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Nutrition Informatics Competencies across All Levels of Practice: A National Delphi Study

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REPORTS FROM THE Institute of Medicine are transforming health care as we know it today. In 1999, a landmark report entitled *To Err Is Human* focused on the elimination of paper-based medical records to help reduce medical errors.¹ A year later, *Crossing the Quality Chasm* followed up with a report pointing out how innovation and information technology can improve the quality of our outdated health care system.² To help cross that chasm, the Institute of Medicine published another report focusing on educating the next generation of health care professionals.³ As outlined in *Health Professions Education, A Bridge to Quality*, patient-centered care, evidence-based practice, quality-improvement approaches, and informatics will all be necessary to improve health care in the future.

Our profession is beginning to acknowledge the specialized area of nutrition informatics and how it will impact our practice.⁴ We have already seen the introduction and implementation of the Nutrition Care Process, International Dietetics and Nutrition Terminology, *Nutrition Care Manual*, and the Evidence Analysis Library. In 2006, the first article entitled “Nutrition Informatics” appeared in the *Journal of the American Dietetic Association*.⁴ By 2007, the Academy of Nutrition and Dietetics (formerly the American Dietetic Association) appointed a work group to look at what role informatics would play in the profession. The work group defined the term *nutrition informatics* as “the effective retrieval, organization, storage, and optimum use of information, data, and knowledge for food and nutrition-related problem solving and decision making. Informatics is supported by the use of information standards,

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

Additional information on this study, including the competencies by level of practice and the survey instruments, can be found at www.eatright.org/NIDelphi2012.

information processes, and information technology.” In short, “nutrition informatics is the intersection of information, nutrition, and technology.”

Many definitions for informatics include the term *information technology*. Bernstam and colleagues⁵ have defined informatics as the study of “data plus meaning.” Informaticians study data based on use, context, and the representation that comprises that meaning. Although technology and the use of computers is a necessary adjunct to the field of informatics to efficiently collect, store, and retrieve data, competencies in computer skills do not imply that informaticians must also be computer scientists or computational experts.

Two surveys have been conducted by the Academy to begin a longitudinal analysis of how members are using technology, managing information, and using the Nutrition Care Process in their daily practice. The first survey conducted by the Nutrition Informatics Work Group in 2007 was designed to establish baseline information for planning and educational purposes.⁶ The second survey was conducted in 2011 with the help of Health Information Management Systems Society Analytics. The follow-up survey was designed to look at changes in the adoption and use of technology and also to examine any differences in how members are obtaining and using data/information. The 2011 survey also looked at registered dietitians (RDs) and dietetic technicians, registered (DTRs), and what role they played within their organizations when it came to selection, implementation, and maintenance of information management systems and other technology.⁷ Results of the second survey confirmed that RDs and DTRs are moving toward electronic health care by adopting electronic health records (EHRs), the Nutrition Care Process, and standard terms from the International Dietetics and Nutrition Terminology. Members also believe that information technology will have a positive impact on time management and workflow and will help with the ability to access and analyze data.

In May 2010, a new blog (via www.eatright.org) focusing on nutrition informatics was launched that provides members and others with information about the Health Information Technology for Economic Clinical Health and meaningful use. Aimed at modernizing the delivery of health care in the United States, these initiatives are managed through the US Department of Health and Human Services’ Office of the National Coordinator.⁸ As a result of Health Information Technology for Economic Clinical Health and meaningful use, health care has entered the digital age. The 2011 Dietetics Workforce Demand Study conducted a future scan of trends and issues that will shape dietetics practice in the future.⁹ A consistent theme of this study was technology driving change for all areas of practice, as well as the potential for practitioners to embrace technology and new forms of information management to remain competitive in the marketplace.

Although other professions have addressed informatics competencies at different levels of practice, the dietetics profession has yet to do so. Eldredge and colleagues¹⁰ compared library and informatics skills competency statements from major health professional associations. Absent from this study were informatics skills for food and nutrition practitioners. Based on the changing health care environment and the growing body of knowledge on informatics competencies based on efforts by other medical and allied health professionals, members of the Academy’s Nutrition Informatics Committee conducted a study to determine informatics competencies applicable to the practice of dietetics. The purpose of this study was to establish the first compilation of informatics competencies for RDs, DTRs, and students based on the Academy’s Career Development Guide’s¹¹ six levels of practice:

- *Novice*: A student, for example, an individual in a Didactic Program in Nutrition and Dietetics, Dietetic Technician Education Programs, or Dietetic Education Programs.

- *Beginner*: An individual in a supervised practice program, for example, internship program, or the supervised practice phase of a Technician Education or Dietetic Education Program. At the conclusion of this phase, the individual can sit for the registration examination for RDs and DTRs.
- *Competent*: First 3 years of practice for RD or DTR. Defined as entry-level practice employment.
- *Proficient*: An RD or DTR with 3+ years of experience. Has experience augmented with continuing education, technical training, and/or a professional credential (specialist).
- *Informatics Specialist (Advanced Practice)*: An RD or DTR, through education, training, and/or experience has additional knowledge and skills in information management and technology.
- *Informatics Expert*: Highest degree of skill or knowledge. Advanced practice implies master's degree or higher. Performs informatics research. Educator of nutrition informaticists.

This study had two goals: 1) define informatics competencies for the field of nutrition and dietetics, and 2) determine the assignment of each competency to the appropriate level of practice. The desired outcome was to have members of the Academy reach agreement on competencies based on these two goals.

SURVEY DESCRIPTION

The Academy Nutrition Informatics Committee formed a competency study subgroup and in 2010 began a systematic review of the health care informatics competency literature.¹²⁻²⁷ Because the goal of this study was to develop competencies for all levels of practice, the literature review included competencies not only for informaticians, but also practitioners.

Selection of Competency Items

Following a review of the literature, the study group established a list of competencies. Based on the practice of dietetics and the levels of practice, competencies were placed into categories based on the Stagers model^{12,13}: computer skills, informatics knowledge, informatics skills, and other. *Computer skills* are defined as the proficiency in the use of computer or device hardware and software; *informatics knowledge* is the theoretical and conceptual basis of informatics; and *informatics skills* are the use of methods, tools, and techniques specific to informatics. The “other” category allowed the inclusion of competencies that crossed categories. Lists of compiled competencies were reviewed by the study group compared with other Academy standards, such as the Standards of Practice for Nutrition Care²⁸ and the surveys conducted by the Nutrition Informatics Committee^{6,7} to ensure consistency as well as completeness.

Competency Validation

To meet the stated goals of this study, the Delphi method was chosen as the study tool of choice.²⁹⁻³¹ The Delphi method was developed in the 1950s as a technique to obtain consensus from a group of experts using structured communication, usually in the form of surveys. Key elements of the Delphi method are the use of experts to achieve consensus on or ranking of issues, anonymity of individual responses, iterative rounds to allow respondents to revise their assessment, and ultimately agreement of group as a whole on the issue at hand.

Participants

In a classic Delphi method, experts in the field are recruited to participate based on criteria such as publications or years in the field.³⁰ Nutrition informatics is a new area for the Academy and there are few “informatics experts” based on published Delphi study criteria. With that in mind, participants were recruited based on their area of practice and their willingness to participate. In order to reach consensus on informatics competencies, groups of practitioners were sought from five constituencies: educators, clinical or community practice (including long-term care), informatics, administration and management, and Academy staff. The inclusion of Academy staff was considered to be important to the findings of this study as the Commission on Dietetic Registration and the Accreditation Council for Education in Nutrition and Dietetics establish educational opportunities for practitioners and educational competencies for students, respectively. Although the development of competencies for students was a stated outcome, students were not recruited to participate in this study. The educator’s cohort served to represent this group based on their experience with curriculum and supervised practice settings.

Calls for participation were published on the Academy’s Nutrition Informatics Community website, as well as e-mail lists for Academy dietetic practice groups related to the desired constituent groups. Participants were asked to self-select their cohort, and each cohort was capped at 30 participants. All cohorts began the study with 30 participants, except for the Academy staff cohort, which began the study with 10 members. The optimal cohort size was determined by a review of the literature with an added factor for attrition.^{29–31} This study was reviewed by the National Institutes of Health Office of Human Subjects Research Protection and approved as an exempted research study. Once selected to participate in a cohort (based on the first 30 individuals who volunteered for each cohort), each participant received a full explanation of the study including the plan and timing for each round, the fact that data were anonymized except for assignment to a cohort, as well as the fact that participants were free to withdraw from the study at any time. No compensation was offered for participation in the study.

Survey Administration

A three-round Delphi study was conducted using an online survey tool developed with Survey Monkey.³² The three iterations of the survey were piloted by the study group before distribution to the study participants. One member of the study team managed all of the lists of participants as well as the distribution of the survey instruments. All surveys were distributed to participants via their preferred e-mail address. Note that study participants had no knowledge of the other study participants or the detailed responses of other participants. Once a participant completed the survey for each round, they were not able to return to the survey and submit multiple responses. All data collected through the survey tool were anonymized (no names or e-mail addresses were retained) and computer internship program addresses were specifically not provided to the study team by the survey tool. This anonymized study design reflected the stated goal of achieving consensus on competency items between cohort groups, rather than consistency of responses from each participant.

Round One (November 16 to November 30, 2011 with a Reminder on November 28, 2011)

The goal of this round was to determine the inclusion or exclusion of competency items based on their relevance to dietetics practice. Participants were first asked three demographics questions: study cohort, number of years worked in their area of practice, and their age category. The participant was then asked select “include” or “exclude” next to each competency item. Competencies were organized into four categories: computer skills, informatics knowledge, informatics skills, and other. Each category had subsections; for example, computer skills had a series of questions related to communications. Respondents

were also able to add additional competencies at the end of each section. The electronic survey tool was sent via e-mail (via bcc) to all study participants without differentiation of cohort.

Round Two (December 6 to December 20, 2011 with Reminders on December 13 and December 19, 2011)

The goal of this round was to assign a level of practice to each competency: novice, beginner, competent, proficient, informatics specialist, and informatics expert based on Academy definitions of levels of practice.¹¹ Surveys were issued and received by cohort for this round. Participants were asked to select the lowest level of practice applicable for each competency, as it was assumed that each competency carried through to all higher levels of practice.

Round Three (January 12 to January 26, 2012 with Reminders on January 20 and January 25, 2012)

The goal of Round Three was to achieve consensus on the level of practice for a subset of competencies where significant variations in level of practice were found in Round Two. Surveys were issued and received by cohort for this round. Participants were asked to select the lowest level of practice applicable for each competency. For each item, the Round Two mode (the most frequent response) was presented as a reference.

Data Analysis

Data analysis was performed using spreadsheets of numerical data files from Survey Monkey.

Round One—Each proposed competency was classified as “include” or “exclude.” If >50% of respondents selected “exclude,” the competency was removed from consideration for Round Two.

Round Two—Round Two data were evaluated with the goal of reaching agreement on assigning each competency to the lowest appropriate level of practice. Data for respondents who did not complete all items and cohorts with <10 responses were not included in the analysis. Data were analyzed in numerical format, where a 1 equated to the novice level, a 2 was the beginner level, and so on.

Because the goal of a Delphi study is to achieve agreement, cohort mode by item (the most frequently chosen practice level for each competency) was used to compare groups. Analysis of variation using means was explored, but elimination of variance through multiple rounds would have resulted in additional study rounds and decreasing respondent participation. Cohort modal values for each competency were determined. Where the mode for level of practice across all cohorts was the same, the classification of that competency item was considered complete. When the modal classification by cohort agreed between three out of the four cohorts, and the outlier cohort differed by only one level of practice with a standard deviation of modes of <.5, classification was considered complete. If the modal comparison between cohorts differed for two or more cohorts with a standard deviation of modes of >.5, the competency item was considered unclassified by level of practice and included in the Round Three survey.

Round Three—Round Three data were evaluated with the goal of reaching agreement across the four cohorts for the classification of remaining competency items.

SURVEY FINDINGS

Demographics

Round One—A total of 130 participants volunteered to participate in the nutrition informatics Delphi Study. Table 1 details the five cohorts and their size for Round One. Of the 130 volunteers, 123 participants (95%) completed Round One. Participant demographics are summarized in Figures 1 and 2. More than 70% of participants were 45 years or older, with a median age category of 45 to 54 years compared with the most recent Academy Compensation and Benefits Survey, where the median age was 47 years.³² Volunteers also had significant experience with 78% reporting 11 or more years of practice.

Round Two—A total of 109 participants (84%) completed Round Two. For Round Two, surveys were distributed and responses collated by cohort. Figures 3 and 4 summarize Round Two participant demographics by cohort. Most respondents had significant years of experience, with the exception of the informatics cohort, which had a number of participants with 2 to 5 years of experience. Due to the limited numbers of Academy staff participating in Round Two, this cohort was not included in Round Two data analysis or Round Three data collection.

Round Three—A total of 90 participants (69%) responded to the Round Three survey representing four cohorts.

Competencies

Round One—In Round One, there were 48 questions that detailed 229 competencies. Participants were asked to determine whether each competency should be included or excluded based on their knowledge of dietetic practice. If >50% of respondents indicated that a competency should be excluded, the competency was removed. Twenty competencies were removed. From computer skills, this included replacement of computer hardware, the use of utility programs for data recovery, and developing models for simulation. No competencies were removed from informatics knowledge. For informatics skills, competencies were removed from the systems maintenance, data and data structures, design and development, and implementation and programming categories. Eight new competencies were added based on participant comments and subsequent review by the authors. Figure 5 details the competencies added by category.

Round Two—In Round Two, there were 47 questions with a total of 217 competencies. The percentage of respondents selecting item inclusion in Round One was included with each individual competency. In this round, participants were instructed to select the lowest level of practice applicable, with the assumption that the competency would be carried through to all higher levels of practice. Round Two had 217 items and agreement on the level of practice between cohorts was achieved on 156 items. The remaining 61 items had significant variation in response requiring a third round.

Round Three—In Round Three, participants revisited the 61 competencies that had significant variation in Round Two. This was to ensure that competencies achieved consensus on level of practice between the four remaining study cohorts; Education, Clinical/Community, Informatics and Food Service/Management. Following the completion of Round Three, agreement on the remaining competencies was achieved for 54 items. As noted in the analysis section, there were seven questions with a modal variation of .5 to .57. Four of these questions were from the computer skills group. The first two related to software: proficiency with the use of spreadsheet software and with the use of desktop data base software. Both were classified at the novice level using the modal value for all

participants. Also under computer skills, there were two systems competencies related to the use of peripheral devices such as thumb drives, and the ability to integrate different programs for data exchanges. These were classified as beginner-level skills. Under informatics knowledge, variance remained in classifying the competency “recognizes that it takes persistent effort and skill for computers to become an effective tool.” The Round Three mode for all respondents was at the beginner level. In the informatics skills group, the role section competency “conducts research to examine impacts of computer technology in nutrition” was ranked at the nutrition informatics expert level and under the management subsection, escalating client issues related to using technology was ranked at the informatics specialist level of practice.

Post-Round Three—There were seven competencies falling under the “other” category. To provide ease of use and integration of these concepts, the authors moved these seven items into existing categories. Figure 6 details the “other” competencies and where these items fit into the three major areas of classification. The level of practice as determined was retained. One item was removed from computer skills—administration, as it was determined to duplicate an item in computer skills—documentation. The skill related to the entry of data into a structured form. This resulted in a total of 216 competency items.

Competencies by Level of Practice

Table 2 summarizes the number of competencies by category and by level of practice. The master list of competencies by level of practice is available at www.eatright.org/NIDelphi2012. It is assumed that competencies at the lower levels of practice apply to higher levels of practice.

SURVEY EVALUATION

This study represents the first analysis of informatics competencies for dietetics practitioners and students. Competence with technology and information management is now a critical skill for those working in any profession. With the rapid changes in health care practice based on the use of technology, all practitioners must now be prepared to work in settings where daily work requires the ability to use technology to access data and information from a variety of sources, document work, and to communicate through multiple modalities.

Competencies for this study were culled from a number of other health care professions as well as informatics publications from the Academy. The final suite of competencies will begin to lay the groundwork for ensuring that practitioners can systematically apply informatics concepts to their area of practice. Educators will now have competencies available to them for use with didactic and experiential program development. Many practitioners are involved with the development of EHRs; food and nutrition systems; and nutrition-related applications for large systems, mobile devices, or social media. Although the dietetics profession is well prepared to provide nutrition-related content, informatics skills ensure practitioners are also prepared to select and use the appropriate technology and manage the data and information related to that technology. More dietetics practitioners are moving full-time into the practice of informatics, to directly support nutrition operations or as part of a larger informatics team within acute care, ambulatory, or long-term care settings. Nutrition informatics specialists and experts will assist with the development of tools, techniques, and project management and informatics research to test the efficacy of these tools and methods.

Distribution of Competencies across All Levels of Practice

For the purposes of this study, it is presumed that competencies will be achieved at the completion of the two educational phases of the Academy's Career Development Guide¹¹ (novice and beginner). For dietetics practitioners, informatics competencies are provided to guide continuing education activities related to practice (competent and proficient). Competencies for informatics specialists and informatics experts may be used to drive education curricula for Academy certifications and advanced degree programs in nutrition informatics as well as continuing education.

Novice—Based on the classification provided by this study, novice competencies focus on computer skills (Table 2). These include the use of basic desktop software, accessing data through online literature searches such as PubMed, and using a computer for communications and research. Informatics knowledge includes a familiarity with the impact of technology and the basics of computer systems such as the ability to identify computer components. No informatics skills were included at the novice level.

Beginner—As students prepare to sit for the registration examination or the DTR examination, this study details additional competencies for both computer skills and informatics knowledge. These additional competencies add computer skills related to using an EHR, a food and nutrition management system, and electronic educational materials for patients or clients. Informatics knowledge includes items related to privacy and security, using data for problem solving and improving practice outcomes, and identifying the differences between paper and electronic systems. No informatics skills were included at the beginner level.

Competent—For those in their first 3 years of practice, competencies include computer skills, informatics knowledge, and informatics skills. Using quality monitoring and project management tools are added to the computer skills list. Informatics knowledge includes the use and development of standardized terminology, computer usability, and using data to make decisions. Knowledge competencies also include recognizing the value of participating in the evaluation and selection of applications and systems used to manage health care data. Informatics skills includes the evaluation of accuracy of health data from electronic systems, the use of systems for the effective collection, organization, and interpretation of data, as well as role-based competencies related to encouraging the use of technology.

Proficient—The proficient practitioner includes one computer skill for research—the ability to use a computer application for statistical analysis. Informatics knowledge related to data aggregation and integration and distinguishing between structured and unstructured data are added at this level. Informatics skills include participating in the process of systems selection, design, implementation, and evaluation, and the ability to collaborate with interdisciplinary teams to accomplish cross-discipline data collection and information management.

Informatics Specialist—An informatics specialist demonstrates knowledge of standardized terminologies, as well as systems design, hardware, software, and user support. Skills include a knowledge of regulations related to technology; the ability to serve as an information resource for others using technology; and competency in the analysis, management, and evaluation of technology and applications. There are 88 informatics skills at the specialist level that will help drive future content for certificate and certification programs as well as advanced degrees in nutrition informatics.

Informatics Expert—Experts in informatics are involved in nutrition informatics research and work with other health care providers to develop new methods for data and information management. These practitioners are the educators for future nutrition informaticists. This study has identified eight competencies at this level, suggesting further study is needed. As noted by Brody and colleagues, dietetics practice lacks a comprehensive definition of advanced practice.³³ In a new practice area such as informatics, this study highlights the dearth of practice parameters at the expert level.

Applications to Practice

Competencies provide a roadmap for informed practice. The following section details the practical application of informatics competencies to different practice settings. Case studies to high-light the application of competencies to different levels of practice are located in Figure 7.

Clinical Practice—Current clinical practice requires the ability to use an EHR or, for organizations in the process of implementing an EHR, the participation of nutrition and dietetics personnel to ensure practice requirements are met. Patients have access to their health care data through patient portals or personal health records and will expect their health care data to be exchanged seamlessly between systems. Software applications for systems and mobile devices will enable the collection of larger volumes of data. Practitioners will need the skill to manage and use large data sets to drive care at the individual level and advance outcomes and practice through the analysis of aggregate data. Quality measures will be based on the electronic submission of data to federal agencies. Reimbursements will depend on the practitioner's ability to document electronically. As a patient leaves a health care institution, their electronic file will follow them to their provider(s) or other institution(s). Nutrition care plans, diet orders, clinical documentation, and discharge plans will need to be a part of the institutional system(s) to be a part of this process and ensure the inclusion of nutrition and dietary information.

Community Practice—This area of practice includes community nutrition programs and program evaluation as well as public health. Informatics relates to not only the collection and analysis of data related to individuals, but the use of aggregate data for monitoring the public health. Examples of informatics skills might relate to the use of personal health records or a smart phone application to monitor an individual's intake, or the use of Twitter to evaluate the impact of a public health program. With the increased use of food tracking using barcoding, out-breaks of food-borne illness can be traced.

Consultation and Business Practice—Practitioners in this area have a host of tools to use in reaching clients and monitoring business and health trends. Social media tools such as Face-book and Twitter allow for networking and outreach. The development of applications related to food and nutrition for the computer or a mobile device are changing the way clients manage their health information.

Food and Nutrition Management—Foodservice operations, including school foodservice, now rely on increasingly sophisticated systems to manage inventory, scale recipes, generate tray tickets, and manage hotel-style room service applications. Systems using food databases calculate nutrition content of recipes or of an individual's intake. Foodservice management systems can receive diet orders and other patient information from EHRs using standardized interfaces preventing errors related to manually copied order. Other systems are used to manage personnel, payroll, and staffing, as well as satisfaction surveys.

Educators—Educators of practitioners can use technology, such as online learning environments, learning simulations, or tracking classroom activities. Educators must also understand health care technology and information management trends to ensure students are prepared for future practice. Accessing resources for practice such as published literature, and Academy resources such as the Nutrition Care Processes, are key skills to include in the curricula.

Research—Researchers now rely on technology for managing and analyzing large volumes of data. Clinical research studies are now managed through clinical trial applications that drive scheduling, data collection, and study milestones. Grant applications are now filed electronically requiring facility with the completion and filing of online forms.

Informatics—Although informatics is not formally recognized by the Academy as an area of practice, many RDs and DTRs now work in this field. This can involve managing a food and nutrition management application, or working with a multidisciplinary team to implement an electronic health care system or a long-term care management system. Others might work for companies that develop applications, or for federal agencies such as the US Department of Agriculture or Centers for Disease Control and Prevention managing databases.

CONCLUSIONS AND IMPLICATIONS

This study represents the initial effort to identify informatics competencies for the field of food and nutrition. Based on trends in health care, technology and information management skills are critical components of contemporary practice. As the public uses technology to support the activities of daily living, so must our profession. The Academy recognizes the need to provide education and training to support practitioner competency in informatics. To this end, the annual Food and Nutrition Conference and Expo now highlights sessions on technology and information management. During the past 3 years, the Academy has offered a training program through the auspices of the American Medical Informatics Association and the Oregon Health Sciences University called the 10×10.³⁴ The Academy continues to partner with RD informaticians within the Academy as well as Health Information Management Systems Society to develop and offer training programs in informatics. In the future, the Academy envisions advanced programs in nutrition informatics leading to certification, as well as advanced degree programs. Although many competencies were assigned to the informatics specialist level (103 competencies or 48% of the total), few were assigned to the expert level (8 competencies or <1%). Additional study is needed to define and classify competencies for the specialist and expert roles based on practitioners currently working in the field of informatics.

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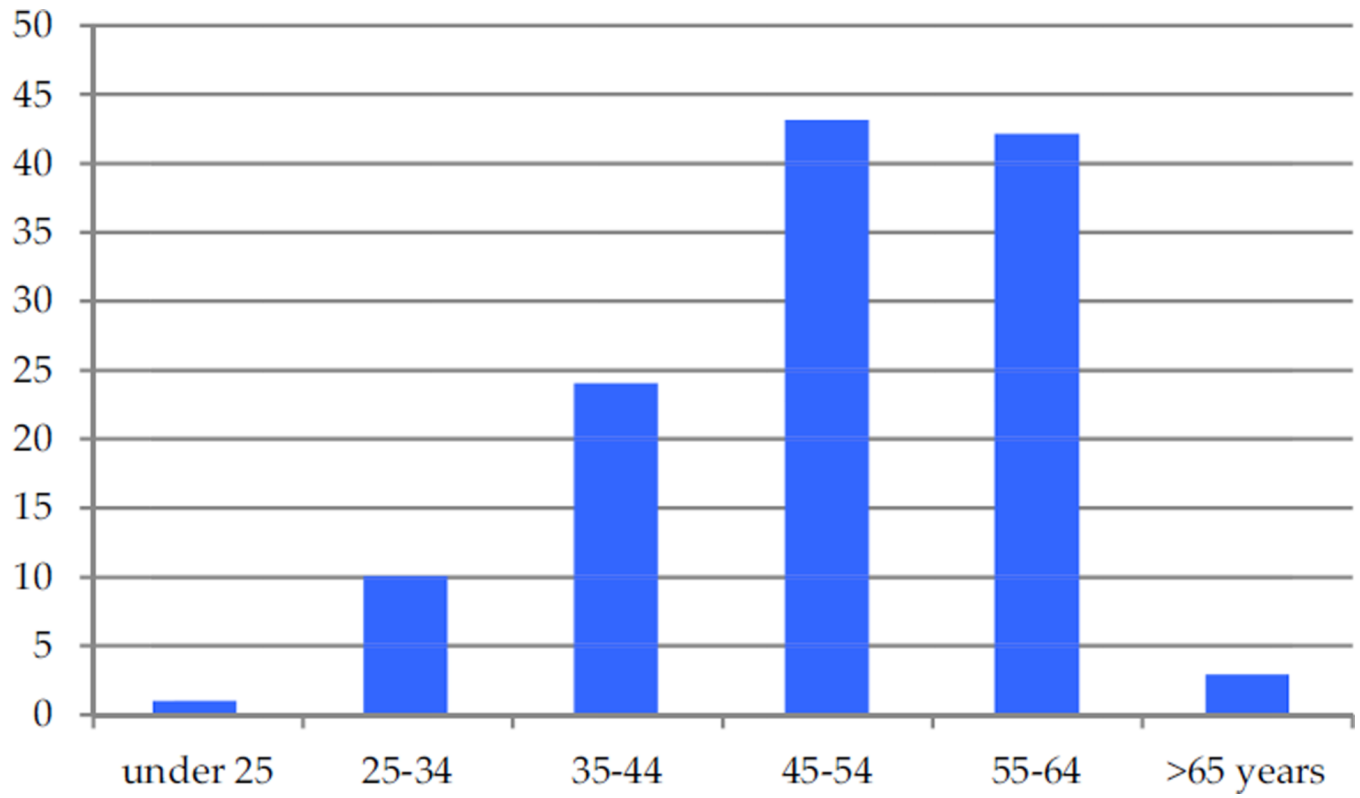


Figure 1. Distribution of age ranges for study participants based on responses from Round One. Round One did not distinguish between cohorts. Most participants were between 45 and 64 years of age.

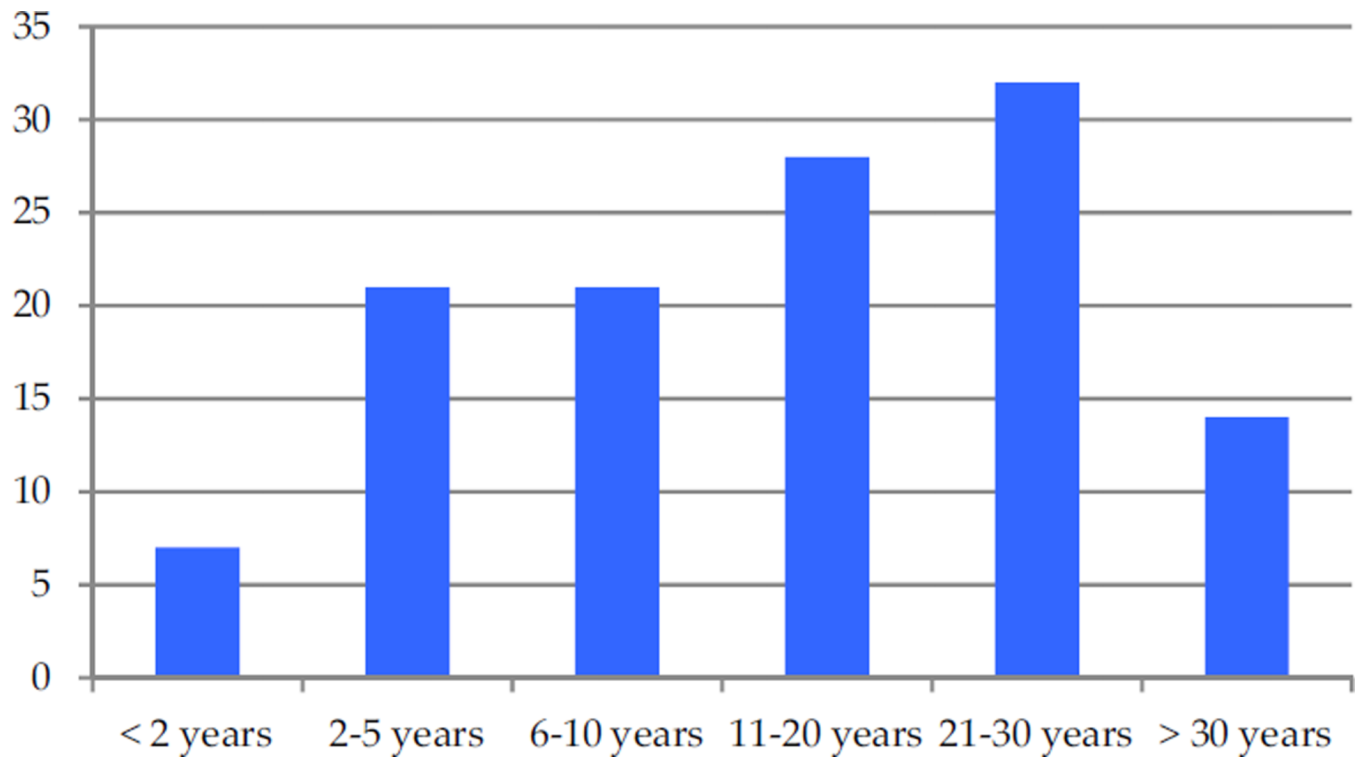


Figure 2. The distribution of the number of years of professional practice based on responses from Round One of the survey. Note that while the most frequent response was for 21 and 30 years of practice, participants represented a full range of practice experience.

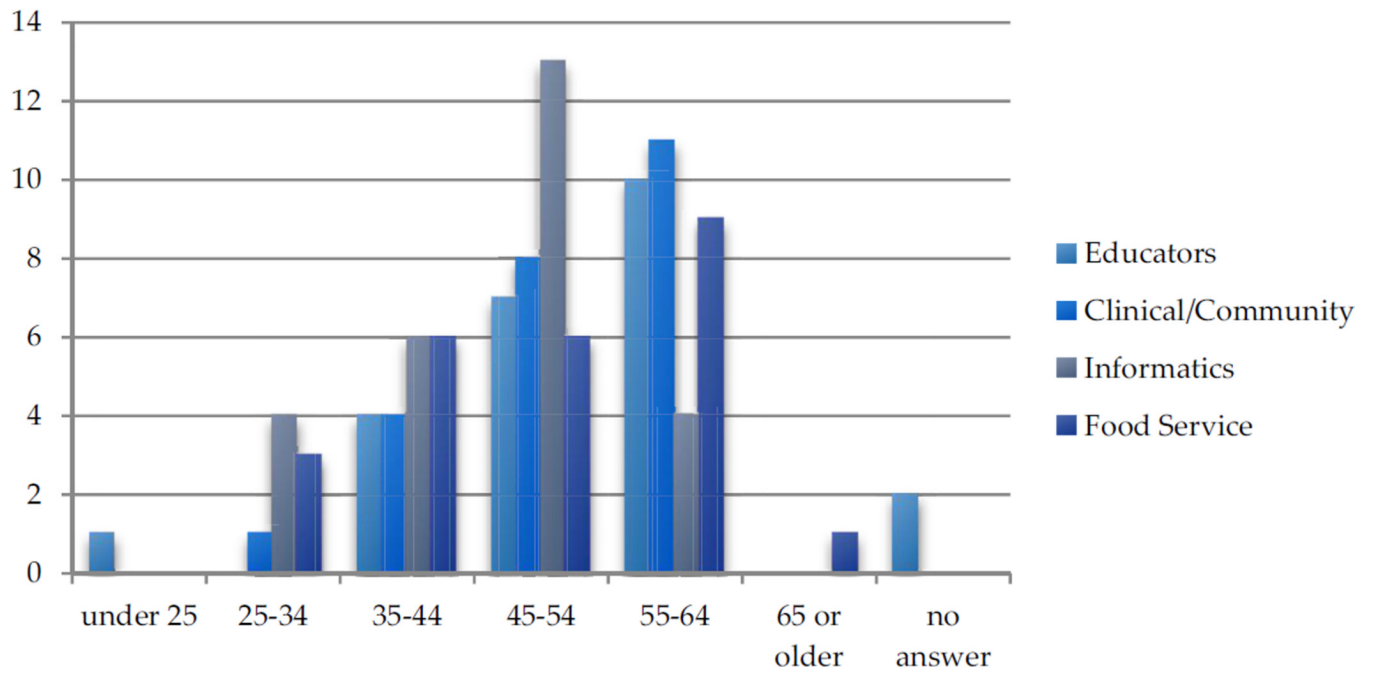


Figure 3. Distribution of study participants age ranges with details by cohort based on responses from Round Two. Note that the informatics cohort has a different distribution of age ranges compared to the other three cohorts.

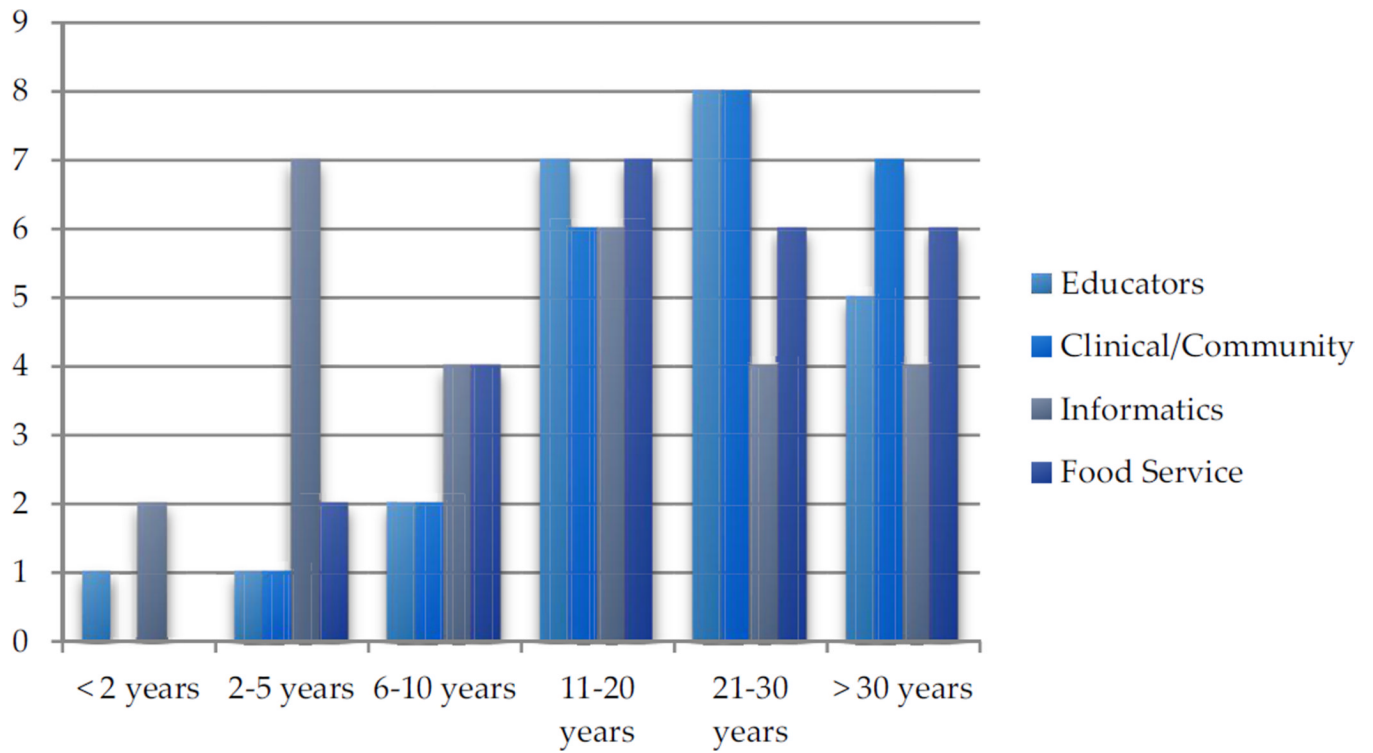


Figure 4. The distribution of the number of years of professional practice by cohort based on responses from Round Two of the survey. The distribution for the informatics cohort indicates fewer years in practice.

Competencies Added—Round Two	Category	Subgroup
1. Able to participate in e-mail list discussions	Computer skills	Communications
2. Able to use software programs for nutrition analysis and menu development	Computer skills	Data access
3. Able to scan and share documents	Computer skills	Documentation
4. Able to create a report from multiple data sources	Computer skills	Documentation
5. Able to follow "down-time procedures" when electronic systems are not available	Computer skills	Systems
6. Able to use data to problem solve	Informatics knowledge	Data
7. Able to utilize data for making decisions	Informatics knowledge	Data
8. Able to articulate the difference between unstructured and structured data	Informatics knowledge	Data

Figure 5.

Eight competencies were added to the Round Two survey based on Round One comments. These additional competencies were based on participant's practice experience.

"Other" Competencies	Category Placement	Subgroup
1. Other Computer Aided Instruction—able to use a virtual learning environment and demonstrate the effective transfer of skills and knowledge	Computer Skills	Education
2. Other Systems Lifecycle—able to evaluate a system or proposed system that addresses all phases of its existence including conception, design and development, production/construction, distribution, operation, maintenance/support, retirement, phase-out, and disposal	Informatics Skills	Evaluation
3. Other Organizational Change Management—able to define a structured approach to shifting objectives, content, and process of change from a current state to a desired future state	Informatics Skills	Evaluation
4. Other Standards for Privacy and Security—able to articulate the principles and practices of Information security—protecting information and information systems from unauthorized access, use, disclosure, disruption, modification, perusal, inspection, recording, or destruction	Informatics Skills	Privacy/Security
5. Other Human Computer Interface—able to articulate the principles and practices related to the interaction between user and computer (hardware and software) which includes data input and the feedback/outcomes to aid in decisions	Informatics Skills	Design/Development
6. Other Computer Aided Instruction—able to develop a virtual learning environment to effectively transfer skills and knowledge	Informatics Skills	Training
7. Other Statistical Analysis—able to use systems for the effective collection, organization, and interpretation of data	Informatics Skills	Analysis

Figure 6.

After Round Three, seven "other" competencies were added to one of the major competency categories and the appropriate subgroup to facilitate ease of use. The ranking for level of practice was retained.

Type	Level of Practice	Competency	Case Study
Computer Skills	Novice	Data Access: Able to access and locate information in the Academy online <i>Nutrition Care Manual</i> .	In order to introduce the topic of Diabetes, the instructor uses Internet access to view the <i>Nutrition Care Manual</i> in the classroom. Students then navigate on their own laptops to the Nutrition Assessment, Nutrition Diagnosis, and the Nutrition Intervention sections. Students were then given a short case scenario and asked to write an appropriate PES ⁹ .
	Novice	Research: Able to use a computer application for nutrition/dietetics research. Basic Desktop Software: Ability to create, save, and print word processor documents.	Students in the Dietetic Technician program at the University do their clinical rotation with the RDs ⁹ and DTRs ^c at the hospital. They use the online <i>Nutrition Care Manual</i> to research the appropriate diet for a patient with diverticulitis. They are able to print off the diet materials for the patient.
	Beginner	Education: Utilizes information management technologies for patient education (eg, identifies areas for instruction, conducts education, evaluates outcomes, manages resources). Documentation: Able to use applications to document patient care and care plans including discharge planning,	During the clinical rotation part of her internship, Sally receives a consult for a patient going home after an acute myocardial infarction. After interviewing the patient, she accesses the facilities' Intranet to find a 1-day heart-healthy menu. After educating the patient, Sally then documents the encounter in the EHR ⁹ for her preceptor to co-sign.
	Beginner	Basic Desktop Software: Demonstrates proficiency with multimedia/presentation software (eg, PowerPoint). Communications: Ability to use technology to communicate.	Dietetics interns are working on a joint presentation from different physical locations. Using an online application, they collaborate on the presentation, merging slides.
	Beginner	Monitoring: Utilizes computerized patient monitoring systems.	Dietetics interns doing their clinical rotation can monitor patients with elevated blood glucose by accessing the Blood Glucose Monitor report. The report will tell them which patients have had a blood glucose >200 mg/dL ^e during the past 24 hours. This will help them prioritize their workload.
	Competent	Quality Improvement: Uses data and statistical analysis to evaluate practice and perform quality improvement.	The RD is able to report productivity electronically to demonstrate how many nutrition consults are done on a monthly basis. This information can be reported to administration and may result in an increase in FTEs ^f for the department.
	Proficient	Research: Ability to use a computer application for statistical analysis.	An RD working in a community food bank wishes to determine the cost range of items distributed to clients. Using spreadsheet software, the range and standard deviation can be calculated.
Type	Level of Practice	Competency	Case Study
Informatics Knowledge	Competent	Data: Supports efforts toward the development and use of standardized nutrition terminology.	The RD works with the Informatics Department to design nutrition documentation screens that incorporate the IDNT ⁹ .
	Competent	Usability/Human Factors: Able to articulate the issues related to the use of computers when working directly with patients and clients.	An RD working at a WIC ^h site arranges the interview area so that eye contact can be maintained with the client while data are entered into the computer.
	Proficient	Data: Able to articulate the difference between unstructured and structured data.	An RD working in foodservice management is in charge of adding new recipes to the food and nutrition management system. The ingredients for the recipe are added from master ingredient lists with predetermined codes (structured data) and the directions for the recipe are added as a block of text (unstructured data).

Type	Level of Practice	Competency	Case Study
Informatics Knowledge	Specialist	Systems: Demonstrates knowledge of the functions of a server and networked computers.	An RD works as a clinical systems analyst for a large hospital. Diet orders are passed from the EHR to the food and nutrition management system. The diet office notes that they have not received any orders for the past hour. The RD sees that the diet office application server is working correctly, so contacts the information systems department to troubleshoot possible issues with the network.
	Expert	Research: Develops research to examine the impact of computer technology on the practice of dietetics.	A nutrition informatics expert researches the impact of using the Evidence Analysis Library to drive clinical decision support rules in an EHR.
Type	Level of Practice	Competency	Case Study
Informatics Skills	Competent	Analysis: Able to use systems for the effective collection, organization, and interpretation of data.	In his job as a public health dietitian, John is asked to develop an educational program for day-care food safety. John reviews the published literature available on PubMed as well as websites from the USDA ⁱ , CDC ^j , and FDA ^k . He compiles data related to day-care food-safety issues on his work desktop and writes up a 1-page fact sheet that can be posted on the State Health Department website.
	Proficient	Role: Participates in the selection process, design, implementation, and evaluation of systems. Systems Selection: Participates with others in selecting applications or systems (eg, users, vendors, system designers).	An RD in working in long-term care for 5 years is on the selection committee for an EHR and is participating in all of the vendor demos. None of the software has the NCP/IDNT included but the EHR vendor selected has agreed to develop the nutritional assessment using the NCP/IDNT with the RD's help. The RD is involved in the design and development of the additional screens, and has accessed the Evidence Analysis Library and uses the Long Term Care Toolkit, which includes NCP to help guide the RD through the process of development.
	Advanced Practice	Analysis: Analyzes business practices to determine need for re-engineering information flow/work flows. Testing: Conducts tests of information management applications and systems.	An RD works for a foodservice/nutrition software vendor. Duties include testing a new functionality that is programmed into the system. A new module has been developed to incorporate the NCP and IDNT as part of the nutrition assessment. Testing includes functionality and workflows based on requirements.
	Expert	Fiscal Management: Develops strategies to obtain funding for informatics research.	An RD wishes to develop a method for linking nutrient data in a USDA database to package UPC ^m codes. A grant application to the NIH ⁿ National Library of Medicine is developed and submitted to support this informatics research.

Figure 7. Application to practice case studies by category and level of practice. ^aPES=a statement of the problem, etiology, and signs/symptoms derived from a nutrition assessment. ^bRD=registered dietitian. ^cDTR=dietetic technician, registered. ^dEHR=electronic health record. ^eTo convert mg/dL glucose to mmol/L, multiply mg/dL by 0.0555. To convert mmol/L glucose to mg/dL, multiply mmol/L by 18.0. Glucose of 200 mg/dL=11.1 mmol/L. ^fFTE=full-time equivalent. ^gIDNT=International Dietetics & Nutrition Terminology. ^hWIC=Special Supplemental Nutrition Program for Women, Infants, and Children. ⁱUSDA=US Department of Agriculture. ^jCDC=Centers for Disease Control and Prevention. ^kFDA=US Food and Drug Administration. ^lNCP=Nutrition Care Process. ^mUPC=Universal Product Code. ⁿNIH=National Institutes of Health.

Table 1

Composition and size of study cohorts for Round One

Cohort	Cohort size
Educators	30
Clinical/community practice	30
Informatics	30
Foodservice management	30
Academy staff	10

Table 2

Summary of competency classification by category and level of practice^a

	Novice	Beginner	Competent	Proficient	Informatics specialist	Informatics expert	Total
Computer skills	32	16	8	1	1	0	58
Informatics knowledge	5	7	9	3	14	3	41
Informatics skills	0	0	8	16	88	5	117
Total	37	23	25	20	103	8	216

^aNote that the competencies at lower levels of practice apply to all higher levels of practice.