



## Mark Musen

Professor of Medicine (Biomedical Informatics) and of Biomedical Data Science  
Medicine - Biomedical Informatics Research

 NIH Biosketch available Online

### CONTACT INFORMATION

#### • Administrative Contact

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### Bio

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#### BIO

Dr. Musen is Professor of Biomedical Informatics at Stanford University, where he is Director of the Stanford Center for Biomedical Informatics Research. Dr. Musen conducts research related to intelligent systems, reusable ontologies, metadata for publication of scientific data sets, and biomedical decision support. His group developed Protégé, the world's most widely used technology for building and managing terminologies and ontologies. He is principal investigator of the National Center for Biomedical Ontology, one of the original National Centers for Biomedical Computing created by the U.S. National Institutes of Health (NIH). He is principal investigator of the Center for Expanded Data Annotation and Retrieval (CEDAR). CEDAR is a center of excellence supported by the NIH Big Data to Knowledge Initiative, with the goal of developing new technology to ease the authoring and management of biomedical experimental metadata. Dr. Musen chaired the Health Informatics and Modeling Topic Advisory Group for the World Health Organization's revision of the International Classification of Diseases (ICD-11) and he currently directs the WHO Collaborating Center for Classification, Terminology, and Standards at Stanford University.

Early in his career, Dr. Musen received the Young Investigator Award for Research in Medical Knowledge Systems from the American Association of Medical Systems and Informatics and a Young Investigator Award from the National Science Foundation. In 2006, he was recipient of the Donald A. B. Lindberg Award for Innovation in Informatics from the American Medical Informatics Association. He has been elected to the American College of Medical Informatics, the Association of American Physicians, the International Academy of Health Sciences Informatics, and the National Academy of Medicine. He is founding co-editor-in-chief of the journal Applied Ontology.

#### ACADEMIC APPOINTMENTS

- Professor, Medicine - Biomedical Informatics Research
- Professor, Biomedical Data Science
- Member, Bio-X

#### ADMINISTRATIVE APPOINTMENTS

- Deputy Director for Bioinformatics, Immune Tolerance Network, (2005-2007)
- Head, Stanford Center for Biomedical Informatics Research, (1992- present)
- Co-Editor-in-Chief, Applied Ontology: An International Journal of Ontological Analysis and Conceptual Modeling, (2005-2016)
- Principal Investigator, National Center for Biomedical Ontology, (2005- present)

- Principal Investigator, Center for Expanded Data Annotation and Retrieval, (2014- present)

## HONORS AND AWARDS

- Elected member, International Academy of Health Sciences Informatics (2017)
- Elected member, National Academy of Medicine (2016)
- "Ten Year Award" for the most influential paper presented at ISWC, ten years previously, Semantic Web Science Association (2014)
- General Chair, Association for Computing Machinery Conference on Knowledge Capture (K-Cap '11) (2011)
- Elected member, Association of American Physicians (2010)
- Donald A. B. Lindberg Award for Innovation in Informatics, American Medical Informatics Association (2006)
- General Chair, International Semantic Web Conference (2005)
- Chair, Scientific Program Committee, American Medical Informatics Association Annual Symposium (2003)
- Elected member, American Society for Clinical Investigation (1997)
- NSF Young Investigator Award, National Science Foundation (1992)
- Elected Fellow, American College of Medical Informatics (1989)
- Young Investigator Award for Research in Medical Knowledge Systems, American Association for Medical Systems and Informatics (1989)

## BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Chair, Health Informatics and Modeling Topic Advisory Group, ICD Revision Steering Group, World Health Organization (2008 - 2016)
- Member, National Advisory Council on Biomedical Imaging and Bioengineering (2011 - 2015)

## PROGRAM AFFILIATIONS

- Symbolic Systems Program

## PROFESSIONAL EDUCATION

- Postdoctoral fellow, Erasmus University, Rotterdam , Medical Informatics (1988)
- Ph.D., Stanford University , Medical Information Sciences (1988)
- Residency, Stanford University Hospital , Internal Medicine (1983)
- M.D., Brown University , Medicine (1980)
- Sc.B., Brown University , Biology (1977)

## LINKS

- The Center for Expanded Data Annotation and Retrieval: <http://metadatascenter.org>
- The National Center for Biomedical Ontology: <http://bioontology.org>
- The Protégé resource: <http://protege.stanford.edu>

## Research & Scholarship

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### CURRENT RESEARCH AND SCHOLARLY INTERESTS

Semantic technology, which makes explicit the knowledge that drives computational systems, offers great opportunities to advance biomedical science and clinical medicine. Our laboratory studies the use of semantic technology in a range of application systems.

The Center for Expanded Data Annotation and Retrieval (CEDAR) investigates new computational approaches that use semantic technology to ease the creation of metadata to describe scientific experiments. Metadata are data about data—machine-interpretable descriptions of experimental data, of the methods used to acquire

the data, of the analyses that have been performed on the data, and of the provenance of all this information. Science suffers because much of the metadata that investigators create to annotate the datasets that they archive in public repositories are incomplete and nonstandardized. CEDAR studies new methods to assist the ahoring of high-quality metadata. The goal is to improve the dissemination of scientific data and to ensure that online datasets are "explained" by rich metadata that can be interpreted by both humans and computers. The long-term goal is to aid the dissemination of scientific knowledge in machine-processable form and to create intelligent agents that can help scientists to track experimental results online, to integrate datasets, and to use public data repositories to make new discoveries.

We see CEDAR as the first step in the development of a new kind of technology to change the way in which scientific knowledge is communicated—not as prose journal articles but as computer-interpretable data and metadata. Automated systems one day will access such online "publications" to augment the capabilities of human scientists as they seek information about relevant studies and as they attempt to relate their own results to those of other investigators.

Our laboratory has pioneered methods for the development of intelligent systems. An important element of this work has involved the use of ontologies—formal descriptions of application areas that are created in a form that can be processed by both people and computers. CEDAR uses ontologies to ensure that scientific metadata are represented in a standardized way. Our Protégé system for ontology development—now with more than 300,000 registered users—allows us to continue to explore new methods for ontology engineering and for the construction of intelligent systems.

## Teaching

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### COURSES

#### 2018-19

- Biomedical Informatics Student Seminar: BIOMEDIN 201 (Win, Spr, Sum)
- Digital Health Practicum in a Health Care Delivery System: BIOMEDIN 226 (Aut, Win, Spr, Sum)
- Modeling Biomedical Systems: Ontology, Terminology, Problem Solving: BIOMEDIN 210, CS 270 (Win)

#### 2017-18

- Biomedical Informatics Student Seminar: BIOMEDIN 201 (Aut, Win, Spr, Sum)
- Digital Health Practicum in a Health Care Delivery System: BIOMEDIN 226 (Aut, Spr)
- Modeling Biomedical Systems: Ontology, Terminology, Problem Solving: BIOMEDIN 210, CS 270 (Win)
- Seminar on Linking Open Data and Knowledge Graphs - Methods and Challenges: BIOMEDIN 274 (Spr)

#### 2016-17

- Biomedical Informatics Student Seminar: BIOMEDIN 201 (Aut, Win, Spr, Sum)
- Computational Methods for the Modern Biologist: BIOMEDIN 227SI (Sum)
- Modeling Biomedical Systems: Ontology, Terminology, Problem Solving: BIOMEDIN 210, CS 270 (Win)

#### 2015-16

- Biomedical Informatics Student Seminar: BIOMEDIN 201 (Aut, Win, Spr, Sum)
- Modeling Biomedical Systems: Ontology, Terminology, Problem Solving: BIOMEDIN 210, CS 270 (Win)

### GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Biomedical Informatics (Masters Program)
- Biomedical Informatics (Phd Program)
- Health Services Research (Masters Program)
- Medicine (Masters Program)

## Publications

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### PUBLICATIONS

- **The variable quality of metadata about biological samples used in biomedical experiments.** *Scientific data*  
Goncalves, R. S., Musen, M. A.  
2019; 6: 190021
- **Interpretation of biological experiments changes with evolution of the Gene Ontology and its annotations** *SCIENTIFIC REPORTS*  
Tomczak, A., Mortensen, J. M., Winnenbunrg, R., Liu, C., Alessi, D. T., Swamy, V., Vallania, F., Lofgren, S., Haynes, W., Shah, N. H., Musen, M. A., Khatri, P.  
2018; 8: 5115
- **The center for expanded data annotation and retrieval.** *Journal of the American Medical Informatics Association*  
Musen, M. A., Bean, C. A., Cheung, K., Dumontier, M., Durante, K. A., Gevaert, O., Gonzalez-Beltran, A., Khatri, P., Kleinstein, S. H., O'Connor, M. J., Pouliot, Y., Rocca-Serra, P., Sansone, et al  
2015; 22 (6): 1148-1152
- **The Protégé Project: A Look Back and a Look Forward.** *AI matters*  
Musen, M. A.  
2015; 1 (4): 4-12
- **The National Center for Biomedical Ontology** *JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION*  
Musen, M. A., Noy, N. F., Shah, N. H., Whetzel, P. L., Chute, C. G., Story, M., Smith, B.  
2012; 19 (2): 190-195
- **PhLeGrA: Graph Analytics in Pharmacology over the Web of Life Sciences Linked Open Data** *International Conference on World Wide Web*  
Kamdar, M. R., Musen, M.  
: 321–29
- **BiOnIC: A Catalog of User Interactions with Biomedical Ontologies** *International Semantic Web Conference*  
Kamdar, M. R., Walk, S., Tudorache, T., Musen, M. A.  
: 130–38
- **The CAIRR Pipeline for Submitting Standards-Compliant B and T Cell Receptor Repertoire Sequencing Studies to the National Center for Biotechnology Information Repositories** *FRONTIERS IN IMMUNOLOGY*  
Bukhari, S., O'Connor, M. J., Martinez-Romero, M., Egyedi, A. L., Willrett, D., Graybeal, J., Musen, M. A., Rubelt, F., Cheung, K., Kleinstein, S. H.  
2018; 9
- **CEDAR OnDemand: a browser extension to generate ontology-based scientific metadata** *BMC BIOINFORMATICS*  
Bukhari, S., Martinez-Romero, M., Connor, M., Egyedi, A. L., Willrett, D., Graybeal, J., Musen, M. A., Cheung, K., Kleinstein, S. H.  
2018; 19: 268
- **Analyzing user interactions with biomedical ontologies: A visual perspective** *JOURNAL OF WEB SEMANTICS*  
Kamdar, M. R., Walk, S., Tudorache, T., Musen, M. A.  
2018; 49: 16–30
- **AgroPortal: A vocabulary and ontology repository for agronomy** *COMPUTERS AND ELECTRONICS IN AGRICULTURE*  
Jonquet, C., Toulet, A., Arnaud, E., Aubin, S., Yeumo, E., Emonet, V., Graybeal, J., Laporte, M., Musen, M. A., Pesce, V., Larmande, P.  
2018; 144: 126–43
- **The CAIRR Pipeline for Submitting Standards-Compliant B and T Cell Receptor Repertoire Sequencing Studies to the National Center for Biotechnology Information Repositories.** *Frontiers in immunology*  
Bukhari, S. A., O'Connor, M. J., Martínez-Romero, M., Egyedi, A. L., Willrett, D., Graybeal, J., Musen, M. A., Rubelt, F., Cheung, K. H., Kleinstein, S. H.  
2018; 9: 1877
- **How Sustainable are Biomedical Ontologies?** *AMIA ... Annual Symposium proceedings. AMIA Symposium*  
Geller, J., Keloth, V. K., Musen, M. A.  
2018; 2018: 470–79
- **An ontology-driven tool for structured data acquisition using Web forms** *JOURNAL OF BIOMEDICAL SEMANTICS*

- Goncalves, R. S., Tu, S. W., Nyulas, C. I., Tierney, M. J., Musen, M. A.  
2017; 8: 26
- **NCBO Ontology Recommender 2.0: an enhanced approach for biomedical ontology recommendation.** *Journal of biomedical semantics*  
Martínez-Romero, M., Jonquet, C., O'Connor, M. J., Graybeal, J., Pazos, A., Musen, M. A.  
2017; 8 (1): 21-?
  - **An Empirical Analysis of Ontology Reuse in BioPortal.** *Journal of biomedical informatics*  
Ochs, C., Perl, Y., Geller, J., Arabandi, S., Tudorache, T., Musen, M. A.  
2017
  - **Use of Ontology Structure and Bayesian Models to Aid the Crowdsourcing of ICD-11 Sanctioning Rules.** *Journal of biomedical informatics*  
Lou, Y., Tu, S. W., Nyulas, C., Tudorache, T., Chalmers, R. J., Musen, M. A.  
2017
  - **A systematic analysis of term reuse and term overlap across biomedical ontologies** *SEMANTIC WEB*  
Kamdar, M. R., Tudorache, T., Musen, M. A.  
2017; 8 (6): 853-71
  - **The New HIT: Human Health Information Technology**  
Leung, T. I., Goldstein, M. K., Musen, M. A., Cronkite, R., Chen, J. H., Gottlieb, A., Leitersdorf, E., Gundlapalli, A. V., Jaulent, M. C., Zhao, D.  
IOS PRESS.2017: 768-72
  - **PhLeGrA: Graph Analytics in Pharmacology over the Web of Life Sciences Linked Open Data.** *Proceedings of the ... International World-Wide Web Conference. International WWW Conference*  
Kamdar, M. R., Musen, M. A.  
2017; 2017: 321-29
  - **BiOnIC: A Catalog of User Interactions with Biomedical Ontologies.** *The semantic Web--ISWC ... : ... International Semantic Web Conference ... proceedings. International Semantic Web Conference*  
Kamdar, M. R., Walk, S., Tudorache, T., Musen, M. A.  
2017; 10588: 130-38
  - **High-Risk Drug-Drug Interactions Between Clinical Practice Guidelines for Management of Chronic Conditions.** *AMIA Joint Summits on Translational Science proceedings. AMIA Joint Summits on Translational Science*  
Tso, G. J., Tu, S. W., Musen, M. A., Goldstein, M. K.  
2017; 2017: 531-39
  - **Precision annotation of digital samples in NCBI's gene expression omnibus.** *Scientific data*  
Hadley, D., Pan, J., El-Sayed, O., Aljabban, J., Aljabban, I., Azad, T. D., Hadied, M. O., Raza, S., Rayikanti, B. A., Chen, B., Paik, H., Aran, D., Spatz, et al  
2017; 4: 170125
  - **Fast and Accurate Metadata Authoring Using Ontology-Based Recommendations.** *AMIA ... Annual Symposium proceedings. AMIA Symposium*  
Martinez-Romero, M., O'Connor, M. J., Shankar, R. D., Panahiazar, M., Willrett, D., Egyedi, A. L., Gevaert, O., Graybeal, J., Musen, M. A.  
2017; 2017: 1272-81
  - **Mechanism-based Pharmacovigilance over the Life Sciences Linked Open Data Cloud.** *AMIA ... Annual Symposium proceedings. AMIA Symposium*  
Kamdar, M. R., Musen, M. A.  
2017; 2017: 1014-23
  - **A unified software framework for deriving, visualizing, and exploring abstraction networks for ontologies.** *Journal of biomedical informatics*  
Ochs, C., Geller, J., Perl, Y., Musen, M. A.  
2016; 62: 90-105
  - **Utilizing a structural meta-ontology for family-based quality assurance of the BioPortal ontologies.** *Journal of biomedical informatics*  
Ochs, C., He, Z., Zheng, L., Geller, J., Perl, Y., Hripcsak, G., Musen, M. A.  
2016; 61: 63-76
  - **Utilizing a structural meta-ontology for family-based of the BioPortal ontologies** *JOURNAL OF BIOMEDICAL INFORMATICS*  
Ochs, C., He, Z., Zheng, L., Geller, J., Perl, Y., Hripcsak, G., Musen, M. A.  
2016; 61: 63-76

- **Is the crowd better as an assistant or a replacement in ontology engineering? An exploration through the lens of the Gene Ontology.** *Journal of biomedical informatics*  
Mortensen, J. M., Telis, N., Hughey, J. J., Fan-Minogue, H., Van Auken, K., Dumontier, M., Musen, M. A.  
2016; 60: 199-209
- **An Open Repository Model for Acquiring Knowledge About Scientific Experiments**  
O'Connor, M. J., Martnez-Romero, M., Egyedi, A. L., Willrett, D., Graybeal, J., Musen, M. A., Blomqvist, E., Ciancarini, P., Poggi, F., Vitali, F.  
SPRINGER INT PUBLISHING AG.2016: 762–77
- **Snap-SPARQL: A Java Framework for Working with SPARQL and OWL**  
Horridge, M., Musen, M., Tamma, Dragoni, M., Goncalves, R., Lawrynowicz, A.  
SPRINGER INT PUBLISHING AG.2016: 154–65
- **How to apply Markov chains for modeling sequential edit patterns in collaborative ontology-engineering projects** *INTERNATIONAL JOURNAL OF HUMAN-COMPUTER STUDIES*  
Walk, S., Singer, P., Strohmaier, M., Helic, D., Noy, N. F., Musen, M. A.  
2015; 84: 51-66
- **Investigating Term Reuse and Overlap in Biomedical Ontologies.** *CEUR workshop proceedings*  
Kamdar, M. R., Tudorache, T., Musen, M. A.  
2015; 1515
- **Analysis and Prediction of User Editing Patterns in Ontology Development Projects.** *Journal on data semantics*  
Wang, H., Tudorache, T., Dou, D., Noy, N. F., Musen, M. A.  
2015; 4 (2): 117-132
- **Using the wisdom of the crowds to find critical errors in biomedical ontologies: a study of SNOMED CT.** *Journal of the American Medical Informatics Association*  
Mortensen, J. M., Minty, E. P., Januszyk, M., Sweeney, T. E., Rector, A. L., Noy, N. F., Musen, M. A.  
2015; 22 (3): 640-648
- **Data breaches of protected health information in the United States.** *JAMA*  
Liu, V., Musen, M. A., Chou, T.  
2015; 313 (14): 1471-1473
- **Using ontologies to model human navigation behavior in information networks: A study based on Wikipedia.** *Semantic web*  
Lamprecht, D., Strohmaier, M., Helic, D., Nyulas, C., Tudorache, T., Noy, N. F., Musen, M. A.  
2015; 6 (4): 403–22
- **Applied ontology: The next decade begins** *APPLIED ONTOLOGY*  
Guarino, N., Musen, M.  
2015; 10 (1): 1–4
- **Understanding How Users Edit Ontologies: Comparing Hypotheses About Four Real-World Projects**  
Walk, S., Singer, P., Noboa, L., Tudorache, T., Musen, M. A., Strohmaier, M., Arenas, M., Corcho, O., Simperl, E., Strohmaier, M., DAquin, M., Srinivas, K., Groth, et al  
SPRINGER INT PUBLISHING AG.2015: 551–68
- **User Extensible System to Identify Problems in OWL Ontologies and SWRL Rules**  
Orlando, J., Musen, M. A., Moreira, D. A., Bassiliades, N., Gottlob, G., Sadri, F., Paschke, A., Roman, D.  
SPRINGER-VERLAG BERLIN.2015: 112–26
- **Using Aggregate Taxonomies to Summarize SNOMED CT Evolution**  
Ochs, C., Perl, Y., Geller, J., Musen, M., Huan, J., Miyano, S., Shehu, A., Hu, Ma, B., Rajasekaran, S., Gombar, V. K., Schapranow, I. M., Yoo, I. H., et al  
IEEE.2015: 1008–15
- **Ten years of Applied Ontology** *APPLIED ONTOLOGY*  
Guarino, N., Musen, M. A.  
2015; 10 (3-4): 169–70

- **Helping Users Bootstrap Ontologies: An Empirical Investigation**  
Zhang, Y., Tudorache, T., Horridge, M., Musen, M. A., Assoc Comp Machinery  
ASSOC COMPUTING MACHINERY.2015: 3395–98
- **Toward a science of learning systems: a research agenda for the high-functioning Learning Health System** *JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION*  
Friedman, C., Rubin, J., Brown, J., Buntin, M., Corn, M., Etheredge, L., Gunter, C., Musen, M., Platt, R., Stead, W., Sullivan, K., Van Houweling, D.  
2015; 22 (1): 43-50
- **A Method to Compare ICF and SNOMED CT for Coverage of U.S. Social Security Administration's Disability Listing Criteria.** *AMIA ... Annual Symposium proceedings / AMIA Symposium. AMIA Symposium*  
Tu, S. W., Nyulas, C. I., Tudorache, T., Musen, M. A.  
2015; 2015: 1224-1233
- **Automating Identification of Multiple Chronic Conditions in Clinical Practice Guidelines.** *AMIA Joint Summits on Translational Science proceedings AMIA Summit on Translational Science*  
Leung, T. I., Jalal, H., Zulman, D. M., Dumontier, M., Owens, D. K., Musen, M. A., Goldstein, M. K.  
2015; 2015: 456-460
- **Using ontologies to model human navigation behavior in information networks: A study based on Wikipedia** *SEMANTIC WEB*  
Lamprecht, D., Strohmaier, M., Helic, D., Nyulas, C., Tudorache, T., Noy, N. F., Musen, M. A.  
2015; 6 (4): 403-422
- **Discovering Beaten Paths in Collaborative Ontology-Engineering Projects using Markov Chains** *JOURNAL OF BIOMEDICAL INFORMATICS*  
Walk, S., Singer, P., Strohmaier, M., Tudorache, T., Musen, M. A., Noy, N. F.  
2014; 51: 254-271
- **WebProtégé: a collaborative Web-based platform for editing biomedical ontologies.** *Bioinformatics*  
Horridge, M., Tudorache, T., Nyulas, C., Vendetti, J., Noy, N. F., Musen, M. A.  
2014; 30 (16): 2384-2385
- **Cross-domain targeted ontology subsets for annotation: The case of SNOMED CORE and RxNorm.** *Journal of biomedical informatics*  
López-García, P., LePendu, P., Musen, M., Illarramendi, A.  
2014; 47: 105-111
- **Investigating Collaboration Dynamics in Different Ontology Development Environments** *7th International Conference on Knowledge Science, Engineering and Management (KSEM)*  
Rospocher, M., Tudorache, T., Musen, M. A.  
SPRINGER-VERLAG BERLIN.2014: 302–313
- **Knowledge Representation** *METHODS IN BIOMEDICAL INFORMATICS: A PRAGMATIC APPROACH*  
Musen, M. A., Sarkar, I. N.  
2014: 49–79
- **Organizational factors affecting implementation of the ATHENA-Hypertension clinical decision support system during the VA's nation-wide information technology restructuring: a case study** *Health System*  
Shluzas, L. M., Cronkite, R. C., Hoffman, B. B., Breeling, J., Musen, M. A., Owens, D. K., Goldstein, M. K.  
2014
- **An empirically derived taxonomy of errors in SNOMED CT.** *AMIA ... Annual Symposium proceedings / AMIA Symposium. AMIA Symposium*  
Mortensen, J. M., Musen, M. A., Noy, N. F.  
2014; 2014: 899-906
- **A Study on the Atomic Decomposition of Ontologies** *13th International Semantic Web Conference (ISWC)*  
Horridge, M., Mortensen, J. M., Parsia, B., Sattler, U., Musen, M. A.  
SPRINGER INT PUBLISHING AG.2014: 65–80
- **How ontologies are made: Studying the hidden social dynamics behind collaborative ontology engineering projects** *JOURNAL OF WEB SEMANTICS*  
Strohmaier, M., Walk, S., Poeschko, J., Lamprecht, D., Tudorache, T., Nyulas, C., Musen, M. A., Noy, N. F.  
2013; 20: 18-34

- **The knowledge acquisition workshops: A remarkable convergence of ideas** *INTERNATIONAL JOURNAL OF HUMAN-COMPUTER STUDIES*  
Musen, M. A.  
2013; 71 (2): 195-199
- **WebProtege: A collaborative ontology editor and knowledge acquisition tool for the Web** *SEMANTIC WEB*  
Tudorache, T., Nyulas, C., Noy, N. F., Musen, M. A.  
2013; 4 (1): 89-99
- **BioPortal as a Dataset of Linked Biomedical Ontologies and Terminologies in RDF.** *Semantic web*  
Salvadores, M., Alexander, P. R., Musen, M. A., Noy, N. F.  
2013; 4 (3): 277-84
- **How Ontologies are Made: Studying the Hidden Social Dynamics Behind Collaborative Ontology Engineering Projects.** *Web semantics (Online)*  
Strohmaier, M., Walk, S., Pöschko, J., Lamprecht, D., Tudorache, T., Nyulas, C., Musen, M. A., Noy, N. F.  
2013; 20
- **PragmatiX: An Interactive Tool for Visualizing the Creation Process Behind Collaboratively Engineered Ontologies.** *International journal on Semantic Web and information systems*  
Walk, S., Pöschko, J., Strohmaier, M., Andrews, K., Tudorache, T., Noy, N. F., Nyulas, C., Musen, M. A.  
2013; 9 (1): 45-78
- **BioPortal as a dataset of linked biomedical ontologies and terminologies in RDF** *SEMANTIC WEB*  
Salvadores, M., Alexander, P. R., Musen, M. A., Noy, N. F.  
2013; 4 (3): 277-284
- **Analysis of User Editing Patterns in Ontology Development Projects** *On The Move (OTM) Federated International Conference*  
Wang, H., Tudorache, T., Dou, D., Noy, N. F., Musen, M. A.  
SPRINGER-VERLAG BERLIN.2013: 470-487
- **Getting Lucky in Ontology Search: A Data-Driven Evaluation Framework for Ontology Ranking** *12th International Semantic Web Conference (ISWC)*  
Noy, N. F., Alexander, P. R., Harpaz, R., Whetzel, P. L., Fergerson, R. W., Musen, M. A.  
SPRINGER-VERLAG BERLIN.2013: 444-459
- **WebProtégé: A Collaborative Ontology Editor and Knowledge Acquisition Tool for the Web.** *Semantic web*  
Tudorache, T., Nyulas, C., Noy, N. F., Musen, M. A.  
2013; 4 (1): 89-99
- **Using Semantic Web in ICD-11: Three Years Down the Road** *12th International Semantic Web Conference (ISWC)*  
Tudorache, T., Nyulas, C. I., Noy, N. F., Musen, M. A.  
SPRINGER-VERLAG BERLIN.2013: 195-211
- **Simplified OWL Ontology Editing for the Web: Is WebProtege Enough?** *12th International Semantic Web Conference (ISWC)*  
Horridge, M., Tudorache, T., Vendetti, J., Nyulas, C. I., Musen, M. A., Noy, N. F.  
SPRINGER-VERLAG BERLIN.2013: 200-215
- **Crowdsourcing the verification of relationships in biomedical ontologies.** *AMIA ... Annual Symposium proceedings / AMIA Symposium. AMIA Symposium*  
Mortensen, J. M., Musen, M. A., Noy, N. F.  
2013; 2013: 1020-1029
- **PragmatiX: An Interactive Tool for Visualizing the Creation Process Behind Collaboratively Engineered Ontologies** *INTERNATIONAL JOURNAL ON SEMANTIC WEB AND INFORMATION SYSTEMS*  
Walk, S., Poeschko, J., Strohmaier, M., Andrews, K., Tudorache, T., Noy, N. F., Nyulas, C., Musen, M. A.  
2013; 9 (1): 45-78
- **Chapter 9: Analyses Using Disease Ontologies** *PLOS COMPUTATIONAL BIOLOGY*  
Shah, N. H., Cole, T., Musen, M. A.  
2012; 8 (12)
- **AMIA Board white paper: definition of biomedical informatics and specification of core competencies for graduate education in the discipline** *JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION*



- Kulikowski, C. A., Shortliffe, E. H., Currie, L. M., Elkin, P. L., Hunter, L. E., Johnson, T. R., Kalet, I. J., Lenert, L. A., Musen, M. A., Ozbolt, J. G., Smith, J. W., Tarczy-Hornoch, P. Z., Williamson, et al  
2012; 19 (6): 931-938
- **Unified Medical Language System term occurrences in clinical notes: a large-scale corpus analysis** *JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION*  
Wu, S. T., Liu, H., Li, D., Tao, C., Musen, M. A., Chute, C. G., Shah, N. H.  
2012; 19 (E1): E149-E156
  - **Applications of ontology design patterns in biomedical ontologies.** *AMIA ... Annual Symposium proceedings / AMIA Symposium. AMIA Symposium*  
Mortensen, J. M., Horridge, M., Musen, M. A., Noy, N. F.  
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