

Point of Care Ultrasound by Primary Care Physicians and Geriatricians: Old Adults, New Technology, Potential Benefits and Burdens

Sarah M. Schumacher¹, Andres F. Leone^{1*}, Victor Rao², Duncan Howe³, G.Paul Eleazer⁴ and Richard Hoppmann⁵

¹Assistant Professor, Dept of Internal Medicine, University of South Carolina School of Medicine, Columbia, USA

²Director, Ultrasound Education, University of South Carolina School of Medicine, Columbia, USA

³PI, Ultrasound Institute, University of South Carolina School of Medicine, Columbia, USA

⁴Clinical Professor of Medicine, Dorn Veterans' Administration Medical Center, Columbia, USA

⁵Professor of Medicine, University of South Carolina School of Medicine, Columbia, USA

Abstract

Background/Objectives: Availability of economical, portable ultrasound systems that provide rapidly available, useful, information has transformed the clinical assessment of patients. As hand-held ultrasound systems become widely accessible, this technology will become standard of care in primary care practices. Little has been written about the use of ultrasound by Geriatricians, and the usefulness of POC-US specifically in caring for Older Adults.

Study design: In order to assess the current state of knowledge regarding use of ultrasound by geriatricians, and assess (POC-US) for the population of older adults, we conducted a review of published studies using Pub Med and Ovid search engines. Selected publications were included in a systematic review.

Results: Thirty-five articles were identified for systematic review. Eighteen articles addressed the use of ultrasound in the evaluation of Older Adult patients. Four articles that identified performance of ultrasound by Geriatricians, and an additional three articles were not clear the specialty performing the exam, but geriatricians used the information gained. A total of fifteen articles highlighted use by primary care physicians. Thirty-one articles identified the usefulness in specific diseases and conditions that are more common in older adults. Limitations and potential harm were identified in twelve articles.

Conclusion: There is very little literature on POC-US in Geriatrics, but existing literature highlights significant potential clinical use. POC-US holds great promise in primary care practices and in geriatrics. Our literature review found numerous potential uses for POC-US in caring for older adults. Few studies addressing the application of ultrasound in the geriatric population have been reported. The usefulness of POC-US by Geriatricians remains to be clarified. Judicious use of this technology in the geriatric population will be necessary to maximize the potential benefit while avoiding the potential harm of unnecessary tests, anxiety, and iatrogenic illness.

Keywords: Point of care ultrasound; Geriatrics; Ultrasound; Primary care

Introduction

The availability of economical, portable ultrasound systems that provide rapidly available, useful information has already transformed the clinical assessment and management of patients in a number of settings. A significant shift has been the performance and interpretation by physicians who are not radiologists or ultrasonographers, *per se*. Numerous specialties have already adopted or are proposing competency standards for performance as well as interpretation of ultrasound including Emergency Medicine[1], Critical Care[2], Cardiology, Anesthesiology,[3] Obstetrics and Gynecology[4], Intensivists routinely utilize bedside ultrasound for the care of ICU patients both for diagnosis/ evaluation as well as for guidance during procedures[5,6]. Bedside ultrasound is rapidly becoming a standard of care in the triage of trauma patients, placement of central lines, and in the Operating room [7].

The value of POC-US is no longer limited to just a small number of subspecialties [8]; rather POC-US is broadly applicable in primary care as well [9]. As the technology continues to improve, and as more primary care physicians have experience and the clinical skills to utilize ultrasound, it is likely to become a standard part of the patient care encounter. It has become apparent that an increasing number of graduating medical students see the utility of ultrasound in their chosen fields; leading to calls for medical schools to train students in POC-US [10-19]. The University Of South Carolina School Of Medicine has developed a four year Integrated Ultrasound Curriculum (iUSC) for

Medical students [20,21] and other medical schools are following a similar path [22].

A particular advance that is likely to increase use of POC-US is the advent of small, hand held ultrasound systems that can be carried easily in a coat pocket much like a stethoscope. With the handheld unit, a physician can immediately perform an exam with patients are encountered who could benefit from an ultrasound scan. The inconvenience and time required to set up even a portable laptop unit in the exam room is avoided. As the cost continues to decline, and hand-held ultrasound machines become widely accessible, this technology is likely to become the standard of care in many situations [23]. Examples of Handheld ultrasound devices include GE Vscan, Sonosite NanoMaxx, Siemens Acuson P10, among others.

***Corresponding author:** Andres F. Leone, Geriatrician, Palmetto Health Senior Primary Care Practice, Assistant Professor of Clinical Medicine, Dept of Internal Medicine, University of South Carolina School of Medicine, Columbia, SC 29212; Tel. 803 434-4700; E-mail: Andres.Leone@Palmettohealth.org

Received November 30, 2011; **Accepted** December 31, 2011; **Published** January 03, 2012

Citation: Schumacher SM, Leone AF, Rao V, Howe D, Eleazer GP, et al. (2012) Point of Care Ultrasound by Primary Care Physicians and Geriatricians: Old Adults, New Technology, Potential Benefits and Burdens. J Gerontol Geriat Res 1:102. doi:10.4172/2167-7182.1000102

Copyright: © 2012 Schumacher SM, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

The prevalence of certain diseases and conditions in older adults that are amenable to diagnosis and management with the help and support of ultrasound is considerable. For example, in the outpatient setting, primary care physicians can non-invasively evaluate post void residual in urinary Incontinence [24], and could potentially screen elderly patients for abdominal aortic aneurysm (AAA), prostatic enlargement, and could evaluate cardiac function. Primary care physicians frequently encounter these diagnostic needs in older people and the use of POC-US could enhance their diagnosis and management. Monitoring with ultrasound could also facilitate management of chronic conditions on an ongoing basis. For example, a patient with prostatic hypertrophy, started on a medication that could worsen bladder emptying, can be monitored with POC-US after initiating medication [24]. This provides convenient, pertinent information for that physician to use to guide further therapy.

The purpose of this systematic literature review was to assess the current state of knowledge regarding use of ultrasound by geriatricians. In addition, we sought to determine the clinical usefulness as well as potential harm of POC-US for the population of older adults. The authors recognize that medical interventions that initially seem to be beneficial to older adult patients can often lead to a cascade of events that prove harmful. Our rationale was that if reproducible, accurate, safe and timely bedside ultrasound techniques were identified to be clinically relevant in older adults without causing harm, we could incorporate this technology into daily geriatric medical practice. In addition, use of POC ultrasound in older adults could potentially serve as a diagnostic teaching tool for our geriatric fellows, medical residents and students. Point of Care Ultrasound in geriatrics is currently being proposed as an adjunct to the standard physical exam, and is being received favorably by Geriatric specialists [25].

Methods

We conducted a review of published studies (1950- August 2010) using Pub Med and Ovid. A medical reference librarian implemented the literature search. Main search parameters included the terms “ultrasonography, ultrasound and geriatrics”. Additional search terms “handheld, bedside ultrasound, and review articles” were also applied. Multiple variations of the terms and term order were employed in our six part search. Search strategies were executed in a stepwise approach with six parts. Searches in Parts 1 to 5 were for the time frame 1950-August 2010. Part 1 - “Ultrasonography” was used as the subject heading and we specified that this subject heading must be one of main concepts in the article. Ultrasound /ultrasonography words were included in title of the article. We searched all articles indexed under the subject heading geriatrics or with geriatric (s) or geriatrician(s) in the title of article. This search did not limit language to English. Part 2- The subheading “ultrasound” was attached to a disease or organ as the main subject heading. Articles in which ultrasound was worded in the title of the article were included. The subject heading “geriatrics” and all articles with “geriatric(s) and geriatrician(s)”worded in the title of the article were searched. We did not limit this part of our search to articles written in the English language. Part 3-“Ultrasound” term was used in the subheading with the subject heading of “geriatrics”. This part of our search included articles in all journals that had the following words in their title (geriatric (s), age, aging, elderly, elder). This strategy was limited to review articles. Part 4 - The term “Ultrasonography” was utilized as a subject heading. This part of the search specifically removed any article indexed under echocardiography. Articles with the words “geriatrics, age, aging, elderly, or elder” in the title were included. We limited this part of our search to review articles. Part

5-1980 to August 2010. “Ultrasonography” term was used in the subject heading combined with a portable ultrasound concept by searching for “point of care systems” or articles with “mobile, portable, handheld, hand or bedside” in the title. Subject headings used were Geriatrics or Aged. Articles with “geriatric(s) or geriatrician” in title were also searched. Part 6-2005 to August 2010. This final part of our literature search strategy included using terms for focused ultrasonography. We employed broader geriatric terms by using “aged” as a subject heading. In addition, we included portable ultrasound concepts as outlined in part five of our search.

Initial retrieval identified a total of 190 abstracts (19 from Part I; 26 from part 2; 12 from part 3; 22 from part 4; 10 from part 5, and 101 from part 6) that met search parameters. Abstracts were then reviewed and selected for relevance by at least two authors using pre-determined criteria that included “use of ultrasound technology” and “potential primary care/geriatric application”.

Thirty five full articles were deemed to be pertinent publications and were included in this systematic literature review. At least two authors critiqued each publication. Each publication was reviewed in its entirety and evaluated using a structured review form with the following criteria:

1. Portable or point of care ultrasound technology use discussed in the publication;
2. Specific use of ultrasound in patients age 65 and older (considered “older adults”);
3. Ultrasound performed by Geriatricians;
4. Ultrasound use performed by primary care physicians (internal medicine, family medicine)
5. Ultrasound use for medical conditions that are more common in older adults, and
6. Limitations and potential harm of ultrasound use in older adult patients.

Emergency medicine was not included in our definition of primary care, but articles about use of POC-US for older adults in the Emergency department were included. In the event that the reviewing authors’ findings differed, a third review was performed and the composite result reported.

Results

Our initial search yielded 190 articles that met the initial search criteria. Abstracts for these were obtained and based on the review of the abstracts, a total of 35 articles were determined to meet the review criteria (i.e., they included the use of ultrasound technology and described ultrasound applications that could be used by primary care physicians and /or geriatricians) and were selected for structured review.

Of the 35 publications selected for structured review, 14 were research articles, 10 were review articles, 5 were case series, 3 were case reports, 2 were editorials, and 1 was a published guideline. In 24 of the 35 selected articles, the ultrasound technology that was used as portable and/or POC units. Eighteen articles specifically addressed the use of Ultrasound in Geriatric Practice. In only 4 articles was there evidence that Geriatricians actually performed ultrasound and in only 7 was the geriatrician involved in interpretation of the images resulting from the ultrasound study. Fifteen articles addressed the use of ultrasound

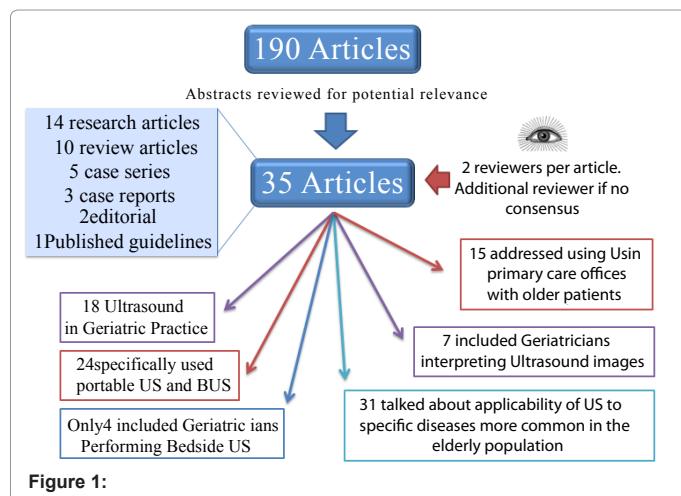


Figure 1:

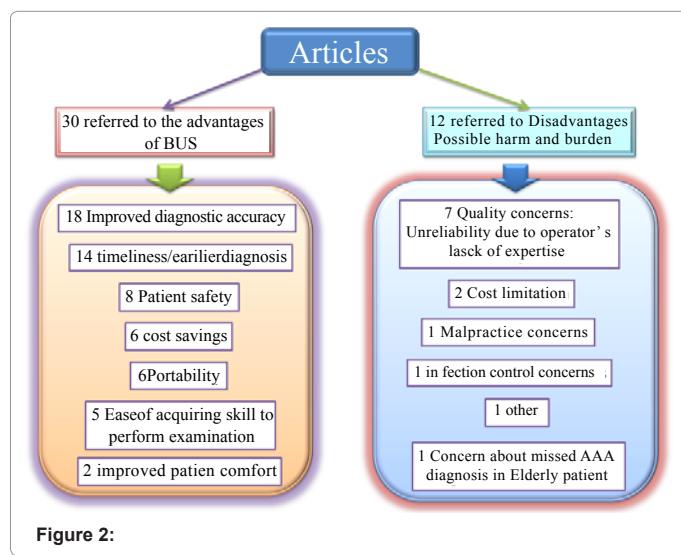


Figure 2:

in primary care practices with older patients. Thirty-one of 35 articles discussed applicability of Ultrasound to specific diseases or conditions that are more common in older adults.

The advantages of POC ultrasound were noted in 30 of 35 articles and included: Improved diagnostic accuracy (18 citations), timeliness/earlier diagnosis (14 citations), patient safety (8 citations), cost savings (6 citations), portability (6 citations), ease of acquiring the skill to perform the examination (5 citations), and improved patient comfort (2 citations).

Possible harm or burden of POC Ultrasound was mentioned in 12 citations, including: quality concerns including possible unreliability due to lack of expertise of the operator (7 citations), cost (2 citations), malpractice (1 citation), infection control issues (1 citation) and other (1 citation); while only one article mentioned harm that was specific for older adults, that of inaccurate diagnosis of abdominal aortic aneurysm in older patients.

Eleven articles recommended further research on the use of POC ultrasound.

Discussion

We undertook the present review to assess the current state of knowledge regarding use of bedside ultrasound by geriatricians and

to determine the clinical usefulness and potential harm of POC-US in older patients. Our approach was intended to consider older adults as a "special population" that could have specific benefits and risks from this new technology.

Our results highlight several things of interest in considering the application of POC ultrasound in the older adult population. First, it is interesting that so few publications, 18 of the 35 articles reviewed focused on the usefulness of this technique in older adults as a special population. This is supported with our finding that 31 of the 35 articles identified the usefulness of ultrasound in specific diseases and conditions that are more common in older adults. The higher prevalence of diseases and conditions that are seen in older adults increases the likelihood of positive findings and usefulness in this population. The relative low cost and safety make ultrasound attractive in primary care practices that care for significant numbers of older adults, and especially in geriatric practices. For these reasons, point-of-care ultrasound training should be considered as a basic clinical skill to be taught in medical school to help future physicians who will care for our aging population.

The small number of articles in which geriatricians performed (4 of 35 articles) or interpreted (7 of 35 articles) the ultrasound is also worthy of note. As early as 1982, the usefulness of ultrasound in older patients was recognized and supported with data from a case study [26]. However, this series included standard ultrasound performed in radiology rather than bedside ultrasound performed by a primary care physician. Two articles from the early 1990's addressed POC US performance by geriatricians, both for determining post void residual [i.e. bladder scanning] [27,28]. A 2002 article by Weirebe describes use of ultrasound to measure muscle size in evaluating nutritional status in older adults [29]. Additional research is needed to verify the potential benefits of incorporating relevant point of care ultrasound applications into the care of older adults in primary care and geriatrician practices.

In addition to potential benefits of ultrasound in the older adult population, we looked at the literature to determine if publications were identifying potential harm. From this point of view, there were relatively few studies that commented on the potential harm, and those that did focused mainly on cost, lack of technical proficiency in performing point of care ultrasound, or ill-defined sensitivity and specificity of the test being performed. No studies addressed what the authors believe to be a central issue in applying any new technology to the older adult population: "Just because you can do something, should you?"

Often older adults are subjected to new diagnostic or therapeutic approaches that are relevant and useful in younger adults, but have questionable benefit and potential harm in older adults. For example, PSA testing is potentially of benefit in "Young Old" men, but rarely is it of benefit for screening in men over age 80, and may potentially cause harm by leading to further invasive tests, and also by causing needless anxiety.

Potentially, POC-US could have the same limitations and cautions as performing screening PSAs. For example, screening ultrasound of the carotid arteries may lead to anxiety about having a stroke without proven benefits of performing the test. Future research should evaluate not only the benefits but also the potential harm of ultrasound diagnosis and screening to the patient and to the health care system, including unnecessary testing, anxiety, and cost.

For practicing physicians, incorporating ultrasound training time into a busy primary care practice can cause short term harm to the

financial health of the practice. This issue was not mentioned in any of the articles reviewed, probably because there have so few attempts to train practicing physicians in their office setting. However, it is a barrier that will need to be resolved if POC-US is to become a standard of practice in geriatric practices. The practice's decision to incorporate ultrasound will depend on the balance between the cost of equipment and training time and the benefits of improved patient outcomes and practice revenue. Cost benefit evaluations for this application of ultrasound have not been performed.

There is controversy about the amount of exposure required for an individual to become proficient in ultrasound. There are various recommendations in the literature specifically about ultrasound training and number of procedures needed to establish competency [1-4]. Guidelines for training geriatricians in point-of care ultrasound use will need to be established and may occur in a similar manner as current Emergency Medicine ultrasound guidelines. This is an area requiring future research.

Point-of-care ultrasound holds great promise in primary care practices and in geriatrics. It appears that portable and handheld ultrasound machines are becoming the "stethoscopes of the future" and could be easily incorporated into the physical examination of patients. However, little is known about the appropriate application of this technology for clinical care in older adults. Our systematic literature review identified only 4 references that specified use by Geriatricians. Outcomes regarding this innovative tool for care in older adults are unknown and require further investigation. Judicious use of this exciting new technology will be necessary to avoid the potential harm of unnecessary tests and iatrogenic illness. In addition, bedside ultrasound could potentially serve as a diagnostic and screening teaching tool for our geriatric fellows, medical residents and students as they care for older adult patients.

Acknowledgments

The authors wish to thank Ruth A. Riley, MS, AHP, Director of Library Services, School of Medicine Library, University of South Carolina, for her expertise in the electronic data base literature search. Drs. Schumacher and Leone are the primary investigators of a HRSA Equipment Grant for Health Care Professionals.

Author Contributions: GPE, SS, and AL: concept and design, literature review, data analysis and interpretation, preparation of manuscript. DH, VR, and RH: data analysis and interpretation, critical revision of the manuscript for intellectual content.

Drs. Schumacher and Leone are the Primary Investigators for a Department of Health and Human Services Grant for Equipment to Enhance Training for Health Professions Geriatric Training for Physicians, Dentists and Behavioral and Mental Health Professionals grant program (DH76HP2808) 2010-2011. These funds are awarded to purchase portable ultrasound equipment for Palmetto Health Division of Geriatrics.

Drs. Rao, Howe and Hoppmann have multiple grant funding sources and are listed below:

1. Duke Endowment, Integration of Point of Care Ultrasound into Rural Primary Care Practices, Jan 1 2009 to Dec 31 2011, \$645K
2. Sisters of Charity Foundation of SC, Use of Point of Care Ultrasound in a Free Clinic to identify left ventricle wall thickening in chronically hypertensive patients, May 2010 to August 2011, \$75K
3. Fullerton Foundation, Use of Hand Held Ultrasound Devices in 3rd year Medical Student Primary Care Clerkships, May 2011 to April 2013, \$209K
4. Fullerton Foundation, Integration of Point of Care into VAMC Primary Care to Screen for AAA, May 2011 to May 2012, \$82.5K
5. Fullerton Foundation, Development of USC SOM Ultrasound Institute Infrastructure, August 2006 to August 2009, \$228K

References

1. American College of Emergency Physicians (2009) Policy Statement: Emergency Ultrasound Guidelines. *Ann Emerg Med* 53: 550-570.
2. American Institute of Ultrasound in Medicine (2003) Training guidelines for physicians who evaluate and interpret diagnostic ultrasound examinations.
3. Thomas J, Zoghbi W, Beller G, Bonow R, Budoff MJ, et al. (2009) ACCF 2008 Training Statement on Multimodality Noninvasive Cardiovascular Imaging A Report of the American College of Cardiology Foundation/American Heart Association/American College of Physicians Task Force on Clinical Competence and Training Developed in Collaboration with the American Society of Echocardiography, the American Society of Nuclear Cardiology, the Society of Cardiovascular Computed Tomography, the Society of Cardiovascular Magnetic Resonance, and the Society for Vascular Medicine. *J Am Coll Cardiol* 53: 125-146.
4. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 101: Ultrasound in pregnancy. *Obstet Gynecol* 113: 451-461.
5. Beaulieu Y, Marik PE (2005) Bedside Ultrasonography in the ICU (Part 1) *Chest* 128: 881-895.
6. Beaulieu Y, Marik PE (2005) Bedside Ultrasonography in the ICU (Part 2) *Chest* 128: 1766-1781.
7. Milling T, Rose J, Briggs WM, Birkhan R, et al. (2005) Randomized, controlled clinical trial of point-of-care limited ultrasonography assistance of central venous cannulation: The third sonography outcomes assessment program (SOAP-3) trial. *Crit Care Med* 33: 1764-1769.
8. Fedson S, Neithardt G, Thomas P, Lickerman A, et al. (2003) Unsuspected clinically important findings detected with a small portable ultrasound device in patients admitted to a general medicine service. *J Am Soc Echocardiogr* 16: 901-905.
9. Kirkpatrick JN, Davis A, Decara JM, Hong AE, Kurtz PL, et al. (2004) Hand-carried cardiac ultrasound as a tool to screen for important cardiovascular disease in an underserved minority health care clinic. *J Am Soc Echocardiogr* 17: 399-403.
10. Metcalf N, Prentice E, Metcalf W, Stinson W (1982) Peer group models in examinations and instruction as an integral part of medical gross anatomy. *J Med Edu* 57: 640-644.
11. Arger PH, Schultz SM, Sehgal CM, Cary TW, Aronchick J (2005) Teaching medical students diagnostic sonography. *J Ultrasound Med* 24: 1365-1369.
12. Tshibwabwa ET, Groves HM (2005) Integration of ultrasound in the education programme in anatomy. *Med Educ* 39: 1148.
13. Syperda VA, Trivedi PN, Melo LC, Freeman ML, Ledermann EJ, et al. (2008) Ultrasonography in preclinical education: A pilot study. *J Am Osteopath Assoc* 108: 601-605.
14. Shapiro RS, Ko PP, Jacobson S (2002) A pilot project to study the use of ultrasonography for teaching physical examination to medical students. *Comput Biol Med* 32: 403-409.
15. Wright SA, Bell AL (2008) Enhancement of undergraduate rheumatology teaching through the use of musculoskeletal ultrasound. *Rheumatology* 47: 1564-1566.
16. Tshibwabwa ET, Groves HM, Levine MA (2007) Teaching musculoskeletal ultrasound in the undergraduate medical curriculum. *Med Educ* 41: 517-518.
17. Wicke W, Brugger PC, Firbas W (2003) Teaching ultrasound of the abdomen and the pelvic organs in the medicine curriculum in Vienna. *Med Educ* 37: 476.
18. Butter J, Grant TH, Egan M, Kaye M, Wayne DB, et al. (2007) Does ultrasound training boost Year 1 medical student competence and confidence when learning abdominal examination? *Med Educ* 41: 843-848.
19. Wittich CM, Montgomery SC, Neber MA, Palmer BA, Callahan MJ et al. (2002) Teaching cardiovascular anatomy to medical students by using a handheld ultrasound device. *JAMA* 288: 1062-1063.
20. Hoppmann R, Cook T, Hunt P, Fowler S, Paulman L, et al. (2006) Ultrasound in medical education: a vertical curriculum at the University of South Carolina School of Medicine. *J S C Med Assoc* 102: 330-334.

21. Hoppmann RA, Rao VV, Poston MB, Howe DB, Hunt PS, et al. (2011) An integrated ultrasound curriculum (iUSC) for medical students: 4-year experience. *Crit Ultrasound J* 3: 1-12.
22. Rao S, van Holsbeeck L, Musial JL, Parker A, Bouffard JA, et al. (2008) A pilot study of comprehensive ultrasound education at the Wayne State University School of Medicine: a pioneer year review. *J Ultrasound Med* 27: 745-749.
23. Lapostolle F, Petrovic T, Lenoir G, Catineau J, Galinski M, et al. (2006) Usefulness of hand-held ultrasound devices in out-of-hospital diagnosis performed by emergency physicians. *Am J Emerg Med* 24: 237-242.
24. Gibbs C, Johnson T, Ouslander J (2007) Office Management of Geriatric Urinary Incontinence. *The Am J Med* 120: 211-220.
25. Leone AF, Schumacher SM, Krotish DE, Eleazer GP (2011) Geriatricians' Interest to Learn Bedside Portable Ultrasound (GEBUS) for application in the Clinical Practice and in Education. *J Am Med Dir Assoc*.
26. Coles JA, Beynon GP, Lees WR (1982) The use of ultrasound in geriatric medicine. *Age Aging* 11: 145-152.
27. Ouslander JG, Simmons S, Tuico E, Nigam JG, Fingold S, et al. (1994) Use of a portable ultrasound device to measure post-void residual volume among incontinent nursing home residents. *J Am Geriatr Soc* 42: 1189-1192.
28. Grosshans C, Passadore Y, Peter B (1993) Urinary Retention in the Elderly: A Study of 100 Hospitalized Patients. *J Am Geriatr Soc* 41: 633-638.
29. Weinrebe W, Gräf-Gruss R, Schwabe R, Stippler D, Füsgen I (2002) The two-factor method--a new approach to categorizing the clinical stages of malnutrition in geriatric patients. *J Am Geriatr Soc* 50: 2105-2107.