

Career Development Initiatives in Biomedical Health Informatics

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Abstract— The disciplines of biomedical engineering and health informatics complement each other. These two scientific fields sometimes strive independently to deliver better health care services. The rapid evolution in data-intensive methods has made practitioners to think about reviewing the educational needs of the biomedical health informatics workforces. This paper discusses the changing skills requirements in biomedical health informatics discipline. The author reports on the challenges faced by IEEE Engineering in Medicine and Biology (EMBS) in the context of continuous career development of the EMBS members. This paper discusses Queensland chapter’s initiative towards an integrated career development to address challenges faced by IEEE EMBS.

I. INTRODUCTION

The challenges in global health demands continuous improvement in skills on the workforce engaged in biomedical engineering and more importantly, on the workforce engaged in delivering health services as well engaged in conducting clinical research. The IEEE Engineering in Medicine and Biomedical Society (EMBS) define the biomedical engineering discipline as a multidisciplinary field that integrates principles from engineering, life sciences and healthcare [1]. The main output from the application of all these principles is to provide better healthcare. Health informatics is defined as integration and management of a person’s health record to provide critical clinical decision support [2]. The evolution in electronic means of recording data including physiological signals as well as other relevant clinical data has given increasing importance to innovative informatics methods for managing the health data. The combination of Biomedical Engineering and Health Informatics discipline is considered as Biomedical Health Informatics (BMHI) [3-5]. The ultimate goal of BMHI is to assist the clinicians in delivering better health care.

It is widely acknowledged that both disciplines should be well integrated in conducting research as well as practical application in clinical settings [6-7]. The integration of these disciplines also demands continuous skills development of

the BMHI workforce. Our research and observations show that there is an apparent gap in continuous career development of new generation of BMHI professionals [8-9]. Newer methods are needed to engage BMHI community including students, academia, early career professionals as well as industry members. The turn of the century has witnessed rapid growth of biomedical engineering and health informatics disciplines. The rapid advances in soft computing and data driven methods has especially been crucial factor in the health care improvements [10]. These advances suggest that biomedical health informatics professionals need newer ways of exploring career development pathways. This paper reviews the changes needed for improving career development pathways. The author on behalf of IEEE EMBS Queensland chapter reports on the challenges faced by IEEE EMBS in extending its impact through increased membership as well as active participation in the BMHI community. The term “we” refers to the EMBS Queensland chapter team. We also discuss ways in which IEEE EMBS can contribute to career development of BMHI professionals. We report on the initiatives taken by the Queensland chapter. The objectives of our initiatives were to promote awareness of BMHI and increase collaboration between the BME and HI professionals.

II. LITERATURE REVIEW

We conducted a literature review to understand changing skills requirements for BMHI professionals. We conducted a literature review of the biomedical engineering methods applied in current skill set of biomedical engineers and health informaticians according to specifications outlined by international medical informatics association (IMIA) [11]. We also conducted a literature review that specifies the challenges in BMHI education [12-13].

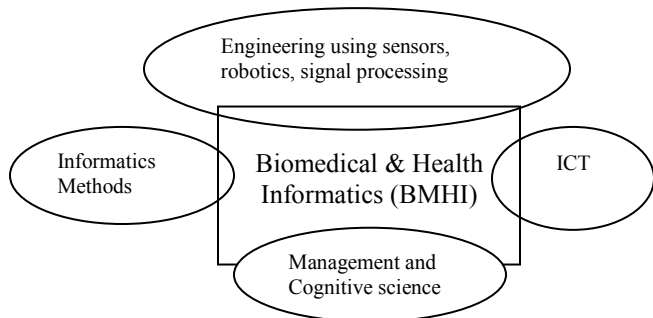


Figure 1. BMHI discipline

The IMIA recommendations suggest that BMHI is an aggregation of fields such as informatics, biomedical

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engineering, information and communication technology (ICT). Figure 1 shows that the BMHI discipline can be considered as an intersection of various disciplines. BMHI also uses principles from other disciplines such as management science, cognitive science and basic sciences such as chemistry and biology. The review of IMIA recommendations also suggest that the formal education of those disciplines should be integrated. The main findings of our review are as below.

- There are subtle differences in skill requirements for both disciplines
- The change is required at various levels of the education
- The changes are required for students community as well as practitioners

The formal education in individual disciplines leads to various career pathways in BMHI. Figure 2 shows the formal education requirements for BMHI career pathways.

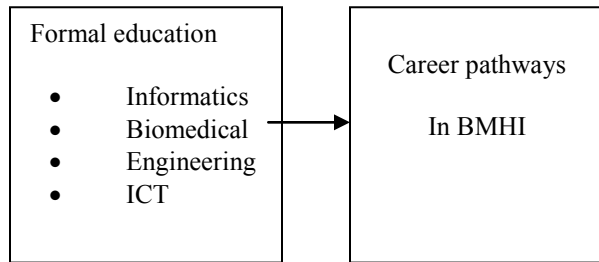


Figure 2. Formal education for BMHI career

The implementation of these recommendations needs interventions at various level of the BMHI community. The stakeholders include students, academics, research organisations as well as commercial industries engaged in producing health care goods and services. The challenge lies in bringing all the stakeholders together on the same platform. Research suggests that there is gap between biomedical engineering and health informatics communities [14-15]. Both disciplines work towards a common and shared goal. However, there is a disconnect between the disciplines. There is a need to maintain relationships between the changing skills requirements and learning outcomes due to new changes in BMHI technologies. The change should be maintained at all levels from students, early career professionals as well as across academic, research and industry community.

A. EMBS Challenges

The IEEE EMBS has challenges to promote the BMHI disciplines together. The challenges are to increase awareness of importance of integration of health informatics disciplines into EMBS. We observe the challenges as below-

- Integration of Health informatics into EMBS events
- Including Health informatics members into EMBS memberships

- Revising subscriptions to students in health informatics community
- Engagement of core health informatics professionals into EMBS

The challenges faced by IEEE EMBS especially growing the membership of EMBS community can be described by the following factors

1. Subscription costs to the institutions
2. Lack of personal incentive in terms of education
3. Lack of continuity in maintaining the membership
4. Differences in the industry agenda and academic agenda

We propose that such challenges can be addressed by a systematic approach focusing on education and awareness of BMHI principles and engagement of various stakeholders in BMHI community.

III. PROPOSED APPROACH

We suggest the following interventions to engage the BMHI community especially for meeting continuous career development of BMHI professionals-

1. Establish a career development forum that can bring all the stakeholders together.
2. Continuous engagement of student, research as well as industry community

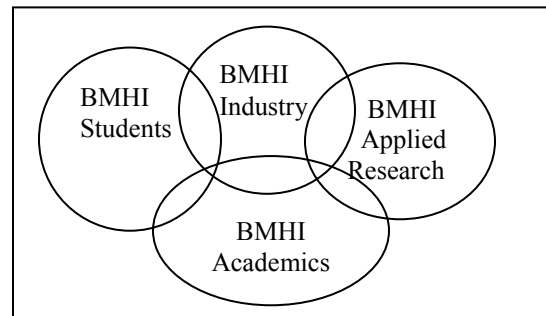


Figure 3. BMHI Stakeholders

We propose that an integrated approach that brings together all the disciplines such as industry, academia and students. This multidisciplinary approach can provide better outcomes for continuous skills development and career progression of BMHI professionals and thus, will ultimately meet the challenges of BHMI as well as IEEE EMBS. We propose that the change can be driven through professional societies such as IEEE EMBS. The IEEE EMBS chapter in Queensland (IEEE EMBS Qld) has already taken such an initiative. The IEEE EMBS Qld has conducted annual Career Development Forums (CDF) for students and BMHI professionals that involved a panel of industry experts, academic researchers from biomedical as well as health informatics disciplines. The CDF was also designed to share insights between industry experts and academics on how they developed their career in BMHI. The CDF consisted of 15-20 minutes oral presentations from leading experts from industry, academia, BMHI research as well as graduate students. The experts presented their viewpoints on the skills

needed for a successful BMHI career. CDF was attended by between 20-50 professionals including students. An example of CDF format is shown in Table 1. The presentations invited valuable discussions from the participants. CDF established a good learning platform for BME and HI professionals.

Table 1. CDF Presentation Topics

CDF Presentation Topic	Target Audience
Career Pathways in Biomedical Engineering	Students and early career professionals
Project Management of Healthcare Service Delivery	Industry Professionals, Students and Early Career Professionals
Biomedical engineering in Commercial ICT Industry	biomedical engineering skills
Biomedical Engineering projects vacation experience	Students

IV. DISCUSSION

Our study as well as the initiatives taken by IEEE EMBS Qld can offer one of the solutions to the dynamic challenge of career development for BMHI professionals. The main outcome of the BMHI discipline is to deliver better health care. It is widely acknowledged that application of health information technology (HIT) in clinical setting has certain barriers [16-17]. The barriers are mainly due to lack of appropriate integration of the technology in the clinical workflow by the practitioners [18]. The root cause of such barriers can be attributed to lack of skills at various levels of the career in BHMI. We observed that the integration of stakeholders from various levels of BMHI community facilitates valuable exchange of ideas. Our approach facilitated important communication among the stakeholders and it has also provided clarity to career paths of the BMHI professionals. We observed that early career professionals require a career path for their skills development. A clear career path is often not provided by the formal education as well as the employers. The communication with the research as well as industry members established a clearer understanding of the career development requirements. The integrated approach was not only useful to graduates but it also provided valuable platform to promote and exchange ideas among industry and research members. The latest industry developments provided practical insights into the uptake of research done by the academics and university researchers. The forum provided a platform to discuss practical aspects of implementing ideas from the research community into industrial goods and services. The outcome of the IEEE EMBS Qld approach to engage student community increased interest in career development activities as well as EMBS promotion. The student community showed interest in BMHI vacation research projects and also in career

development opportunities in applied research organisations. The students and early career professionals also showed interest in BMHI innovation. CDF also provided valuable networking opportunities to the participants. Our CDF approach also addressed challenges faced by the EMBS to grow EMBS community and serve EMBS members in a better way. Based on the experience of conducting CDF events continuously for the past 3 years we make the following recommendations –

1. CDF initiative should be followed by other chapters in Australia
2. Improve inter-chapter collaboration between EMBS Region 10 (R10) chapters on CDF topics
3. Improvement of modern social media technologies to deliver CDF events and BMHI skill development courses

We recommend that other EMBS chapters in Australia and other IEEE region should develop their own CDF as per needs of the local audience and the outcomes should be shared thorough IEEE communication mechanisms.

A. Need for Integrated Continuous Professional Development

We also observed that IEEE EMBS Qld's CDF approach provided continuing professional (CPD) development opportunity to the biomedical as well as health informatics professionals. The disciplines of BME and HI require continuous upgrade of respective skills due to rapid advances in the technology. The CPD programs for BMHI professionals should include BME as well as HI components. Our research shows that the educational initiatives undertaken propose dedicated health informatics and BMHI courses at tertiary levels [19-21]. These are excellent initiatives. However, success of these educational programs in practical industrial setting has its own challenges. The professionals completing these programs are mainly from engineering and technology background lacking significant clinical expertise and specific clinical domain knowledge. On the other hand, practicing clinicians need to understand skills required for successful development and implementation of a BMHI system for improving health care services in a clinical setting. There seems to be a "skills-gap" between BMHI professionals and clinicians. Currently, CPD programs are targeted towards only one type of audience either clinical or technical. This approach has limitations in educating the workforce about the challenges involved in aggregating principles from both disciplines successfully.

The "skills-gap" can be addressed by developing innovative educational methods that can address complementary educational needs of BMHI professionals as well as clinicians. The efforts made in this direction provide a good starting point to introduce changes in the BMHI education [22-24]. The innovative initiatives in BMHI education suggest use of problem-focused learning, online content delivery using social media technologies. The evolution in the web-based educational program is also another delivery mechanism that must be considered for an integrated CPD program for BMHI professionals and

clinicians. These programs can also be targeted at the medical practitioners. The BMHI programs should be considered as a CPD opportunity for medical practitioners.

It is widely acknowledged that the changes in technology require continuous updates in skills. CPD for biomedical engineering professionals can be any educational activity which helps to maintain, develop or increase knowledge, problem-solving, technical skills or professional performance standards all with the objective that the biomedical engineers can add value in health care delivery in the clinical setting. The discussion of latest developments in technology as well clinical practices helps BMHI professionals for performing their tasks more efficiently. These discussions also keep the BMHI professional motivated and interested in the discipline. We observed that the discussions with the industry experts lead increased interest in IEEE EMBS participation. We think that CPD practices can be enhanced if a multidisciplinary approach is undertaken. During the CDFs, we observed that the interaction among various members of the industry added value to their respective CPD.

CONCLUSION

This paper has reviewed changing skills requirements for the BMHI professionals. The discussion in the paper suggests an integrated CDF approach where stakeholders from various disciplines are engaged. The CDF approach has multiple benefits such as promote IEEE EMBS agenda as well as provide a valuable learning opportunity to members of the EMBS community. The main challenge is to maintain the engagement of these stakeholders. We have described initiatives taken by the IEEE EMBS Queensland chapter. The proposed approach and success of the subsequent initiative depends upon the continuous support of the BMHI community as well as EMBS educational policy makers.

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