within and outside the institution, and with statisticians and non-statisticians from their field of studies. Networking within institutions often happens naturally due to the collaborative nature of the CBF’s work, but external connection requires work and resources. Therefore, the most important step of networking for an early-stage CBF is to join academic societies within their discipline. For example, a CBF working in oncology might begin with membership in the American Statistical Association (ASA) and the American Society of Clinical Oncology (ASCO), and present their statistical and collaborative work in these two venues and attend talks by others. Following up with contacts made at these venues for continuing discussions of the common methods used, or sharing data for validation of statistical models, are ways to remain connected. Introducing these colleagues to others, inviting them to present at a departmental seminar series, and appointing them to thesis committees for graduate students in the CBF’s institution are ways that CBFs can expand their professional network. Typically, these acts will be followed by reciprocation from the person who was invited, but if that does not happen naturally, asking for such a favor is recommended. Conferences are typically annual; contacting the existing network members just before the next meeting to ensure re-connection is always a good idea for developing deeper relationships. Offering new ideas to discuss at the conference can make these meetings more productive and meaningful. Since there are many associations and conferences, picking a few to concentrate on is key. Attending disease-specific continuing education workshops, such as ‘Methods in Cancer Biostatistics Workshop’ (<http://www.aacr.org/Meetings/Pages/MeetingDetail.aspx?EventItemID=35&DetailItemID=135#.V8yZZJgrKUI>) or ‘Biostatistics Methodology Training for Clinical Trials in Imaging’ (<http://stattrak.amstat.org/2014/07/01/biotravelaward2014/>) are excellent ways to network with other biostatisticians in the field. This focused deepening of a professional network will enhance progress toward leadership and teaching roles. In addition, getting involved in programs like Statistics without Borders (<http://community.amstat.org/statisticswithoutborders/home>) or the Laboratory for

Interdisciplinary Statistical Analysis (LISA) and exchanging ideas on their blog (<http://www.lisa2020.org/>) are other ways of networking that can lead to collaborative projects at the national/international level and provide practice for leadership skills.

### 3. Ways to Increase Productivity and Obtain Recognition

Discussed below are several mechanisms for increasing productivity to meet promotion and tenure requirements and obtain recognition for scholarly achievements as a collaborative biostatistician.

**a. Publications**—There are opportunities for publication that biostatisticians in AHCs frequently miss, including publishing manuscripts that compare the performance of various analytic methods. The statistical literature is filled with articles about one individual proposed method, but is sorely lacking in articles to help a biostatistician choose the best method. In addition, writing tutorials in biostatistical journals that include new methods or innovative combinations of several existing methods is a significant contribution. Also of great influence are critiques for a commonly utilized methodology for medical, epidemiologic, and health services research journals. Writing such articles helps increase the scholarly productivity of a biostatistical faculty member. Importantly, they can also help other investigators better understand the nuances of various methods and when to apply them in their own research.

The publications mentioned above are all considered useful for the promotion and tenure process, as are papers where CBFs are middle authors. Such papers help to show that the biostatistician is a key contributor on multiple teams, and can disseminate their biostatistics work. For CBFs, some university promotion and tenure committees prefer to see at least 4 to 6 middle-author papers per year, combined with one first- or senior-author paper every few years (Guidelines for Promotion and Tenure, Department of Biostatistics, School of Public Health, University of North Carolina (UNC-Stat APT 2016), Goals for Tenure-Track Faculty, Department of Biostatistics, Vanderbilt University (VU-Stat APT 2016)).

**b. Grant Funding**—In many departments, obtaining grant funding is just as important as producing publications (Loyola 2016). Successful CBFs will have many opportunities for obtaining external funding, usually as a co-investigator on a research project led by another faculty member. Working on team projects is a good place to learn about multiple fields of research and to start finding future collaborators. Typically, CBFs will have some amount of their effort covered on multiple awards. Importantly, including a collaborative biostatistician as a co-Investigator is an asset to such applications – it reassures reviewers that the application will have an appropriate study design, power calculations, and analytic plans (Berg 2007; Inouye 2005). Being listed as a co-Investigator (or “key personnel”) also means the biostatistician’s effort is less likely to be cut from the budget if the proposal is funded.

An additional source of funding for an early-stage collaborative faculty member is an NIH Quantitative Mentored Career Development (K25) award, explicitly designed to allow early-stage biostatisticians (or other quantitative researchers) to acquire a skill set needed to become an independent investigator, with the guidance of a multi-disciplinary mentoring team (<http://grants.nih.gov/grants/guide/pa-files/PA-16-194.html>). Many foundations also

offer similar career development awards American Heart Association Mentored Clinical and Population Research Award ((AHA-Award 2016), American Asthma Foundation Scholar Award (AAFS-Award 2016)). Obtaining a K25 award can allow an early-stage CBF to develop leadership skills and to gain skills necessary for working in a team environment, while receiving protected time to develop such skills and conduct a research project. For the continued success of such an individual, an R01-level grant should be developed before the K award ends (<https://www.nichd.nih.gov/training/extramural/Pages/career.aspx>; <http://www.nimh.nih.gov/funding/training/career-development-programs-k-series.shtml>). Such an R01-level application can have a shared leadership structure, with both the collaborative biostatistician and a basic science or clinical researcher serving as multiple PIs. This arrangement will further demonstrate the leadership potential of the CBF. In addition, a CBF could serve as the PI of an R03 application. These are often designed for secondary analysis of existing datasets that a collaborative biostatistician could use to further investigate data from a collaborative project. An advantage of such a project includes strengthening the working relationship with the collaborative team by applying innovative statistical techniques to answer additional research questions.

**c. Peer Recognition**—To be considered for promotion or tenure, faculty members must demonstrate significant peer recognition of their accomplishments. Promotion and tenure committees often ask for names of 5 to 10 individuals to write reference letters, who are not collaborators and are senior to one's current position. Well-tended relationships with respected leaders in the field, through the networking tips given above or service roles, described below, make this task less daunting to accomplish.

Becoming a member of an Institutional Review Board (IRB), or reviewing proposals for an internal center or funding mechanism, are good ways to foster connections with other faculty members. However, it is also important to realize that committee work takes time away from other endeavors such as teaching and research. Thus, it is critical to join committees that do not reduce productivity in other areas. For any committee one is considering becoming a member of, it is also extremely important to be mindful of the timing and the goals to be accomplished. If the committee's goals are outside those of the faculty member, or if the committee is one that requires many hours of work per week or month, the collaborative biostatistician should carefully consider whether such responsibilities align with their career goals. Sometimes IRBs will allow CBFs to review only the protocols aligned with one's field of interest. Such an arrangement allows CBFs to learn more about that field and allocate their time more productively. A similar approach could be used by CBFs regarding participation in teaching and thesis advisory committees.

Once strong internal relationships have been fostered, CBFs can focus more on external relationships. Serving on an intramural committee may lead to serving on external committees, which can be advantageous for obtaining external recognition. Another strategy is to become involved with a local/regional organization or larger national organization, such as the ASA or the American Public Health Association (APHA). The ASA has many local chapters, which facilitates meeting peers outside one's home institution. Local, national, and international organizations all have associated subcommittees or working groups. Planning committees for annual meetings are a good fit for early-stage CBFs. Such committees are

often structured within sections of the larger organization (e.g. the Statistical Consulting section of the ASA or the Statistical Education section of the APHA). Becoming an officer of any career-oriented organization is another step towards peer recognition. Frequently, being an officer at the chapter or regional level can lead to becoming an officer in the national organization, which is prestigious.

Another way to gain national recognition is by serving as a manuscript reviewer for a journal. Many top-tier biomedical journals now require a separate statistical review for all manuscripts, so there are many opportunities for collaborative statisticians to become a reviewer for a journal pertinent to a medical specialty in which they frequently work (Burtkiewicz 2009). Journals frequently seek out new reviewers and welcome those with specific areas of interest and expertise they need covered. Serving on a journal's editorial board is also an excellent way to gain recognition, and often is the next step after exemplary service as a reviewer.

A prestigious way to gain external recognition is becoming a member of a grant review panel, many of which require statistical experts to be included (Burtkiewicz 2009). Reviewing proposals for smaller or more topic-specific funding agencies can yield valuable experience and links to other opportunities. In turn, the CBF becomes a better-informed member of any team seeking to apply to that agency, and can demonstrate leadership in that fashion.

Instructions on how to apply to be a reviewer are usually on the funding agency's website. Many grant-giving organizations welcome contacts from individuals volunteering to be reviewers. Therefore, expressing interest to the mentors who might already be the reviewers might work. Meeting program officers at scientific conferences is another excellent way to begin such activities.

Another often overlooked strategy to obtain recognition is to nominate colleagues for awards like ASA fellowships or Team Science Awards, and help prepare the nomination package. This task can help to elucidate a successful person's career path and how he/she has progressed, with potentially valuable lessons for the nominator in his or her own career.

### **Ways to Document Accomplishments**

When applying for promotion and/or tenure, faculty members must document their professional activities and achievements. Many AHCs allow faculty members to write a cover letter or personal statement as part of their promotion/tenure packet. For CBFs, this is the perfect place to explain how and why their contributions are meritorious, even though they may look different from other faculty members under consideration. In such a section, a collaborative biostatistician can document the importance of their role as a co-investigator in both grant applications and journal articles. Additionally, the collaborative biostatistician should explain the extent of participation and type of contribution to such activities. Some institutions, such as the Feinberg School of Medicine at Northwestern University, have implemented the use of a Team and Collaborative Research Documentation Form to make this process more streamlined (NWU-FSM-APT 2016). This form requests the collaborative biostatistician provide the team name, source of support, the role of the collaborative

biostatistician, a description of the role/contributions to the team/collaboration, and documentation of publications or other work products. In addition, the CBF could include in the packet at least one letter of support from a program leader documenting the applicant's unique collaborative contributions to programmatic research, including grants and manuscripts. Use of research, education/teaching (UTMB-APT 2016, U Pitt-APT 2016), and/or service portfolios can also be extremely helpful in documenting accomplishments unique to the collaborative biostatistician (Mazumdar 2015).

## Conclusions

Early stage CBF hired at AHCs often face the challenge of balancing various scholarly and service activities. Although graduate and postdoctoral programs attempt to prepare trainees for a successful career, the training on this balancing act is often lacking. Junior CBF often struggle to figure out the importance of various kind of efforts they need to be involved in and how to properly time them. New faculty orientation programs may be in place for formal orientation to the institution and exposure to school's policy and procedures but they are generally not enough to address the ongoing development needs. In this paper, we adapt a faculty progression grid from the field of nursing to the field of biostatistics for providing structured guidance to junior faculty. We provide suggestion for its further adjustment to fit needs of faculty in the tenure or non-tenure track, in a variety of biostatistics unit, and for an adjustable promotion timeline. Junior faculty may utilize the tool to self-monitor progress and use as a basis for discussion with the department chair or the mentors. We recommend the biostatistics units provide information about this tool to their new faculty within the first quarter of their joining and have a system for its follow-up. This will foster a proactive approach to setting and realizing CBF's career development goals.

Continuing education and expansion of skills is essential for a CBF. Since the statistical training in school is primarily mathematical for building a strong foundation in theory, an early stage CBF needs to learn about other skills such as collaboration, leadership, networking, and writing to name a few. This article provides a list of 'useful resources for skill development' to aid in this process. We encourage early stage CBFs to negotiate time and resources for these activities during recruitment and urge department chairs and mentors to create opportunities and align incentives.

The process for attaining promotion and tenure in an academic health center is multifaceted. Sustained attention from all stakeholders including the junior CBF, their departmental chairs, their collaborators, and school administrators is needed for successful career development. A recent analysis conducted by the American Statistical Association (ASA) finds statistics to be one of the fastest-growing degrees in the U.S., but that the growth may not be enough to satisfy the high demand for statisticians in schools of medicine and public health, government, manufacturing, technology, consumer products, finance, and other areas of the economy. (Litton 2015) At this time of shortage for statisticians, proper development and retention of CBF needs to be a priority for schools of medicine and public health to maintain their competitive edge. The number of biostatistics faculty is shown to be significantly positively associated with the amount of NIH awards, both as a school total and on a per faculty basis, across various sizes of U.S. school of medicine. (Zhang 2015)The

‘faculty progression grid’ and ‘useful resources for skill development’ provided here, if adapted and used in a consistent manner, could influence the success of currently appointed CBF and aid in future CBF recruitment and retention.

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**Chart 1:**  
**Progression Grid for Advancement Towards Promotion and Tenure for Collaborating**  
**Biostatistics Faculty at Academic Health Center (adapted from Garand 2010)**

Area of Importance	Milestones in Progression to Promotion and Tenure	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
<b>Supporting Network Development</b>	Meet at least semi-annually with your Department chair to review progress toward reaching pre-set milestones	***	***	***	**	*	*
	Appoint a mentoring committee of at least 3 mid-career and senior faculty; 1 faculty should be chosen from ones' home department, 1 faculty from collaborating department within the institution, and 1 faculty external to the institution	**	***	***			
	Get to know your Office of Faculty Development. Attend Faculty Development Seminars covering such topics as time management, negotiation skills, conflict resolution, how to write a letter of recommendation, etc. If your school does not have one, look at other universities within your area	***	**	*			
	Participate in a group that can provide peer support and mentoring, especially in grant development and manuscript writing. Create such a group if none exists.	***	***	***	***	***	***
	Assemble materials for the promotion packet and add to them over time	*	*	*	**	**	***
<b>Publications</b>	Publish your dissertation or data from your postdoctoral fellowship as soon as possible	***	**	*			
	Develop a publication track record (4–6 collaborative papers per year and 1 methods paper per two years has been a reasonable target for most schools)	*	**	***	***	***	***
	Obtain internal funding for a pilot/feasibility study and check appropriate web sites for deadlines			**	***	***	**
<b>Grant Funding</b>	Be familiar with the statistical grant funding list on the ASA website ( <a href="http://www.amstat.org/careers/fellowshipsgrants.cfm">http://www.amstat.org/careers/fellowshipsgrants.cfm</a> )	*	**	***	***	***	***
	If an Assistant Professor with a tenure-track appointment, submit an application for a career development award (e.g. NIH K25)				***	***	***
	Write grant applications with your collaborators as PI and you as Co-Investigator or primary biostatistician (i.e., key personnel) with appropriate full-time effort; Write R03 proposal for secondary data analysis with data available within your research team or national databases		**	***	***	***	***
<b>Mentoring</b>	Meet with the Director of the relevant PhD program to discuss your areas of expertise and volunteer to serve on dissertation committees			***	**	*	
	Mentor graduate students, become a member of a dissertation committee, and facilitate PhD students' research practicum experience			**	**	**	***
	Qualify for graduate faculty status and membership (your Department Chair must nominate you)		**	***	***	***	***
<b>Teaching Skills</b>	Attend seminars focused on teaching skills. If your institution does not have one, find one at other institution. For foreign graduate students, speaking lessons to reduce an accent could be important.	***	***	**	**	*	*
	Develop your teaching portfolio (e.g., sample student papers, teaching philosophy, curriculum evaluation paper, etc.)	*	*	*	**	**	***
<b>Service</b>	Join a departmental committee and gradually progress to chair that committee before submitting promotion package, if		*	*	**	***	***

Area of Importance	Milestones in Progression to Promotion and Tenure	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	possible. Develop a committee to chair in the area you think there is a need						
	Join an institutional committee and gradually advance to a leadership position just before promotion, if possible			*	**	**	***
	Join a national committee in an area of interest as a member and progress gradually towards leadership position just before promotion, if possible	*	**	***	***	***	***

Priority Rating Key:

\* Important

\*\* More Important

\*\*\* Most Important

Note: This document was created to serve as a resource for tenure-track faculty in a Biostatistics Department. Activities listed and the times suggested for completion are to be used only as a guide and/or a basis of discussion with your Department Chair and may differ for non-tenure track faculty. Timely completion of the activities listed on the grid does not guarantee tenure or promotion. A 6-year time span is chosen because that is the typical timeframe for promotion from Assistant to Associate Professor, but the Chart can be modified for those with a different schedule.

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**Chart 2:**  
**Some Useful Resources For Skills Development**

Topics	Resource
<b>Developing and Maintaining Collaboration</b>	Thabane L, Walter SD, Hanna S, Goldsmith CH, and Pullenayegum E (2008) Developing a Biostatistical Collaboration Course in a Health Science Research Methodology Program Journal of Statistics Education, 16(2), <a href="http://www.amstat.org/publications/jse/v16n2/thabane.html">www.amstat.org/publications/jse/v16n2/thabane.html</a>
– <b>Writing Skills</b>	Zeiger M (2000) Essentials of Writing Biomedical Research Papers; McGraw-Hill, NYC
– <b>Management Skills</b>	Flannes S. (2004) Effective People Skills for the Project Manager: A Requirement for Project Success and Career Advancement. Proceedings of the Twenty-Ninth SAS® User Group International, <a href="http://www2.sas.com/proceedings/sugi29/131-29.pdf">http://www2.sas.com/proceedings/sugi29/131-29.pdf</a>
– <b>Team-Building Skills</b>	National Cancer Institute's Team Science Toolkit: <a href="https://www.teamsciencetoolkit.cancer.gov/Public/SciTSSites.aspx">https://www.teamsciencetoolkit.cancer.gov/Public/SciTSSites.aspx</a>
– <b>Time and Stress Management Skills</b>	Traits of a successful Statistician: <a href="http://stattrak.amstat.org/2012/06/01/successfulstatistician/">http://stattrak.amstat.org/2012/06/01/successfulstatistician/</a>
– <b>Communication Skills</b>	Derr J (1999) Statistical Consulting: A Guide to Effective Communication; <b>Cengage Learning</b> . Cook A (2012) American Accent Training with 5 Audio CDs; Barron's Educational Series, NY, NY
– <b>Reporting Skills</b>	Enhancing the QUALity and Transparency Of health Research (EQUATOR) Network: <a href="http://www.equator-network.org/reporting-guidelines/">http://www.equator-network.org/reporting-guidelines/</a>
– <b>Conflict Resolution Skills</b>	Carey Smoak C. (2006) My Experience as a Facilitator Between Biostatisticians and SAS Programmers, Paper MA-05, <a href="http://www.lexjansen.com/pharmasug/2006/management/ma05.pdf">http://www.lexjansen.com/pharmasug/2006/management/ma05.pdf</a>
<b>Develop Statistics Teaching Skills</b>	Vanderbilt University, Center for Teaching: <a href="https://cft.vanderbilt.edu/guides-sub-pages/teaching-statistics/">https://cft.vanderbilt.edu/guides-sub-pages/teaching-statistics/</a>
<b>Develop Mentoring Skills</b>	Odueyungbo, A., and Thabane, L. (2012), "Mentoring in Biostatistics: Some Suggestions for Reform," Journal of Multidisciplinary Healthcare, 5, 265–272. doi: 10.2147/jmdh.s35792. Thabane, L., Thabane, M., and Goldsmith, C.H. (2007), "Mentoring Young Statisticians: Facilitating the Acquisition of Important Career Skills," The African Statistical Journal, no. 4, 123–136.
<b>Develop Leadership Skills</b>	Golbeck AL, Olkin I, Gel YR (Editors) (2015) Leadership and Women in Statistics; CRC Press, NY, NY American Statistical Association Leadership Courses: <a href="http://magazine.amstat.org/blog/2012/02/01/leadershipncarolin/">http://magazine.amstat.org/blog/2012/02/01/leadershipncarolin/</a> Association of American Medical Colleges (AAMC) Leadership Courses: <a href="https://www.aamc.org/members/leadership/catalog/322618/careerdevelopment.html">https://www.aamc.org/members/leadership/catalog/322618/careerdevelopment.html</a>
<b>Develop Networking Skills</b>	Streeter J (2014) Networking in academia. EMBO Rep. 15(11):1109–12. doi:10.15252/embr.201439626. PubMed PMID: 25319713 <a href="http://postdoc.harvard.edu/files/postdoc/files/networking_in_academia.pdf">http://postdoc.harvard.edu/files/postdoc/files/networking_in_academia.pdf</a>
<b>Increasing Productivity in Publication</b>	Pfirman S, Balsam P, Bell R, Culligan P (2007): Maximizing Productivity and Recognition, Part 1: Publication, Citation, and Impact; <a href="http://www.sciencemag.org/careers/2007/11/maximizing-productivity-and-recognition-part-1-publication-citation-and-impact">http://www.sciencemag.org/careers/2007/11/maximizing-productivity-and-recognition-part-1-publication-citation-and-impact</a> Sonnad SS, Goldsack J, McGowan KL (2011) A Writing Group for Female Assistant Professors. J Natl Med Assoc, 103:805–809, <a href="http://www.med.upenn.edu/focus/user_documents/WritersGroupPapercopy.pdf">http://www.med.upenn.edu/focus/user_documents/WritersGroupPapercopy.pdf</a>
<b>Increasing Productivity in Grant Funding</b>	External Funding Sources: <a href="http://www.amstat.org/careers/efs.cfm">http://www.amstat.org/careers/efs.cfm</a> Parent RO3 grants for Secondary Analysis of Existing Data: <a href="http://grants.nih.gov/grants/funding/r03.htm">http://grants.nih.gov/grants/funding/r03.htm</a> Mentored Quantitative Research Development Award (Parent K25): <a href="http://grants.nih.gov/grants/guide/pa-files/PA-16-194.html">http://grants.nih.gov/grants/guide/pa-files/PA-16-194.html</a> Multiple PI RO1: <a href="https://grants.nih.gov/grants/multi_pi/">https://grants.nih.gov/grants/multi_pi/</a> Berg KM, Gill TM, Brown AF, Zerzan J, Elmore JG, Wilson IB. (2007) Demystifying the NIH Grant Application Process. Journal of general internal medicine. 22(11):1587–1595. Inouye SK, Fiellin DA. (2005) An evidence-based guide to writing grant proposals for clinical research. Annals of internal medicine. 142(4):274–282. Research Portfolio Online Reporting Tools: <a href="https://projectreporter.nih.gov/reporter.cfm">https://projectreporter.nih.gov/reporter.cfm</a> The Grants On-Line Database (GOLD) for Agency for Healthcare Research and Quality (AHRQ): <a href="http://www.ahrq.gov/cpi/about/otherwebsites/gold.ahrq.gov/index.html">http://www.ahrq.gov/cpi/about/otherwebsites/gold.ahrq.gov/index.html</a>
<b>Increasing Productivity in Peer Recognition</b>	American Statistical Association (ASA) Awards and Recognitions: <a href="https://www.amstat.org/awards/">https://www.amstat.org/awards/</a> Translational Science Awards: <a href="http://www.actscience.org/page/2016-annual-meeting-awards">http://www.actscience.org/page/2016-annual-meeting-awards</a>
<b>Documenting Accomplishments</b>	Mazumdar, M., Messinger, S., Finkelstein, D.M., Goldberg, J.D., Lindsell, C.J., Morton, S.C., Pollock, B.H., Rahbar, M.H., Welty, L.J., Parker, R.A., and Biostatistics, and Research Design (BERD) Key Function Committee of the Clinical and Translational Science (CTSA) Consortium. (2015), "Evaluating Scientists Collaborating in Team-Based Research: A Proposed Framework," Acad Med;90 (10), 1302–1308

Topics	Resource
<b>Attending Conferences and Continuing Education Opportunities</b>	American Statistical Association (ASA) conferences: <a href="http://www.amstat.org/meetings/">http://www.amstat.org/meetings/</a> ASA Webinar Series <a href="http://www.amstat.org/education/weblectures/">http://www.amstat.org/education/weblectures/</a> Eastern North American Region (ENAR) Meetings: <a href="http://www.enar.org/meetings/index.cfm">http://www.enar.org/meetings/index.cfm</a> ENAR Webinar Series: <a href="http://www.enar.org/education/index.cfm">http://www.enar.org/education/index.cfm</a>

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