Original Contribution

HemOnc.org: A Collaborative Online Knowledge Platform for Oncology Professionals

By Jeremy L. Warner, MD, MS, Andrew J. Cowan, MD, Aric C. Hall, MD, and Peter C. Yang, MD

Vanderbilt University, Nashville, TN; Fred Hutchinson Cancer Research Center and University of Washington School of Medicine, Seattle, WA; University of Wisconsin School of Medicine and Public Health, Madison, WI; Massachusetts General Hospital, Boston, MA

Abstract

Purpose: Cancer care involves extensive knowledge about numerous chemotherapy drugs and chemotherapy regimens. This information is constantly evolving, and there has been no freely available, comprehensive, centralized repository of chemotherapy information to date.

Methods: We created an online, freely accessible, ad-free, collaborative wiki of chemotherapy information entitled HemOnc.org to address the unmet need for a central repository of this information. This Web site was developed with wiki development software and is hosted on a cloud platform. Chemotherapy drug and regimen information (including regimen variants), as well as other information of interest to hematology/oncology professionals, is housed on the site in a fully referenced and standardized format. Accredited users are allowed to freely contribute information to the site.

Results: From its inception in November 2011, HemOnc.org has grown rapidly and most recently has detailed information on 383 drugs and 1,298 distinct chemotherapy regimens (not counting variants) in 92 disease subtypes. There are regularly more than 2,000 visitors per week from the United States and international locations. A user evaluation demonstrated that users find the site useful, usable, and recommendable.

Conclusion: HemOnc.org is now the largest free source of chemotherapy drug and regimen information and is widely used. Future enhancements, including more metadata about drugs and increasingly detailed efficacy and toxicity information, will continue to improve the value of the resource.

Introduction

Cancer medicine is a large and complex arena, with 120+ disease subtypes that are often treated in radically different ways.[1] The body of knowledge surrounding the treatment of cancer has grown rapidly as conventional chemotherapeutics have been augmented and sometimes supplanted by novel therapies, such as immunotherapy and targeted agents. Because of this complexity, the field has become fractured, with clinical trials and resultant treatment paradigms becoming increasingly narrow in scope. This has resulted in narrow approvals by the US Food and Drug Administration, widespread off-label use,[2] and a dauntingly large knowledge space. Chemotherapy treatments are complex, costly, and potentially highly toxic; thus, there are multiple stakeholders with an interest in accurate and timely information about dosages, sequencing of therapies, supportive medications, and durations of treatment. These include, but are not limited to, physicians and physician extenders, nurses, pharmacists, cost and resource decision makers, payers, vendors of computerized provider order entry software, and patients.

In November 2011, we began an experiment that was based on the fundamental question: How can we improve the sharing and access of information in cancer medicine? This question was inspired in part by the Web site Chemoregimen.com,[3] which was a commonly used free source of chemotherapy regimen information and primary references. By 2011, it was evident that this Web site was no longer being updated, and it had become a partner with a commercial entity, the Monthly Prescribing Reference. Additionally, there were no means to correct or augment the information content of the Chemoregimen site. To our knowledge, there were no other noncommercial electronic media that offered a comparable information source for chemotherapy regimens and chemotherapeutics. Thus, we created HemOnc.org to provide an online, collaborative, wiki-based knowledge base for chemotherapy regimens, chemotherapeutics, and other related information of interest to hematology/oncology professionals.

Wikis are Web sites that allow people to collaborate on the Internet to create documents and knowledge bases.[4] In traditional publishing, articles are written by a limited number of authors/editors, and once published, the content is fixed, except for infrequent erratum and retractions. Information flows in one direction, from the content creators to the content consumers. Conversely, wikis crowdsource information from a potentially much larger pool of contributors, who may add or edit information in an article in real-time to incrementally improve articles through continuous revision. This facilitates a more rapid and comprehensive means of knowledge dissemination. Information flows back and forth between the original content creators and content consumers.

Wikis retain past versions of pages, which allows for straightforward auditing, reversal of errors, and attribution of contributions. Wikis are accessible from any Internet-connected device, searchable, and have internally cross-linked information to connect pages to one another, which facilitates ease of infor-

mation discovery for users. However, depending on the qualifications and expertise of contributors, wikis have been criticized for being vulnerable to the addition of inaccurate or poorly edited information. Furthermore, depending on how openly granted editing rights are, wikis can be prone to vandalism. Despite these potential disadvantages, this model has proven to be quite successful; the free online encyclopedia Wikipedia[5] is perhaps the most well-known example of a wiki. The legitimacy of this approach has recently been bolstered by the finding that pharmacology information on Wikipedia is 99.7% accurate compared with textbooks of pharmacology.[6]

We were specifically interested in whether an open, collaborative, chemotherapy regimen knowledge base that would be more comprehensive and accurate than existing resources could be created using a wiki platform. This article reports on the progress to date and the initial successes and challenges, and includes the results of a user evaluation.

Methods

Needs Analysis

Before creation of the site, we informally polled oncology trainees and attending physicians to ascertain focus areas for development. One of the most frequently cited frustrations was the lack of a comprehensive, up-to-date chemotherapy regimen reference. Commonly used references were often years old and contained a limited set of references that sometimes did not match the listed regimen. One group's chemotherapy ordering system did not consistently list references for the regimens being ordered. As a result, trainees in particular believed that they were spending too much time trying to find rather than reading the primary literature. Clinicians who were questioned wanted to have a reference that could be used from anywhere and a way to easily record useful information or Web sites to be accessed at a later time. They expressed frustration about the limits of information sharing via only direct communication and conferences and wished to have a means to share information with a broader audience outside of their institution and invite collaboration. Approximately 18 months after the Web site's creation, we conducted a formal survey of its users through the Web site to elicit usability feedback and to learn about users' experiences with errors and inconsistencies found in other resources.

Knowledge base generation. To appropriately frame the scope of HemOnc.org, we created an organizational matrix based on Zack's knowledge strategy.[7,8] This strategy describes knowledge as a function of two axes: Levels and Categories. Categories include: declarative knowledge (termed know-what knowledge), procedural knowledge (know-how), and analytic knowledge (know-why). Levels include core knowledge, advanced knowledge, and innovative knowledge. The initial focus of development was to flesh out the core knowledge components as much as possible. To inform these elements, a wide range of source materials was used to identify data for inclusion in the site. A list of commonly used sources is available (http://hemonc.org/wiki/Sources). Content was manually created by clinicians with access rights to the site.

Drug and chemotherapy regimen information. For chemotherapeutics and supportive medications included on the wiki, a page was created for each individual drug with general information about mechanism of action and specific information about safety, FDA approval history, common usage, and synonyms. Appendix Table A1 (online only) lists the current categories being applied to individual drugs. Information on antiemetic potential, which is a key concern for many chemotherapeutics, is accessible on the left sidebar of every page (http://hemonc.org/wiki/Antiemesis). For chemotherapy regimens included on the site, regimens are provided on a disease subtype–specific page and further classified by the context in which they were evaluated (eg, first-line metastatic, relapsed/refractory, adjuvant, and so on). An example is shown in Figure 1. Additional details about the information included on drug and chemotherapy regimen pages are available in the Appendix (online only).

Other information. In addition to a primary focus on chemotherapy drugs and regimens, HemOnc.org has several other content areas. These include sample order sets, lists of diagnosis and billing codes that are commonly used in hematology/oncology practice, reference tables for vesicant and irritant chemotherapeutics, performance status, corticosteroid conversions, and a large number of external links. There is also an extensive style guide (http://hemonc.org/wiki/Style_guide) to guide content contributors.

Platform and security. HemOnc.org is hosted on a server within a data center run by Linode (Galloway, NJ), a computer hosting provider. The server runs on the Ubuntu Linux operating system (Canonical, London, United Kingdom) with Apache (Apache Software Foundation, Forest Hill, MD) as the Web server and MySQL (Oracle, Redwood City, CA) as the database. The Web site is powered by MediaWiki software (Wikimedia Foundation, San Francisco, CA). There are multiple security measures taken to ensure the integrity and performance of the system. The server is regularly patched with security updates to limit susceptibility to unauthorized access (hacking), and multiple offsite backups are regularly created to protect against data loss. Traffic for the site is routed through the CloudFlare content delivery network (CloudFlare, San Francisco, CA), which helps to improve speed and block traffic from spammers and bots (which include malicious software and/or humans that harvest user data to post or e-mail unsolicited, commercial, and/or malicious content). Asirra[9] (Animal Species Image Recognition for Restricting Access; Microsoft, Redmond, WA) is used during the account creation process to ensure that creators are human rather than automated computer programs that are attempting to create spam accounts. Most importantly, the administrators verify the credentials of all users who wish to obtain access rights to add or modify content, and every account is manually approved.

Contributorship. The Web site does not require visitors to login or have an account to use the site, but people who sign up for a free account have additional benefits, such as custom views. After creating an account, individuals must manually contact

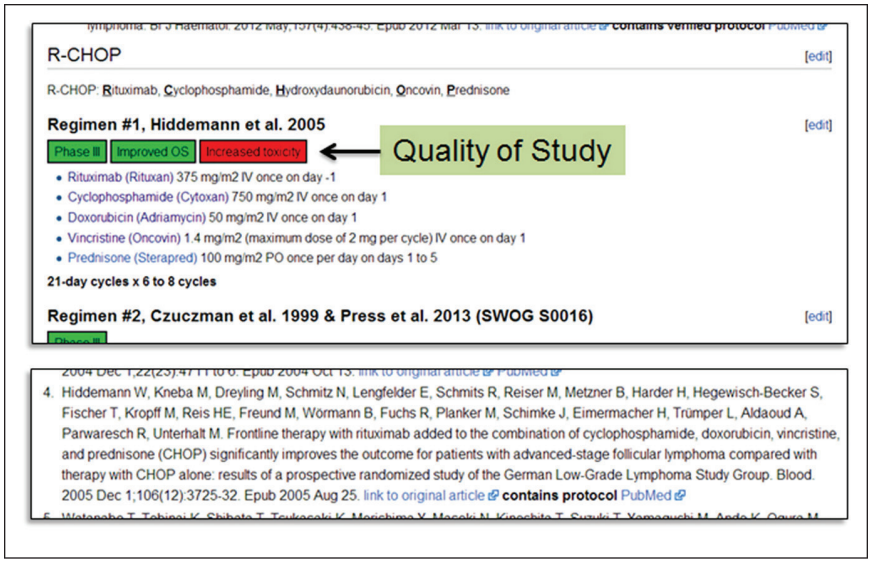


Figure 1. A portion of the rituximab plus cyclophosphamide, doxorubicin, vincristine, and prednisone (R-CHOP) regimen description for untreated follicular lymphoma. There are currently seven variants of this regimen for this context on HemOnc.org. Study design, efficacy, and toxicity information are shown directly above the regimen. All drug names are active links to the respective drug pages. The original reference is listed at the end of the regimen (references are listed in chronologic order), with links to the original article as well as the PubMed abstract page.

the administrators if they wish to have editing privileges. Editing privileges are generally restricted to hematology/oncology professionals (eg, physicians, nurse practitioners, physician assistants, and pharmacists). Thus far, 23 users have been granted editing privileges on the site. Of those 23 users, 10 have contributed content to HemOnc.org.

Results

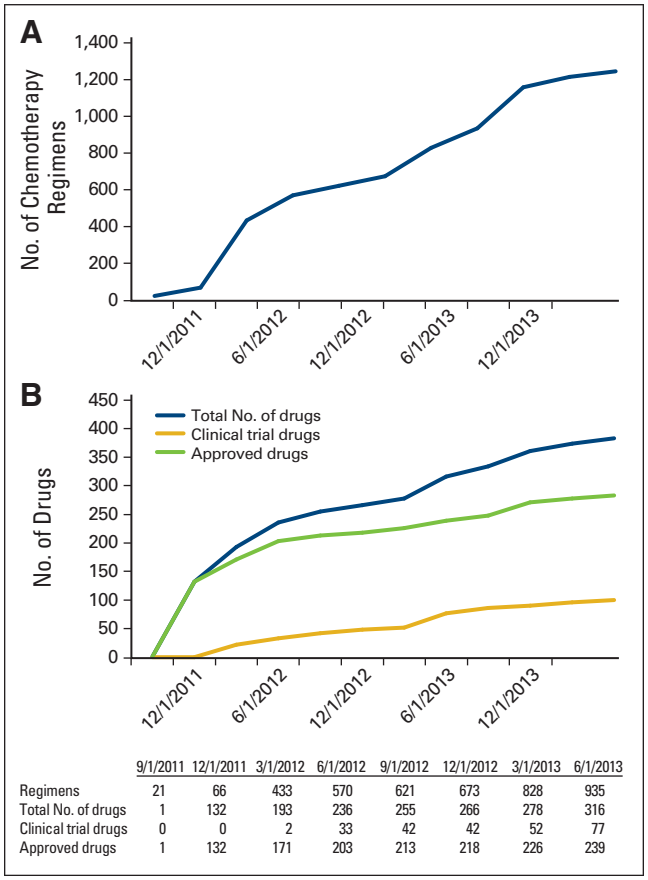
Content Growth

The first version of the HemOnc.org Web site went live in November 2011. By December 2011, there was content on 66 distinct chemotherapy regimens in eight disease subtypes, and 132 drugs (all FDA approved). By June 2014, there were 1,298 distinct chemotherapy regimens in 58 disease subtypes that are further divided into 92 distinct entities (Appendix Table A2, online only), and 383 drugs (100 of which are in clinical trials). Figure 2 shows the growth of chemotherapy regimen and drug content over time. Annotation of chemotherapy regimens has also increased over time. In June 2013, less than 5% of regimens had information about study design; by February 2014, more than 99% of regimens had such information. The content of drug pages has also expanded over time, with information about FDA approval dates and indications, as well as synonyms, including RxNorm concept unique identifiers, for some drugs. For example, dexamethasone has three RxNorm concept unique identifiers (dexamethasone acetate [22690]; dexamethasone phosphate [235486]; dexamethasone sodium phosphate [48933]) and 529 synonyms. The latest enhancement to the site, which is still underway, is the addition of categorization metatags to drugs (Appendix Table A1).

Visitors. Figure 3 illustrates how the user traffic to HemOnc.org has changed during its existence. The site had 34,327 visits in 2012, and traffic increased by 159% in 2013, when there were 88,974 visits. From January 2014 through July 2014, there were 63,252 visits. Overall, 69.5% of users entered the site from search engines; 23.7% of users directly entered the address in their Web browsers or had it bookmarked; and 6.8% of users arrived via referral links from other sites. Over time, presumably as people became more familiar with the site, a greater percentage of them accessed it directly. For example, in July 2014, 32.5% of users directly accessed the site, 61.1% used a search engine, and 6.3% entered via a referral link.

User evaluation. We conducted a survey to evaluate the usability of the site. The survey was open from May 1 through May 31, 2013. Survey data were collected and managed using REDCap (Research Electronic Data Capture) software hosted at Vanderbilt University.[10] REDCap is a secure, Web-based application that is designed to support data capture for research studies, providing an intuitive interface for validated data entry, audit trails for tracking data manipulation and export procedures, automated export procedures for seamless data downloads to common statistical packages, and procedures for importing data from external sources. Because this survey was anonymous and HemOnc.org does not fall under the auspices of an institutional review board, institutional review board approval was not obtained. Participants were invited by site announcements, social media, and e-mails to hematology/oncology fellowship programs. Usability was assessed by 100-point Likert scales (0 being worst and 100 being best). Other data, including information about which other resources the respondents often used, were collected via multiple choice questions with optional free text entry.

There were 139 respondents, the majority of which were physicians (61%; 26% were nurses, 10% were pharmacists, and 3% were other). The respondents expressed that the site was



	9/1/2011	12/1/2011	3/1/2012	6/1/2012	9/1/2012	12/1/2012	3/1/2013	6/1/2013
Regimens	21	66	433	570	621	673	828	935
Total No. of drugs	1	132	193	236	255	266	278	316
Clinical trial drugs	0	0	2	33	42	42	52	77
Approved drugs	1	132	171	203	213	218	226	239

Figure 2. (A) The number of chemotherapy regimens for which information is available on HemOnc.org (count does not include variants of the same regimen). Counts were sampled at 3-month intervals. (B) The number of drugs (antineoplastic and supportive) for which information is available on HemOnc.org. Counts were sampled at 3-month intervals.

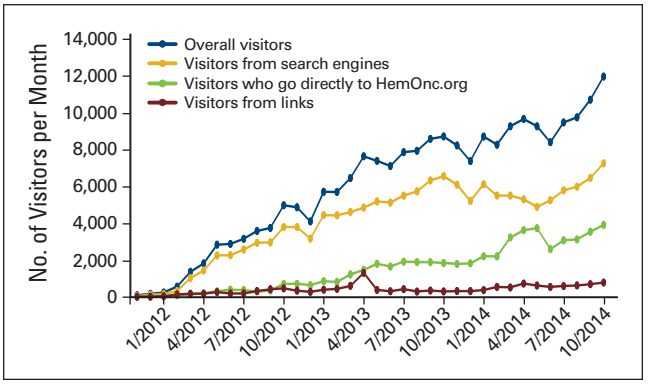


Figure 3. The number of visitors per month to HemOnc.org. The blue line represents the total number of visitors. The yellow, green, and brown lines represent the number of visitors per month who entered the site via search engines, directly entering the address in web browsers, and referral links from other sites, respectively.

useful (median score, 90; interquartile range [IQR], 76-99.5), usable (median score, 85; IQR, 69-98), and recommendable to colleagues (median score, 87; IQR, 72-99). All respondents (100%) reported using other references (eg, textbooks), but 70.5% reported accuracy issues with these references. The issues most commonly reported by respondents were: lack of precision needed to properly give the regimen (55%); schedule of administration incorrect (25%); dosage, including body-surface area–based dosing, missing or incorrect (23%); spelling/typographic errors (9%); and route of administration incorrect (5%). Interestingly, only 38 respondents (27%) reported using information provided through their electronic medical record (EMR).

Many respondents indicated a willingness to contribute to the site, including through indirect means such as e-mailing editors with corrections—although only four of 139 (3%) reported being active contributors. For those unwilling to contribute (23 respondents; 17%), the leading reason was a lack of time (15 of 23, 65%). Additional details are available in Appendix Table A3 (online only).

Discussion

HemOnc.org has been a success, as measured by the increase in content, number of visitors, and generally positive user satisfaction. Because of its wiki platform, new content can be added and adapted in real-time to provide whatever information is most interesting to its users. In addition to providing content to a wide variety of stakeholders who are participating in the care of patients with cancer, the site has enabled secondary investigations into the manner in which evidence for cancer treatment evolves over time. For example, we have used HemOnc.org as a content source to inform a treatment regimen network analysis of first-line treatments of chronic myelogenous leukemia,[11,12] and have also conducted preliminary investigations into the reclassification of the cancer ontology as a function of treatment.[13] Future work will expand on these preliminary studies; one goal is the automated synthesis of treatment guidelines.[14] This is especially relevant for disease contexts for which there are large numbers of published regimens, such as the first-line treatment of chronic lymphocytic leukemia (30 regimens on HemOnc.org, 19 of which have been evaluated in randomized controlled trials) or the treatment of metastatic erb-b2 receptor tyrosine kinase 2 (*ERBB2/HER2*) –negative breast cancer (40 regimens on HemOnc.org, 29 of which have been evaluated in randomized controlled trials).

Several challenges have emerged with this process, most notably, the lack of broad user participation with regard to updating content, and the challenges of dissemination. With respect to the former, it has been well documented that content generation and editing is nonuniform in social media, with a small number of users contributing disproportionately to projects such as Wikipedia.[15,16] Medical professionals are typically well compensated for their time and have many conflicting priorities vying for their time, such as patient care, academic pursuits, and teaching. It may be appealing to some individuals to be able to instantly share information that is attributed to them on a well-trafficked, specialized site that their peers visit, but because there is no monetary reward for contributions and limited prestige is associated with an emerging Web site, user participation may remain a challenge. People who requested editing privileges and who did not subsequently contribute or stopped contributing often cited lack of time as a main factor.

Dissemination presents another set of challenges, primarily related to the fact that HemOnc.org is noncommercial and does not have a traditional marketing budget. Thus, awareness of the site is spread by traditional word-of-mouth, media exposure,[17] reciprocal exposure on sites such as MyCancerGenome.org,[18] and social media outlets such as Facebook and Twitter. It is notable that a majority of traffic arrives through search engines. The importance of search engine optimization cannot be overemphasized, and we have found some success here. For example, a search for the phrase vesicant chemotherapy on Google or Bing will return HemOnc.org as the first result (as of the writing of this article).

A future wish list for enhanced functionality includes improving usability on mobile platforms; enabling HL7 Infobutton technology[19] so that drug and regimen information can be obtained by external EMRs; completion of efficacy and toxicity data for all regimens; verification of all unverified regimens; inclusion of more gray literature and abstract sources; determination of so-called outdated status for older regimens that are no longer commonly used; and increased outreach and engagement of patients. Additional information could be added on topics including the cost of treatments, drug shortages, and adverse events.

Many oncology practices use proprietary EMRs and oncology suites with built-in chemotherapy order sets, but they are limited by the release cycles of their vendors or expediency of their in-house order set writers. In a landscape in which the work of discovering new information is often internally duplicated many times over because of lack of information sharing across institutions, we believe that a free, public resource such as HemOnc.org can complement existing tools and be a valuable supplement for our field so that information can be rapidly disseminated and accessed.

In conclusion, HemOnc.org has become, over the course of approximately 3 years, the largest, freely available chemotherapy drug and regimen resource. We anticipate continued growth in content and invite all readers of this article to consider participation in this collaborative project.

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A preliminary version of the survey results was presented in poster format at the American Society of Clinical Oncology Quality Care Symposium, San Diego, CA, November 1 and 2, 2013.

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Author Contributions

Conception and design: Jeremy L. Warner, Peter C. Yang
Financial support: Jeremy L. Warner
Administrative support: Jeremy L. Warner
Collection and assembly of data: All authors
Data analysis and interpretation: Jeremy L. Warner, Peter C. Yang
Manuscript writing: All authors
Final approval of manuscript: All authors

Corresponding author: Jeremy L. Warner, MD, MS, Internal Medicine and Biomedical Informatics, Hematology/Oncology, Vanderbilt University, 2220 Pierce Ave, PRB 777, Nashville, TN 37232; e-mail: Jeremy.warner@vanderbilt.edu.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

HemOnc.org: A Collaborative Online Knowledge Platform for Oncology Professionals

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Jeremy L. Warner
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Andrew J. Cowan
Stock or Other Ownership: Doximity
Consulting or Advisory Role: Doximity

Aric C. Hall
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Peter C. Yang
Stock or Other Ownership: Merck, Pfizer, Cyclacel

Appendix

Drug information. For chemotherapeutics and supportive medications included on the wiki, a page was created for each individual drug with, ideally, the following information: (1) general information, including a description of the mechanism of action, route of administration, extravasation information (when available for intravenous medications), and links to package inserts and Risk Evaluation and Mitigation Strategy information (when present); (2) patient drug information, including links to widely used patient drug information Web sites (Chemocare.com and UpToDate); (3) diseases for which the drug is commonly used; (4) date(s) of US Food and Drug Administration (FDA) approval, including the specific indication and any changes in indication; (5) synonyms, including brand name(s) and precise names in the RxNorm terminology (a systematic nomenclature for drugs developed by the National Library of Medicine; Nelson SJ, et al: J Am Med Inform Assoc 18:441-448, 2011); (6) structured categories based on mechanism of action, indication, and so on. For example, the drug carfilzomib [http://hemonc.org/wiki/Carfilzomib_(Kyprolis)] is categorized as a proteasome inhibitor, a multiple myeloma medication (on the basis of FDA indication; Herndon TM, et al: Clin Cancer Res 19:4559-4563, 2013), a Waldenström macroglobulinemia medication (on the basis of positive phase II trial results; Treon SP, et al: Blood 124:503-510, 2014), and a drug FDA approved in 2012. For drugs to be listed on the wiki, they should have FDA or European Medicines Agency approval or have promising published results (generally defined as phase II results that are sufficiently positive to warrant a phase III trial). Investigational drugs are denoted as such and additionally categorized into an investigational agents category. Discontinued drugs (eg, gemtuzumab ozogamicin) are categorized as such; clinical trial drugs failing in the evaluation stage are removed from the wiki when the failure is clearly disclosed by the manufacturer.

Regimen information. For chemotherapy regimens included on the site, regimens are listed on a disease subtype–specific page and further classified by the context in which they were evaluated, for example, first-line metastatic, relapsed/refractory, adjuvant, and so on. Under each major contextual subheading, regimens are listed in alphabetical order by their commonly known abbreviation (eg, R-CHOP [rituximab plus cyclophosphamide, doxorubicin, vincristine, and prednisone]) or by individual drug names in the absence of a commonly known abbreviation. Synonyms are listed as well as the Unified Medical Language System structured concept (Bodenreider O: Nucleic Acids Res 32:D267-D270, 2004) when available (eg, Unified Medical Language System concept unique identifier C0393023 represents R-CHOP). Each variant of a regimen is listed separately, with the primary author and study consortium name, if there is one, listed (eg, there are seven variants of R-CHOP listed for untreated diffuse large B-cell lymphoma; the first variant listed was used by the LNH-98.5 [Coiffier B, et al: N Engl J Med 346:235-242, 2002] and LNH03-6B [Delarue R, et al: Lancet Oncol 14:525-533, 2013] study consortiums). Directly under each individual variant, a colored box containing information about the level of evidence for the regimen is displayed, using a green-yellow-red traffic light metaphor. Generally, green represents regimens that have been evaluated in a randomized fashion (eg, phase III studies), yellow represents regimens that have been evaluated in at least 20 patients in a nonrandomized fashion (eg, phase II studies, large pilots), and red represents regimens that have been evaluated in fewer than 20 patients or have been evaluated retrospectively. The chemotherapy regimen is then listed by individual drug (with a link to the individual drug page) with dosage, route, infusion time, and day(s) of administration listed. Missing or ambiguous information in the primary article is denoted, except for infusion time, which is usually missing and therefore simply omitted when not available. Supportive medications reported in the article are also listed (these are often omitted or ambiguous). Finally, the length of cycles and the total number of cycles are listed. Primary references are then listed accompanying each regimen, with the following special tags as needed: Abstract (no manuscript has yet been published to our knowledge); Update (an update to a previously published regimen); Retrospective; Meta-Analysis. Once a regimen has been published in a peer-reviewed publication, abstracts are hidden from view. Links to original articles as well as the PubMed citation are provided for every reference, and references for a full publication, rather than an abstract or other early publication, that was reviewed and confirmed as accurate by an authorized contributor are denoted as "contains verified protocol." References that contain regimen information that could not be thoroughly reviewed —such as publications to which the contributors did not have subscription access—are denoted as "contains protocol."

Table A1. The Main Drug Categories and Subcategories in HemOnc.org

Categories
Cytotoxic chemotherapy
Alkylating agents
Anthracyclines
DNA synthesis inhibitors
Nitrogen mustards
Nitrosureas
Nucleic acid analogs
Platinum agents
Proteasome inhibitors
Taxanes
Microtubule inhibitors
Topoisomerase inhibitors
Vinca alkaloids
Antimetabolites
Antifolates
Purine analogues
Pyrimidine analogues
Kinase inhibitors
AAK inhibitors
ALK inhibitors
Bcr-Abl inhibitors
BRAF inhibitors
BTK inhibitors
CDK inhibitors
EGFR inhibitors
FGFR inhibitors
FLT3 inhibitors
HDAC inhibitors
JAK inhibitors
KIT inhibitors
LYN inhibitors
MEK inhibitors
MET inhibitors
mTOR inhibitors
PDGFR inhibitors
PLK1 inhibitors
RET inhibitors
ROS1 inhibitors
SRC inhibitors
SYK inhibitors
TEK inhibitors
VEGF inhibitors
Corticosteroids and corticosteroid mimetics
Antiandrogens
Corticosteroid synthesis inhibitors
Androgen receptor inhibitors
5 alpha-reductase inhibitors
GnRH agonists
GnRH antagonists

continued on next page

Table A1. (continued)

Categories
Aromatase inhibitors
Selective estrogen receptor modulators
Corticosteroids
Somatostatin analogs
Biologics
Antibody medications
Antibody-drug conjugates
Anti-HER2 medications
IL-6 inhibitors
Enzymes
Immunotherapy
Immunomodulatory drugs
Investigational and discontinued
Investigational
Discontinued
Supportive medications
Corticosteroids
Bisphosphonates
RANK ligand inhibitors
Antimicrobial
Antivirals
PCP prophylaxis
Chemotherapy protective agents
Radioactive agents
Alpha emitters
Radioimmunotherapy
Benign hematology medications
Hemostasis medications
Coagulation factors
Fibrinolysis inhibitors
Direct thrombin inhibitors
Factor Xa inhibitors
Heparins
Low-molecular-weight heparins
Phosphodiesterase inhibitors
Cyclooxygenase inhibitors
P2Y12 ADP inhibitors
Chelators
Hematopoietic growth factors
Erythrocyte growth factors
Granulocyte growth factors
Megakaryocyte growth factors
Miscellaneous
Retinoids
Vitamins
Immunosuppresants
Vasopressin analogs
Medications by cancer subtype
Acute lymphocytic leukemia medications
Acute myeloid leukemia medications

continued on next page

Table A1. (continued)

Categories
Acute promyelocytic leukemia medications
Aggressive non-Hodgkin lymphoma medications
Anal cancer medications
Basal cell and squamous cell skin cancer medications
Bladder cancer medications
Bone cancer medications
Breast cancer medications
Cancer of unknown primary medications
Castleman's disease medications
CNS cancer medications
CNS lymphoma medications
Cervical cancer medications
Chronic lymphocytic leukemia and small lymphocytic lymphoma medications
Chronic myelogenous leukemia medications
Chronic myelomonocytic leukemia medications
Colon cancer medications
Esophageal cancer medications
Essential thrombocythemia medications
Follicular lymphoma medications
Gastric cancer medications
Hairy cell leukemia medications
Head and neck cancer medications
Hepatobiliary cancer medications
HIV-associated lymphoma medications
Hodgkin lymphoma medications
Hodgkin lymphoma, nodular lymphocyte–predominant medications
Immune thrombocytopenic purpura medications
Light-chain amyloidosis medications
Mantle cell lymphoma medications
Marginal zone lymphoma medications
Melanoma medications
Mesothelioma medications
Multiple myeloma medications
Myelodysplastic syndrome medications
Myelofibrosis medications
Non-Hodgkin lymphoma medications
Non–small-cell lung cancer medications
Neuroendocrine tumor medications
Ovarian cancer medications
Pancreatic cancer medications
Paroxysmal nocturnal hemoglobinuria medications
Penile cancer medications
Polycythemia vera medications
Prostate cancer medications
Rectal cancer medications
Renal cancer medications
Sarcoma medications

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Table A1. (continued)

Categories
Small-cell lung cancer medications
T-cell lymphoma medications
Testicular cancer medications
Thymoma medications
Thyroid cancer medications
Transplantation medications
Uterine cancer medications
Waldenström macroglobulinemia medications
Medications by year of approval
Specific year of initial approval (eg, 2010)

NOTE. There are 12 main drug categories. One medication can belong to as many subcategories as are relevant.
Abbreviations: AAK, Aurora A kinase; ADP, adenosine diphosphate; ALK, anaplastic lymphoma kinase; BRAF, serine/threonine-protein kinase B-Raf; BTK, Bruton's tyrosine kinase; CDK, cyclin-dependent kinase; EGFR, epidermal growth factor receptor; FGFR, fibroblast growth factor receptor; FLT3, fms-related tyrosine kinase 3; GnRH, gonadotropin releasing hormone; HDAC, histone deacetylase; HER2, human epidermal growth factor receptor 2; IL-6, interleukin 6; JAK, Janus kinase; KIT, tyrosine-protein kinase c-Kit; LYN, tyrosine-protein kinase Lyn; MEK, mitogen-activated protein kinase kinase; MET, hepatocyte growth factor receptor; mTOR, mammalian target of rapamycin; PCP, pneumocystis pneumonia; PDGFR, platelet-derived growth factor receptor; PLK1, polo-like kinase 1; RET, tyrosine-protein kinase ret; ROS1, proto-oncogene tyrosine-protein kinase ROS; SRC, proto-oncogene tyrosine-protein kinase Src; SYK, spleen tyrosine kinase; TEK, angiopoietin-1 receptor; VEGF, vascular endothelial growth factor.

Table A2. Disease Subtypes Currently Represented on HemOnc.org, With No. of Regimens for Each Subtype (excludes regimen variants)

Subtype	No. of Regimens
Benign hematology	
Aplastic anemia	1
Autoimmune thrombocytopenic purpura	6
Castleman's disease	1
Paroxysmal nocturnal hemoglobinuria	2
Malignant hematology	
Acute lymphocytic leukemia	23
Ph positive	
Ph negative	
Acute myeloid leukemia	41
Acute promyelocytic leukemia	22
Aggressive non-Hodgkin lymphoma	68
DLBCL	
Burkitt's lymphoma	
Primary mediastinal B-cell lymphoma	
Gastric DLBCL	
Chronic lymphocytic leukemia and small lymphocytic lymphoma	55
Chronic myelogenous leukemia	25
Chronic phase	
Accelerated phase	
Blast crisis	
Chronic myelomonocytic leukemia	1
CNS lymphoma	7
Essential thrombocythemia	2
Follicular lymphoma	51
Hairy cell leukemia	5
HIV-associated lymphoma	9
Hodgkin lymphoma	26
Hodgkin lymphoma, nodular lymphocyte-predominant	8
Large granular lymphocytic leukemia	2
Light-chain amyloidosis	14
Mantle cell lymphoma	29
Marginal zone lymphoma	20
Multiple myeloma	52
Myelodysplastic syndrome	10
Myelofibrosis	6
Polycythemia vera	1
T-cell lymphoma	28
Anaplastic large-cell lymphoma	
Cutaneous T-cell lymphoma	
Extranodal NK/T-cell lymphoma, nasal type	
NK/T-cell lymphoma	
Peripheral T-cell lymphoma NOS	
Waldenström macroglobulinemia	11
Other	
Transplantation conditioning regimens	18
Autologous stem-cell transplantation	
Allogeneic stem-cell transplantation	

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Table A2. (continued)

Subtype	No. of Regimens
Solid oncology	
Anal cancer	4
Basal cell and squamous cell skin cancer	8
Basal cell carcinoma	
Squamous cell carcinoma	
Bladder cancer	27
Bone cancer	28
Chondrosarcoma	
Ewing's sarcoma	
Osteosarcoma	
Malignant fibrous histiocytoma of bone	94
Breast cancer	
HER2 negative	
HER2 positive	
CNS cancer	35
Anaplastic glioma	
Glioblastoma multiforme	
Oligodendroglioma	
Supratentorial astrocytoma	
Cervical cancer	27
Colon cancer	34
Esophageal cancer	79
Gastric cancer	6
Head and neck cancer	31
Hepatobiliary cancer	24
Hepatocellular carcinoma	
Biliary tract cancer	
Melanoma	27
Mesothelioma	11
Neuroendocrine tumors	29
Adrenal gland tumors	
Carcinoid tumors	
Pancreatic neuroendocrine islet cell tumors	
Pheochromocytoma	
Non–small-cell lung cancer	39
Ovarian cancer	31
Pancreatic cancer	21
Penile cancer	11
Prostate cancer	36
Rectal cancer	9
Renal cancer	18
Sarcoma	27
Angiosarcoma	
GI stromal tumor	
Giant-cell tumor of bone	
Kaposi sarcoma	
Various other histologies	

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Table A2. (continued)

Subtype	No. of Regimens
Small-cell lung cancer	27
Testicular cancer	17
Pure seminoma	
Nonseminoma	
Thymoma	9
Thyroid cancer	8
Medullary	
Various other histologies	
Unknown primary	14
Adenocarcinoma or carcinoma NOS	
Squamous cell carcinoma	
Neuroendocrine	
Uterine cancer	23
Endometrioid	
Various other histologies	
Total	1,298

Abbreviations: DLBCL, diffuse large B-cell lymphoma; HER2, human epidermal growth factor receptor 2; NK, natural killer; NOS, not otherwise specified.

Table A3. Results of Questions From Usability Survey

Questions and Answers	Respondents	
	No.	%
Q1: Have you contributed to HemOnc.org?		
A1: Yes	4	3
A2: No	135	97
Q2 (Multiple choices are allowed): HemOnc.org is a collaborative wiki. This type of site allows all of its users to work together and edit the pages you see. In what ways would you consider contributing to this site?		
A1: Add example order sets	18	13
A2: Add new regimens	23	17
A3: Add new references	31	22
A4: Correct mistakes	33	24
A5: Create new pages that will be helpful to me in clinical practice, such as checklists for certain diseases	27	19
A6: Would not create an account and personally modify any information, but would e-mail an editor about errors, references/papers to be added, or other information to be included	44	32
A7: Would not be interested in contributing at all	23	17
Q3 (Only visible if A7 is checked for Q2, above; multiple choices are allowed): Which of the following best describes the reason for your unwillingness to contribute?		
A1: Fear of introducing errors	6	26
A2: HemOnc.org not likely to be around for long	1	4
A3: I'm not tech-savvy enough	6	26
A4: Information is complete already	1	4
A5: Lack of knowledge (real or perceived)	3	13
A6: Not enough time	15	65
A7: Not worth my time	2	9
A8: Too steep of a learning curve	0	0
Q4 (Multiple choices are allowed): Please choose which of the below, if any, would help you start contributing (or contribute more, if you're already contributing)		
A1: Continuing medical education (CME) or similar professional development recognition	38	27
A2: A different user interface	9	6
A3: Inclusion in future publications based on number of contributions	15	11
A4: Recognition as a content expert (eg, section editor)	21	15
A5: Reminder emails	22	16
A6: A small monetary compensation for each contribution	21	15
A7: None of the above	47	34
A8: Other	5	4

NOTE. These questions specifically focused on the degree to which users have contributed, reasons for noncontribution, and barriers to contribution. Except for Q1, answers may not sum up to 100% because the questions were multiple choice, and leaving a question unanswered was permitted.
Abbreviations: A, answer; Q, question.