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Introducing Aquifer Geriatrics, the American Geriatrics Society National Online Curriculum

Mandi Sehgal, MD^{*}, Quratulain Syed, MD[†], Kathryn E. Callahan, MD, MS[‡], Becky B. Powers, MD[§], G. Paul Eleazer, MD, AGSF[¶], Lauren L. Gleason, MD, MPH^{||}, Ravishankar Ramaswamy, MD, AGSF^{**}, Karen Sauvigne, MA^{**}, Rosanne M. Leipzig, MD, PhD^{**}, Amit Shah, MD, AGSF^{††}

^{*}Florida Atlantic University Charles E. Schmidt College of Medicine, Boca Raton, Florida;

[†]Division of General Medicine and Geriatrics, Emory University School of Medicine, Atlanta, Georgia;

[‡]Internal Medicine: Section on Gerontology and Geriatric Medicine, Sticht Center on Healthy Aging and Alzheimer's Prevention, Wake Forest School of Medicine, Winston-Salem, North Carolina;

[§]Division of Geriatrics, Gerontology, and Palliative Care, Department of Medicine, University of Texas Health Science Center at San Antonio, Geriatric Research Education and Clinical Center, South Texas Veterans Health Care System, San Antonio, Texas;

[¶]Salt Lake City Veterans Administration(VA) Medical Center, University of Utah School of Medicine, Salt Lake City, Utah;

^{||}Section of Geriatrics and Palliative Medicine, Department of Medicine, The University of Chicago Medicine, Chicago, Illinois;

^{**}Brookdale Department of Geriatrics and Palliative Medicine, Icahn School of Medicine at Mount Sinai, New York, New York;

^{††}Mayo Clinic Alix School of Medicine, Division of Community Internal Medicine, Mayo Clinic, Scottsdale, Arizona.

Abstract

Aquifer Geriatrics, formerly web-based Geriatrics Education Modules, was initially developed through Donald W. Reynolds Foundation funding, and is now the national curriculum of the American Geriatrics Society and the Association of Directors of Geriatric Academic Programs. Aquifer Geriatrics consists of 26 evidence-based, peer-reviewed, online case-based modules based on the Association of American Medical Colleges/John A. Hartford Foundation Minimum Geriatrics Competencies for Medical Students and is available by subscription at www.aquifer.org/courses.

Address correspondence to Mandi Sehgal, MD, Florida Atlantic University Charles E. Schmidt College of Medicine, 777 Glades Rd, Boca Raton, FL 33431. sehgal@health.fau.edu.

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This curriculum aims to help address the national shortage of geriatrics educators, complement current teaching, bridge content gaps in geriatrics education, and standardize geriatrics-focused educational content. This report will describe the development of Aquifer Geriatrics, highlight best practices to incorporate cases in a variety of teaching settings, describe teaching methods that utilize the curriculum to create a robust experience for learners, and address the cost of obtaining the curriculum.

Keywords

geriatric education; online education; undergraduate medical education; graduate medical education

The Internet and other technological advances have transformed medical students' and other healthcare trainees' expectations of their professional education. Learners have almost instantaneous access to information, and want to access knowledge and basic skills at their own pace, and then practice their skills in clinical encounters with faculty supervision.¹ As a result, clinician-educators are challenged to impart clinical skills and updated medical knowledge in a way that is effective and actively engages their learners at the same time as they are being pressured to increase their clinical productivity. Web-based curricula are one of the technological advances that help fill these gaps in education.

Although most students will provide significant care to older patients, there is marked variability in the duration and nature of the geriatric experiences and geriatrician teachers available to these learners.² Developed through Donald W. Reynolds Foundation funding, Aquifer Geriatrics, formerly web-based Geriatrics Education Modules (web-GEMs), aims to address these issues by complementing current teaching, bridging content gaps in geriatrics education, and standardizing geriatrics-focused educational content. Aquifer Geriatrics is now the national curriculum of the American Geriatrics Society (AGS) and the Association of Directors of Geriatric Academic Programs (ADGAP). The curriculum consists of 26 evidence-based, peer-reviewed, online case-based modules based on the Association of American Medical Colleges (AAMC)/John A. Hartford Foundation (JAHF) Minimum Geriatrics Competencies for Medical Students³ and is available by subscription at www.aquifer/-org/courses.⁴ The pedagogy of Aquifer Geriatrics matches the needs of today's adult learners. The shift to competency-based learning emphasizes the learning outcome rather than the process of education.⁵ E-learning can be used to improve the efficiency and effectiveness of educational interventions and put learners in control of their own learning.⁵

This report will describe the development of Aquifer Geriatrics, highlight ways to incorporate cases in a variety of teaching settings, describe teaching methods that utilize the curriculum to create a robust experience for learners, and address the cost of obtaining the curriculum.

Development of Web-GEMs

The Donald W. Reynolds Foundation Comprehensive Programs to Strengthen Physicians' Training in Geriatrics provided financial support to 46 academic medical centers to promote geriatric education at US medical schools, as well as to a coordinating center managed by the Icahn School of Medicine at Mount Sinai, AGS, and ADGAP. Each year, the ADGAP Geriatric Education Coordinating Center convened annual meetings of the Reynolds grantees.

Town hall sessions were a popular segment of the Reynolds grantees' meetings and allowed for discussion of topics of relevance to educators. In 2010, Amit Shah, MD, of the University of Texas Southwestern, convened a session on "Building a National Geriatrics Curriculum," which eventually led to a collaboration of 56 clinician-educators from 27 medical schools to develop web-GEMs. The 26 web-based modules were based on the AAMC/JAHF medical student geriatrics competencies,³ and used the same template as the successful Med U/Aquifer online, case-based curricula, such as CLIPP (now Aquifer Pediatrics)⁶ and SIMPLE (now Aquifer Internal Medicine).⁷ Funding from the Reynolds Foundation allowed the web-GEMs to be available to institutions free of charge on the Portal of Geriatric Online Education (POGOe.org),⁸ ending with the 2016 to 2017 academic year. As of the 2017 to 2018 academic year, Aquifer Geriatrics became available by subscription.

Case Design

Cases in Aquifer Geriatrics are centered on individual patients and are naturally evolving. They are evidence based, peer reviewed, and updated at least yearly. "Deep Dives" are embedded throughout the cases and provide additional information for motivated or more advanced learners. Each case delivers knowledge and skills, but also models the geriatrician's approach to patient care. The cases teach clinical reasoning, rather than focusing on "one right answer" questions. Cases use a variety of engagement techniques, including ranking questions and questions in which multiple answers need to be selected to answer correctly. This style reflects the nuances of clinical reasoning in older patients, in whom multifactorial etiologies are common and multi-pronged solutions are the rule, rather than the exception. Physical examination findings highlight differences in the sensitivity and specificity of examination findings with older patients and teach clinical pearls. Communication skills, including prognostication and end-of-life care discussions, are taught via role modeling conversations in the cases. "Key Teaching Points," "Educator Guides," and "Self-Assessment Questions" are in development to pull the essential concepts of each case together in an easy-to-review format to help learners solidify knowledge and give faculty an overview of each case and access to pertinent teaching points.

Case Development

Case authors are provided specific objectives and a standardized template to develop the content of their case. Each case is peer reviewed by the editorial board, which consists of geriatric medicine clinician-educators. On occasion, when the editorial board lacks the required expertise, external reviewers are asked to provide peer review, such as for a case on

osteopathic manipulative treatment. Each case is also assigned an Associate Editor, who is a geriatrician clinician-educator, to review the content on an annual basis who may also work with case editors or case authors on individual cases. Content area experts are brought in to review cases for medical accuracy and to weigh in on areas for improvement as needed. The entire peer-review process is overseen by the editorial board, with the Editor-in-Chief having final review and approval. Since the launch of the course in January 2013, over 20 000 users have logged in for sessions, completing nearly 85 000 cases with an average of 35 minutes spent per case.

How to Use Aquifer Geriatrics

Cases can be completed on smartphones, tablets, or computers. The Aquifer Geriatrics cases have been mapped to the AAMC/JAHF Minimum Geriatrics Competencies for Medical Students³ (Table 1). Since many institutions do not have dedicated Geriatric Medicine clerkships, the cases have been further categorized and matched to medical specialties and curricula (Table 2) to provide a framework for assigning cases across various clerkships, like Neurology, Psychiatry, and Surgery. Although initially written for third-year medical students, the curriculum has been used by medical students at all levels, Internal Medicine and Family Medicine residents, Nurse Practitioner (NP) and Physician Assistant (PA) trainees, and Geriatric Fellows. Cases can also be searched for features of interest (diagnosis, patient age, etc) using Aquifer's case library. Customized courses can be developed by selecting cases from the various Aquifer free courses (described below) as well as from other courses to which an institution subscribes. For example, a case from the Aquifer High-Value Care Course⁹ about an 80-year-old patient and the costs of medications could be added to a faculty member's selection of a subset of the Aquifer Geriatrics courses to create a custom course. Additionally, faculty are able to track a learner's progress through the cases.

Aquifer Geriatrics lends itself to use in a variety of ways, including flipped classroom learning,¹ team-based learning, training learners such as fellows how to teach geriatrics, and developing a geriatrics "bootcamp." Learners can also use these cases for self-study at their own pace, to develop mastery in the content. For schools that have more curricular time available, the cases can serve as anchors for subsequent didactic sessions, standardized patient sessions, and/or in preparation for a geriatric clinical rotation. Geriatrics programs have employed Aquifer Geriatrics for on-boarding of newly hired NPs and PAs. Additionally, geriatric medicine fellowship programs have used Aquifer Geriatrics to ensure fellows have basic geriatrics knowledge at the start of their fellowship and to teach fellows how to teach these topics to junior trainees in a "train-the-trainer" model. Aquifer Geriatrics also provides peer-to-peer consultations with a member of the Aquifer Geriatrics editorial board to assist faculty in better understanding ways to utilize the course to supplement current teaching methods.

Partnership With Aquifer

Without continued funding, web-GEMs would have joined a long list of well-regarded, highly used geriatrics curricula, such as the University of Iowa's *GeriaSims*¹⁰ or Weill

Medical College of Cornell University's *Environmental Geriatrics*,¹¹ that now are out of date and infrequently used, if at all. Software programs cannot remain viable over time if content is not updated and if the original software is incompatible with new technologies (devices, platforms, etc).

The leadership of web-GEMs and the AGS were unsuccessful in finding additional foundation and/or private funding after the Reynolds Foundation funding expired, and recognized the need for a new business plan.

A partnership with MedU, now known as Aquifer, was a natural fit, given that web-GEMs were designed using MedU's template and initially developed on the same case-based learning platform. Aquifer is the most-utilized source of case-based learning in medical education in the world, with over 10 million cases completed by over 300 000 learners since 2006.¹² MedU began as a resource to sustain a Health Resources and Services Administration-funded online, case-based pediatrics curriculum (CLIPP, now Aquifer Pediatrics).⁶ At the end of their funding period, CLIPP⁷ transitioned to a subscription-based model. This transition was successful, and Aquifer Pediatrics is still in use by 90% of US medical schools.¹³

Aquifer is a nonprofit organization composed of course boards of medical educators from multiple specialties, including Internal Medicine, Family Medicine, Radiology, and Pediatrics. Aquifer fulfills its mission with a professional staff of academic experts in medicine, including instructional designers, production associates, and a customer relationship team, who are engaged in continuous quality improvement to make the courses more relevant, engaging, and accessible for learners. Aquifer has developed free courses on oral presentation skills, high-value care, diagnostic excellence, and trauma in medicine through medical associations or government not-for-profit grant funds.

In 2015, the web-GEMs/POGOe team, with the support of AGS and ADGAP, began discussions with MedU/Aquifer to join their consortium. All shared the goal of disseminating geriatrics education to and for all health professionals. Whereas web-GEMs was free, Aquifer Geriatrics requires a paid subscription. Currently, 95% of US allopathic medical schools subscribe to at least one Aquifer course.¹³ To help with the transition to a subscription model and to allow users to discuss subscription costs with their institutional leadership, those who had been prior users of web-GEMs were "grandfathered" in for a year and allowed access to Aquifer Geriatrics for free. Since partnering with Aquifer, the number of cases completed and students trained has gone up (Figure 1). Currently, there are 48 institutions that have subscribed to Aquifer Geriatrics. Nearly 25 000 cases were completed in academic year 2017 to 2018, the highest number of cases completed in any single academic year since the inception of web-GEMs. Most of these were completed by learners in subscribed programs; only nine of the nonsubscribing grandfathered programs had 200 or more case completions, and only two had more than 1000 case completions.

Advantages to Use

There are a number of advantages to using Aquifer Geriatrics. Many medical, NP, and PA schools have a paucity of geriatrician educators. For these schools, the Aquifer Geriatrics' cases provide basic knowledge that can take the place of lectures and prepare students for clinical experiences involving the care of older adult patients, maximizing faculty efficiency and effectiveness. If students are unable to receive a particular clinical experience, Aquifer Geriatrics can ensure that they will be able to learn the topic in a simulated, case-based manner. Further, the curriculum is nationally recognized by AGS/ADGAP, peer reviewed, based on the AAMC/JAHF geriatric competencies for medical students,³ and continuously updated. Aquifer currently supplies online case-based learning that is used in clerkships for multiple specialties, making this platform ideal for institutions looking for stand-alone geriatric content or integration of geriatrics throughout their curriculum. The inter-professional nature and wide-ranging subject matter of Aquifer Geriatrics also lends itself to use for medical learners at every level as well as those in allied health professions. The course has an automated tracking and reporting feature of learners' activities that may lessen faculty administrative burden.

Aquifer Geriatrics has been well received by a variety of learners as well as faculty. Over 12 000 voluntary end-of-case evaluations have been completed by all learners, with 73% of respondents rating the cases as overall good to excellent, 89% agreeing that the cases taught the key teaching points relevant to the learner, and 81% rating the case as a valuable use of the learner's time. Additionally, Aquifer Geriatrics has proven to be useful and is perceived as effective by other learners than the initial target audience of medical students, including residents and NP/PA students. The subset of resident and fellow evaluations (n = 1049) showed similarly high ratings, with 74% rating the cases as good to excellent, 90% agreeing that the cases taught the key teaching points relevant to the learner, and 84% rating the case as a valuable use of the learner's time. The subset of NP/PA students (n = 2424) rated the cases highly, with 85% rating the cases as good to excellent, 94% agreeing that the cases taught the key teaching points, and 91% rating the case as a valuable use of the learner's time. Teaching faculty at academic centers have rated Aquifer Geriatrics as a highly effective and efficient way to impart geriatrics knowledge to a diverse group of learners.

Challenges

Cost is the greatest barrier to the use of Aquifer Geriatrics; however, a "business plan" can be articulated. The cost of a subscription for a medical or other health professions school, when amortized across learners, amounts to the equivalent of a textbook per learner and may be significantly less than the corresponding amount of faculty time, especially if using multiple cases to take the place of recurring didactic sessions. For medical schools facing Liaison Committee on Medical Education (LCME) accreditation, the implementation of the curriculum can help avoid a citation for critical requirements such as LCME standard 7.2,¹⁴ which asks how schools teach each phase of the human life cycle, including continuity of care, chronic care, rehabilitative care, and end-of-life care. Cost for a medical school depends on the total number of students enrolled in the program, allowing the cases to be assigned to students in any year of their medical education. A subscription to Aquifer

Geriatrics allows access to all 26 cases; there is not a per-case pricing structure for the curriculum. About 85% of Aquifer Geriatric's case usage comes from programs whose trainees complete 200 or more cases a year. The Aquifer Geriatrics course board along with AGS/ADGAP are working with Aquifer to develop a reasonable pricing mechanism for smaller programs. For the academic year 2018 to 2019, individual subscriptions are available for purchase at the cost of \$75 per 1-year subscription (without the ability for faculty to track completion of cases or create custom courses).

Other challenges include not having a dedicated geriatrics rotation, or that the timing of the rotation may not allow for completion of a significant number of the cases. The Aquifer Geriatrics cases were designed in such a way that they are able to be embedded within several different clerkships (Table 2), which may help to alleviate this. Finally, curricular time is a perpetual concern. The Aquifer Geriatrics course board is working on streamlining cases from an average of 35 minutes per case to a target of 20 minutes for completion; this time will allow more cases to be assigned, and potentially allow faculty to utilize their in-person time as a means of solidifying knowledge and assessing concepts at a higher level.

DISCUSSION

Aquifer Geriatrics is an innovative teaching resource for teaching geriatrics-focused content. Since the launch of the course in January 2013, over 20 000 users from multiple disciplines have logged in for sessions, with nearly 85 000 cases completed. Case usage has increased each year, rising to approximately 25 000 case completions in the 2017 to 2018 academic year (Figure 1). Both learners and faculty are positive about the experience. Partnering with Aquifer has enhanced and modernized the curriculum. Cases are now available for use on smartphones and tablets, in addition to desktop computers.

Further development of case-based, competency-linked curriculum, like Aquifer Geriatrics, targeted to residents, fellows, and practicing physicians, may be an appealing way of making use of valuable geriatrician-clinician educator resources. Cases on Advanced Care Planning and Frailty are being developed along with the addition of self-assessment questions for each case, with publication anticipated within the next academic year.

In conclusion, Aquifer Geriatrics provides an efficient and engaging way to teach increasing numbers of healthcare trainees and professionals geriatric principles and evidence-based management of geriatric syndromes, providing the foundation for improving the healthcare provided to older adults.

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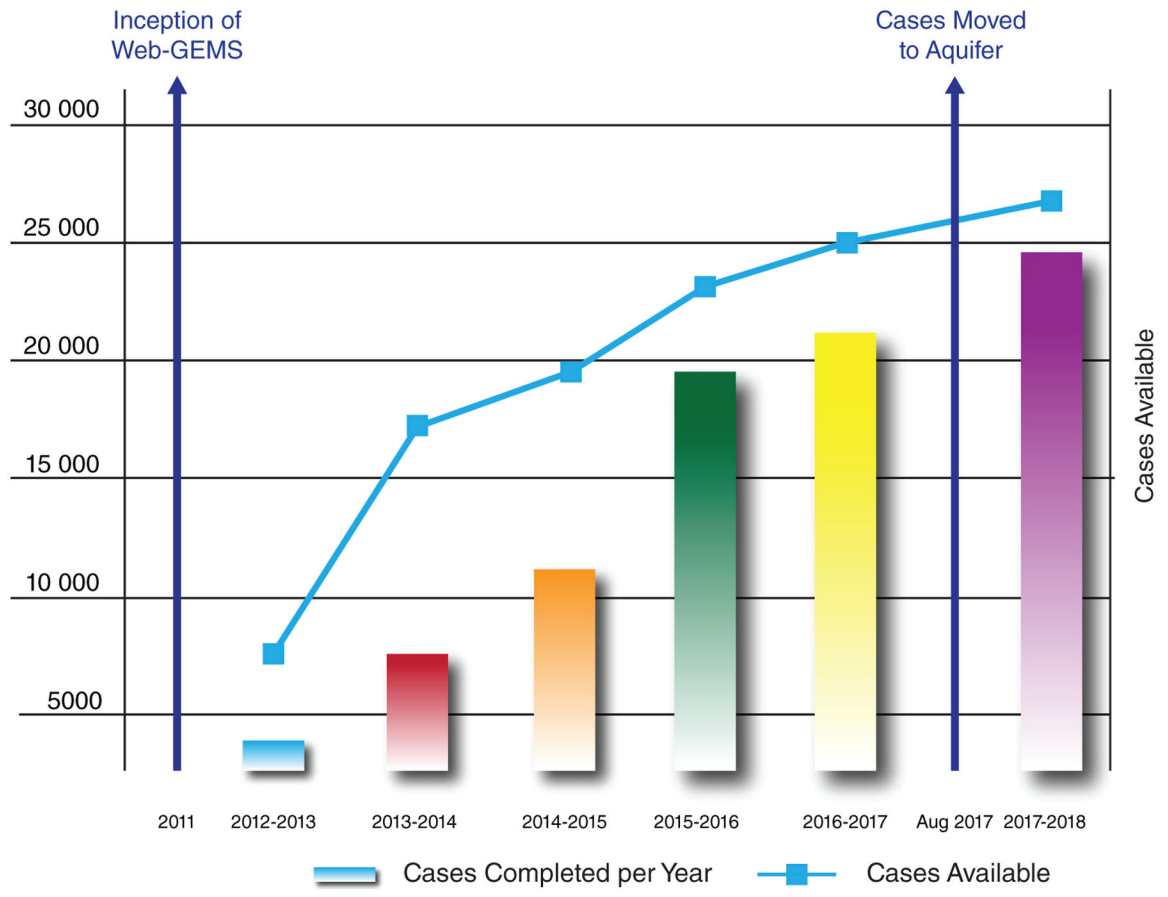


Figure 1.
Case availability and case usage over time.

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Table 1.

AAMC/JAHF Geriatric Competencies Matched to Aquifer Geriatrics Cases^a

Case Number: Case Title	Medication Management	Cognitive and Behavioral Disorders	Self-Care Capacity	Falls, Balance, and Gait Disorders	Healthcare Planning and Promotion	Atypical Presentation of Disease	Palliative Care	Hospital Care for Older People
1: 85-year-old woman using anticoagulants	X							
2: 85-year-old woman with hypoglycemia	X			X		X		
3: 88-year-old woman with urinary incontinence ^a	X		X					
4: 85-year-old woman with dementia		X						
5: 79-year-old woman with agitation		X						
6: 85-year-old woman with delirium	X	X						
7: 78-year-old man with depression		X						
8: 86-year-old man and older person abuse		X	X					
9: 82-year-old woman and functional status and home safety		X	X					
10: 72-year-old man and sexuality in older adults		X	X		X			X
11: 75-year-old woman with neck pain (geriatric osteopathic medicine case)			X					
12: 78-year-old woman and falls				X				
13: 75-year-old man and 80-year-old woman, prognosis and preventative screening for older adults					X			
14: 88-year-old woman with dementia and feeding issues				X			X	
15: 75-year-old man with abdominal pain			X			X		X
16: 87-year-old man with low back pain	X					X		
17: 86-year-old woman with pneumonia		X				X		
18: 83-year-old woman with urinary tract infection	X					X		
19: 70-year-old man with urinary concerns	X					X		X
20: 79-year-old man with severe pain and low health literacy							X	
21: 70-year-old woman and the psychological, social, and spiritual needs in geriatric care							X	
22: 74-year-old man and hazards of hospitalization: geriatric patient safety in the acute care setting	X	X						X
23: 70-year-old woman and hazards of hospitalization: transitions of care and discharge planning for geriatric inpatients			X					X

Case Number: Case Title	Medication Management	Cognitive and Behavioral Disorders	Self-Care Capacity	Falls, Balance, and Gait Disorders	Healthcare Planning and Promotion	Atypical Presentation of Disease	Palliative Care	Hospital Care for Older People
24: 78-year-old woman with pressure injuries								X
25: 85-year-old man and restraints		X	X		X			X
26: 78-year-old man and cultural competency in geriatric care								

Abbreviations: AAMC, Association of American Medical Colleges; JAHF, John A. Hartford Foundation.

^a Full text of competencies available at https://www.pogoe.org/Minimum_Geriatric_Competencies.

Table 2.

Geriatrics: Integration Into Clerkships and Multiple Disciplines^a

Number	Case Title	Geriatrics	IM/ FM	IM/FM (Ambulatory)	Neurology	Psychiatry	OB/ GYN	Surgery	Sub (Acting) Internship	Doctoring/ Preclinical	Osteopathic Medicine	Palliative Medicine	Nursing	Social Work	Rehabilitation (PT/OT)	Physician Assistants	Nurse Practitioners
	85-year-old woman using anticoagulants	X	X		X			X	X							X	X
	85-year-old woman with hypoglycemia	X	X	X					X							X	X
	88-year-old woman with urinary incontinence	X		X			X									X	X
	85-year-old woman with dementia	X		X	X											X	X
	79-year-old woman with agitation	X			X											X	X
	85-year-old woman with delirium	X	X		X				X						X	X	X
	78-year-old man with depression	X		X											X	X	X
	86-year-old man and older person abuse	X	X	X	X				X						X	X	X
	82-year-old woman and functional status and home safety	X	X	X					X						X	X	X
	72-year-old man and sexuality in older adults	X		X						X					X	X	X
	75-year-old woman with neck pain (geriatric)	X															X

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Number	Case Title	Geriatrics	IM/ FM	IM/ FM (Ambulatory)	Neurology	Psychiatry	OB/ GYN	Surgery	Sub (Acting) Internship	Doctoring/ Preclinical	Osteopathic Medicine	Palliative Medicine	Nursing	Social Work	Rehabilitation (PT/OT)	Physician Assistants	Nurse Practitioners
	osteopathic medicine case)																
	78-year-old woman and falls	X	X	X	X			X							X	X	X
	75-year-old man and 80-year-old woman, prognosis and preventative screening for older adults	X	X	X								X				X	X
	88-year-old woman with dementia and feeding issues	X	X		X							X		X	X	X	X
	75-year-old man with abdominal pain	X	X	X					X							X	X
	87-year-old man with low back pain	X	X	X												X	X
	86-year-old woman with pneumonia	X	X						X							X	X
	83-year-old woman with urinary tract infection	X	X	X												X	X
	70-year-old man with urinary concerns	X	X	X				X								X	X
	79-year-old man with severe pain and low health literacy	X	X	X								X				X	X
	70-year-old woman and the psychological, social, and spiritual needs	X	X	X					X			X		X	X	X	X

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Number	Case Title	Geriatrics	IM/ FM	IM/FM (Ambulatory)	Neurology	Psychiatry	OB/ GYN	Surgery	Sub (Acting) Internship	Doctoring/ Preclinical	Osteopathic Medicine	Palliative Medicine	Nursing	Social Work	Rehabilitation (PT/OT)	Physician Assistants	Nurse Practitioners
	in geriatric care																
	74-year-old man and hazards of hospitalization: geriatric patient safety in the acute care setting	X	X					X	X			X	X		X	X	X
	70-year-old woman and hazards of hospitalization: transitions of care and discharge planning for geriatric inpatients	X	X					X	X			X	X	X	X	X	X
	78-year-old woman with pressure injuries	X	X					X	X			X	X		X	X	X
	85-year-old man and restraints	X	X					X	X			X	X		X	X	X
	78-year-old man and cultural competency in geriatric care	X	X	X	X			X	X	X		X	X	X	X	X	X

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Abbreviations: FM, Family Medicine; IM, Internal Medicine; OB/GYN, obstetrics and gynecology; OT, occupational therapy; PT, physical therapy.

This content is often appropriate for use in other clerkships and disciplines. Here, we suggest cases that may be most appropriate for various learners (medical students in core clerkships or electives, residents and new fellows, and associated health professionals in training and practice).