

**Biomedical Informatics at UConn Storrs and UCHC Farmington**  
**Prof. Steven A. Demurjian and Thomas Agresta**  
**steven.demurjian@uconn.edu and agresta@uchc.edu**  
**Current Ph.D. Students: David Etim, Zion Emmanuel and Timo Ziminski**  
**Recently Completed Ph.D. Students: Yaira K. Rivera-Sanchez, Eugene Sanzi, Mohammed Baihan,**  
**Alberto De La Rosa Algarin, and Rishi Sariapalle Knath**

**Ongoing Research in Biomedical Informatics on Access Control and Cloud Computing using FHIR**

The healthcare domain can be seen as an emergent application for cloud computing, in which the Meaningful Use Stage 3 guidelines recommend any health information technology (HIT) system to provide cloud services that enable health-related data owners to access, modify, and exchange such data. This requires mobile and desktop applications for patients and medical providers to obtain health information from multiple HITs, that may be operating with different paradigms (e.g., cloud services, programming services, web services), use different cloud service providers, and employ different security/access control techniques. Health Information Exchange (HIE) provides a more complete health record of an individual that improves patient care with relevant data gathered from multiple health information technology (HIT) systems. In support of HIE, the Health Level Seven (HL7) XML standard was developed to manage, exchange, integrate, and retrieve electronic health information. In 2011, HL7 began drafting a next-generation standard, Fast Healthcare Interoperability Resources (FHIR), to facilitate the development and interaction of mobile health (mHealth) apps, HIT data sharing, and common format for information modeling. FHIR is based on RESTful APIs and supported by a FHIR server infrastructure that facilitates the exchange in a cloud computing setting. FHIR while possessing a security specification, has yet to define and identify actual security mechanisms for secure data exchange via RESTful API calls. The need to develop mobile applications and services has dramatically increased in the marketplace, with the Gartner group forecasting the business demand for new and diverse mobile applications by the end of 2017 will grow five times larger than the ability of a typical IT organization to deliver. The HL7 Fast Healthcare Interoperability Resources (FHIR) standard is designed to enable interoperability and integration with the newest and adopted technologies by the industry. This is facilitated via a FHIR server that provides a RESTful CRUD services to access an HIT system. In support of this broad area, we are conducting work with complementary foci:

- **A Mobile Health Application for Medication Reconciliation:** This work is currently underway (Agresta, Demurjian, Sanzi) [II] which involves Medication Reconciliation which is one of the most critical aspects of patient care that needs to be achieved at the earliest stages of the diagnostic process which is hampered by the fact that a patient's medications might be located in multiple HIT systems such as electronic health records (EHRs) (at physician offices, hospitals, clinics, etc.) and pharmacy systems. The intent of the proposed work is to provide a mechanism that will offer patients in medical providers a Best Possible Medication History (BPMH). Our expectation of participating in ABCT is to transition the proof of concept prototype that was developed in the recent contract towards a alpha/beta product through process of user Center design via stakeholders that include patients, medical providers, home health practitioners, visiting nurses, etc. The intent is to develop both a mobile health application that has a back and server with the programmatic algorithm able to take medications for a given patient from multiple sources and before medication reconciliation in order to return a Best Possible Medication History (BPMH). The server portion of medication reconciliation and it's associated algorithm will be invertible into electronic health record products using the Smart on FHIR framework (<https://docs.smarthealthit.org/>).
- **Lattice-Based Access Control (LBAC) to Control Healthcare Data:** This work is currently underway (Demurjian, Agresta) [I] utilizes our prior work [V] on multi-level security for healthcare that we developed and explore alternative approaches to integrate this approach into *Fast Healthcare Interoperability Resources (FHIR)*. FHIR provides structures for sharing EHR data between healthcare providers. Data is accessed through *resources* utilizing a location URL as part of a REST API in conjunction with a logical ID. This allows data that resources describe to sync between separate FHIR systems. We focus on the FHIR *base* resources (e.g., patients, practitioners, and family relationships; organizations, services, appointments, and encounters) and *clinical resources* which are for a patient's health history. Note that these alternative approaches are described at the specification level of the FHIR resources and not from an implementation perspective.
- **Role-Based Access Control (RBAC) for Mobile Computing:** Our initial work in this area (Rivera Sanchez and Demurjian 2016) focused on user authorization requirements for mobile computing that then led work on the incorporation of API-based role-based access control (RBAC) (Rivera Sanchez, et al., 2016) in a mobile application and its server/database. In (Rivera Sanchez, et al., 2017), we incorporate role-based access control (RBAC) into FHIR to support the ability to control access of who can call which services of FHIR RESTful APIs that manage sensitive healthcare data. The work was demonstrated utilizing a mHealth application that communicates with the OpenEMR electronic health record via the HAPI FHIR server.
- **Blueprints of Architectural Design for Integrating mHealth Apps with HITs via FHIR:** This work (Baihan, et al., 2017) presents a number of blueprints for the design and development of FHIR servers that enable the integration between HIT systems with mHealth applications via FHIR. Each blueprint is based on the location that FHIR servers can be placed with respect to the components of the mHealth application (UI, API, Server) or a HIT system in order to define and design the necessary infrastructure to facilitate the exchange of information via FHIR. To demonstrate the feasibility of the work, this chapter utilizes the Connecticut Concussion Tracker (CT<sup>2</sup>) mHealth application as a proof-

**Biomedical Informatics at UConn Storrs and UCHC Farmington**  
**Prof. Steven A. Demurjian and Thomas Agresta**  
**steven.demurjian@uconn.edu and agresta@uchc.edu**  
**Current Ph.D. Students: David Etim, Zion Emmanuel and Timo Ziminski**  
**Recently Completed Ph.D. Students: Yaira K. Rivera-Sanchez, Eugene Sanzi, Mohammed Baihain,**  
**Alberto De La Rosa Algarin, and Rishi Sariapalle Knath**

of-concept prototype that fully illustrates the blueprints of the design and development steps that are involved. The blueprints can be applied to any mHealth application and are informative and instructional for medical stakeholders, researchers, and developers.

- **Framework for Secure and Interoperable Cloud Computing:** The effort reported in (Baihan and Demurjian, 2017) supports a global security policy and enforcement mechanism access to cloud services with role-based, discretionary, and mandatory access controls. To support interoperability and exchange of healthcare data, the Health Level 7 (HL7) standards organization has proposed the Fast Healthcare Interoperability Resources (FHIR) which models healthcare data with XML or JSON schemas in a set of 93 resources to track a patient's clinical findings, problems, allergies, adverse events, history, suggested physician orders, care planning, etc. For each resource, a FHIR CRUD RESTful Application Program Interface (API) is defined to share data in a common format for each of the HITs that can then be easily accessible by mobile applications. In such a context, there is a need to support with a heterogeneous set of information sources and differing security protocols (such as role-based, mandatory, and discretion access control). To demonstrate the realization of FSICC, the framework has been applied to the integration of the Connecticut Concussion Tracker (CT<sup>2</sup>) mHealth application with the OpenEMR electronic medical record utilizing FHIR.
- **Adaptive Trust Negotiation for Time-Critical Access to Healthcare Data:** *Adaptive trust negotiation* (Sanzi, et al., 2016) in a mobile environment is a means to dynamically adjust security parameters based on the level of trust established during the negotiation process thereby enhancing mobile security via a *trust profile* that contains a proof of history of successful access to sensitive data to facilitate identification and authentication that requests data from a server where no relationship between the user and server has previously existed as a result of trust negotiation. Using that as a basis, our recent work (Sanzi and Demurjian 2017) proposed a new model of trust negotiation using role-based and attribute-based access control that defines a new trust profile that contains a collection of credentials describing the user's access history. As a result of our work, an authorization system based on trust negotiation can examine the user's history in detail, decide whether to authorize the user, and add its own record of user access to the user's trust profile that can be utilized in future attempts at access at other locations. As a proof of concept, our work has been integrated into the Connecticut Concussion Tracker (CT<sup>2</sup>) mobile application and server.
- **Spatio-Situation-Based Access Control Model for Dynamic Permissions:** Medical providers often give care in multiple locations in a given day. For example, a physician using a mHealth app to access patient data may move from his office EHR to a hospital EHR across the street to a clinic's EHR in a neighboring town etc. When the physician moves to a location far enough away for differentiation via GPS, a dynamic adjustment by time and space (spatio) could be utilized to prohibit access to the office EHR while allowing access to the hospital EHR. To address these and other issues our effort (Shao, et al. 2016) presented a Spatio-Situation-Based Access Control (SSBAC) model that extends RBAC to secure sensitive data for mobile applications with the ability to make dynamic authorization decisions according to the time/location and the particular situation being encountered by a user. The SSBAC model allows authorizations to be defined based on a combination of: the actual time that a user is utilizing a mobile application, the physical location of the user, and/or the activities that a user is performing (situation). As a result, the mobile application can dynamically adjust in terms of the information that is accessible/prohibited.
- **Large-Scale Architectural Alternatives for HIE:** In this work, the problem involves adoption of health information systems and the integration of healthcare data and systems into efficient cross-institutional collaboration workflows of stakeholders (e.g., medical providers such as physicians, hospitals, clinics, labs, etc.) which is a challenging problem for the healthcare domain. Our first work in this effort (Ziminski, et al., 2015) studied the way that well-established software engineering architectural styles can be employed to satisfy requirements of the healthcare domain and ease health information exchange (HIE) between stakeholders. Towards this goal, work proposed a hybrid HIE architecture (HHIEA) that leverages the studied styles that include service-oriented architecture, grid computing, publish/subscribe paradigm, and data warehousing to allow the health information systems of stakeholders to be integrated to facilitate collaboration among medical providers. To demonstrate the feasibility and utility of HHIEA, a realistic regional healthcare scenario in introduced that illustrates the interactions of stakeholders across an integrated collection of health information system. Ongoing work is extending the work to include the assessment and utilization of FHIR.

**Biomedical Informatics at UConn Storrs and UCHC Farmington**  
**Prof. Steven A. Demurjian and Thomas Agresta**  
**steven.demurjian@uconn.edu and agresta@uchc.edu**  
**Current Ph.D. Students: David Etim, Zion Emmanuel and Timo Ziminski**  
**Recently Completed Ph.D. Students: Yaira K. Rivera-Sanchez, Eugene Sanzi, Mohammed Baihan,**  
**Alberto De La Rosa Algarin, and Rishi Sariapalle Knath**

## Publications

Related to healthcare since 2009, S. Demurjian and T. Agresta have 17 publications (I to XVII) with other colleagues and undergraduate and graduate students and S. Demurjian as an additional 33 publications (XVIII to L) with other colleagues, undergraduates and graduate students. Publications that are relevant to this proposed ABCT in medication reconciliation are [II, XLII], healthcare interoperability architectures [III, VI, XIV, XII] lattice-based access control for fine grained access to healthcare data [I, V], adaptive trust that negotiation for mobile health applications [X, XVIII, XXVIII, XXVIII, XXX] access control for mobile health applications [IV, IX, XXI, XXII, XXVI, XXVIII, XXXI], access control for cloud computing applications usable for the FHIR standard [VII, VIII, XXII, XXIV], XML-based access control for healthcare standards such as HL7 [XXIX, XXXV, XXXVII, XL, XLI, XLIII], semantics and ontology design and development for healthcare [XIII, XXV, XXXIII, XXXVI, XXXVIII, XLIV-XLVIII], and collaborative security for healthcare [XVI, XVII, XXXII, XXXIV, XLVIII].

## Publications Related to the Healthcare Domain with T. Agresta

- I. Demurjian, S., Sanzi, E., Agresta, T., and DeStefano, J., "Alternative Approaches for Supporting Lattice-Based Access Control (LBAC) in the Fast Healthcare Interoperability Resources (FHIR) Standard," *16<sup>th</sup> International Conference on Web Information Systems and Technologies, WEBIST 2020*, November 2020.
- II. Demurjian, S., Agresta, T., Sanzi, E., DeStefano, J., Ward-Charlerie, S., Rusnak, R., and Tran, R., "A Mobile Health Application for Medication Reconciliation Using RxNorm and FHIR," *HEALTHINFO 2020*, July 2020.
- III. Ziminski, T., Demurjian, S., Sanzi, E., Baihan, M. and Agresta, T., "Chapter 14: An Architectural Solution for Health Information Exchange," in *Virtual and Mobile Healthcare: Breakthroughs in Research and Practice*, Information Resources Management Association (USA), pp. 283-327, July 2020. <https://www.igi-global.com/gateway/chapter/235317>
- IV. K. Rivera Sánchez, Y., Demurjian, S., Conover, J., Agresta, T., Shao, X., and Diamond, Michael, "Chapter 13: Role-Based Access Control for Mobile Computing and Applications," in *Information Diffusion Management and Knowledge Sharing: Breakthroughs in Research and Practice*, Information Resources Management Association (USA), IGI, pp. 253-276, July 2020. <https://www.igi-global.com/gateway/chapter/242134>
- V. Demurjian, S., Sanzi, E., Agresta, T., and Yasnoff, W., "Multi-Level Security in Healthcare using a Lattice-Based Access Control Model," *IGI International Journal of Privacy and Health Information Management (IJPHIM)*, Vol. 7, No. 1, January-June 2019, pp. 80-102, IGI Global, <https://www.igi-global.com/article/multi-level-security-in-healthcare-using-a-lattice-based-access-control-model/219296>
- VI. Ziminski, T., Demurjian, S., Sanzi, E., Baihan, M. and Agresta, T., "An Architectural Solution for Health Information Exchange," *International Journal of User-Driven Healthcare (IJUDH)*, Vol 6, No. 1, pp. 65-103, November 2016, IGI Global, <https://www.igi-global.com/article/an-architectural-solution-for-health-information-exchange/181318>
- VII. Baihan, M., K. Rivera Sánchez, Y., Shao, X., Gilman, C., Demurjian, S., and Agresta, T., "A Blueprint for Designing and Developing an mHealth Application for Diverse Stakeholders Utilizing Fast Healthcare Interoperability Resources", in *Contemporary Applications of Mobile Computing in Healthcare Settings*, R. Rajkumar (ed.), IGI Global. <https://www.igi-global.com/chapter/a-blueprint-for-designing-and-developing-m-health-applications-for-diverse-stakeholders-utilizing-fhir/204693>, pp. 85-124, January 2018.
- VIII. Baihan, M., Demurjian, S., Rivera Sanchez, Y.K., Toris, A., Franzis, A., Onofrio, A., Cheng, B., And Agresta, T. "Role-Based Access Control for Cloud Computing Realized within HAPI FHIR," *Proceedings of 16<sup>th</sup> WWW/Internet 2017 Conference*, October 2017.
- IX. K. Rivera Sánchez, Y., Demurjian, S., Conover, J., Agresta, T., Shao, X., and Diamond, Michael, "[An Approach for Role-Based Access Control in Mobile Applications](http://www.igi-global.com/book/mobile-application-development-usability-security/154083)". Chapter 6 in *Mobile Application Development, Usability, and Security*, S. Mukherja (ed.), IGI Global. November 2016. <http://www.igi-global.com/book/mobile-application-development-usability-security/154083>
- X. Sanzi, E., Demurjian, S., Agresta, T., and Murphy, A., "[Trust Profiling to Enable Adaptive Trust Negotiation in Mobile Devices](http://www.igi-global.com/book/mobile-application-development-usability-security/154083)". Chapter 5 in *Mobile Application Development, Usability, and Security*, S. Mukherja (ed.), IGI Global. November 2016. <http://www.igi-global.com/book/mobile-application-development-usability-security/154083>
- XI. Shao, X., Demurjian, S., and Agresta, T., "[Spatio-Situation-Based Access Control Model for Dynamic Permissions on Mobile Applications](http://www.igi-global.com/book/mobile-application-development-usability-security/154083)." Chapter 7 in *Mobile Application Development, Usability, and Security*, S. Mukherja (ed.), IGI Global, November 2016. <http://www.igi-global.com/book/mobile-application-development-usability-security/154083>
- XII. Ziminski, T., Demurjian, S., Sanzi, E. and Agresta, T., "Toward Integrating Healthcare Data and Systems: A Study of Architectural", Chapter 16 in *Maximizing Healthcare Delivery and Management through Technology Integration*, T. Iyamu and D. Tatnall (eds.), pp 270-304, September 2015, <http://www.igi-global.com/chapter/toward-integrating-healthcare-data-and-systems/137590>

## Biomedical Informatics at UConn Storrs and UCHC Farmington

Prof. Steven A. Demurjian and Thomas Agresta

steven.demurjian@uconn.edu and agresta@uchc.edu

Current Ph.D. Students: David Etim, Zion Emmanuel and Timo Ziminski

Recently Completed Ph.D. Students: Yaira K. Rivera-Sanchez, Eugene Sanzi, Mohammed Baihan, Alberto De La Rosa Algarin, and Rishi Sariapalle Knath

- XIII. Sariapalle, Demurjian, Blechner, Agresta, “HOD2MLC: Hybrid Ontology Design & Development Model with Lifecycle,” *International Journal of Information Technology and Web Engineering (IJITWE)*, Vol. 10, No. 2, pp 16-42, June 2015, <http://www.igi-global.com/article/hod2mlc/138293> and <http://www.igi-global.com/journals/abstract-announcement/11846>.
- XIV. Demurjian, S., De La Rosa Algarin, A., Bi, J, Berhe, S., Agresta, T., Wang, X., Blechner, M., “A Viewpoint of Security for Digital Health Care: What's There? What Works? What's Needed?” in *International Journal of Privacy and Health Information Management (IJPHIM)*, 2(1), pp 1-21, December 2014: <http://www.igi-global.com/article/a-viewpoint-of-security-for-digital-health-care-in-the-united-states/120113>. Article also published as Chapter 62 in: *E-Health and Telemedicine: Concepts, Methodologies, Tools, and Applications (3 Volumes)*, Information Resources Management Association, IGI, 2016: <http://www.igi-global.com/book/health-telemedicine-concepts-methodologies-tools/127616>.
- XV. Crowell, R., Agresta, T., Cook, M., Fifield, J., Demurjian, S., Carter, S., Becerra-Ortiz, I., Vegad, S., and Polineni, K., “Chapter 39: Using a Collaborative Web Portal for Making Health Information Technology (HIT) Decisions,” in *Handbook of Research on Web 2.0, 3.0 and X.0: Technologies, Business and Social Applications*, a volume of the *Advances in E-Business Research Series*, S. Murugesan (ed.), IGI Global, Apr. 2010, pp. 862-698.
- XVI. Berhe, S., Demurjian, S., S Knath ariapalle, R., Agresta, T., Liu, J., Cusano, A., Fequiere, A, and Gedarovich, J., “Secure, Obligated and Coordinated Collaboration in Health Care for the Patient-Centered Medical Home,” in *Proceedings of AMIA 2010 Annual Symposium*, November 2010.
- XVII. Berhe, S., Demurjian, S., and Agresta, T. “Emerging Trends in Health Care Delivery: Towards Collaborative Security for NIST RBAC,” in *Research Directions in Data and Applications Security XXIII*, E. Gudes and J. Viadya (eds.), LNCS 5645, Springer, July 2009, pp. 283-290.

### Other Healthcare Publications of S. Demurjian

- XXVIII. Sanzi, E. and Demurjian, S., “Trust Profile Based Trust Negotiation for the FHIR Standard,” *Proceedings of 9th International Conference on Data Science, Technologies, and Applications (DATA2020)*, July 2020.
- XIX. El Guemhioui, K. and Demurjian, S., “Chapter 29: Semantic Reconciliation of Electronic Health Records Using Semantic Web Technologies,” in *Data Analytics in Medicine: Concepts, Methodologies, Tools, and Applications(4 Volumes)*, M. Khosrow-Pour, S. Clarke, M. E. Jennex, A.-V. Anttiroiko (eds.), pp. 528-550, January 2020. <https://www.igi-global.com/chapter/semantic-reconciliation-of-electronic-health-records-using-semantic-web-technologies/243131>
- XX. K. Rivera Sánchez, Y. and Demurjian, S., “Chapter 62: Towards User Authentication Requirements for Mobile Computing,” in *Data Analytics in Medicine: Concepts, Methodologies, Tools, and Applications(4 Volumes)*, M. Khosrow-Pour, S. Clarke, M. E. Jennex, A.-V. Anttiroiko (eds.), pp. 1254-1282, January 2020. <https://www.igi-global.com/chapter/towards-user-authentication-requirements-for-mobile-computing/243165>
- XXI. K. Rivera Sánchez, Y., Demurjian, S., and Baihan, M., “A service-based RBAC & MAC approach incorporated into the FHIR standard,” *Digital Communications and Networks*, Vol. 5., No. 4, pp. 214-225, November 2019, Elsevier.
- XXII.K. Rivera Sánchez, Y., Demurjian, S., and Gnirke, L., “Attaining Role-Based, Mandatory, and Discretionary Access Control for Services by Intercepting API Calls in Mobile Systems,” In: Majchrzak T., Traverso P., Krempels KH., Monfort V. (eds) *Web Information Systems and Technologies. WEBIST 2017. Lecture Notes in Business Information Processing*, Vol. 322, June 2018, pp. 221-248, Springer. [https://link.springer.com/chapter/10.1007/978-3-319-93527-0\\_11#citeas](https://link.springer.com/chapter/10.1007/978-3-319-93527-0_11#citeas)
- XXIII. Baihan, M. and Demurjian, S., (2017). “An Access Control Framework for Secure and Interoperable Cloud Computing Applied to the Healthcare Domain,” in *Research Advances in Cloud Computing*, Chaudhary, Sanjay, Somani, Gaurav, Buyya, Rajkumar (Eds.), Springer
- XXIV. Baihan, M., Demurjian, S., Rivera Sanchez, Y.K., Toris, A., Franzis, A., Onofrio, A., Cheng, B., And Agresta, T. “Role-Based Access Control for Cloud Computing Realized within HAPI FHIR,” *Proceedings of 16<sup>th</sup> WWW/Internet 2017 Conference*, October 2017.
- XXV. El Guemhioui, K. and Demurjian, S., “Semantic Reconciliation of Electronic Health Records Using Semantic Web Technologies”, *International Journal of Information Technology and Web Engineering(IJITWE)*, Vol. 12, No. 2, pp. 26-48, IGI Global, April-June 2017. <https://www.igi-global.com/article/semantic-reconciliation-of-electronic-health-records-using-semantic-web-technologies/176907>
- XXVI. Rivera Sánchez, Y., K. Demurjian, S., and Baihan, M. “Achieving RBAC on RESTful APIs for Mobile Apps using FHIR,” *Proceedings of 5<sup>th</sup> IEEE International Conference on Mobile Cloud Computing, Services, and Engineering, IEEE Mobile Cloud 2017*, <http://www.mobile-cloud.net/>, April 2017.
- XXVII. Sanzi, E., S. A. Demurjian, S., and Billings, J., “Integrating Trust Profiles, Trust Negotiation, and Attribute Based Access Control,” *Proceedings of International Workshop on The Security, Privacy, and Digital Forensics of Mobile Cloud (SeMoCloud 2017)*, <http://www.mobile-cloud.net/workshop-cfp>, April 2017.

**Biomedical Informatics at UConn Storrs and UCHC Farmington**

**Prof. Steven A. Demurjian and Thomas Agresta**

**steven.demurjian@uconn.edu and agresta@uchc.edu**

**Current Ph.D. Students: David Etim, Zion Emmanuel and Timo Ziminski**

**Recently Completed Ph.D. Students: Yaira K. Rivera-Sanchez, Eugene Sanzi, Mohammed Baihan, Alberto De La Rosa Algarin, and Rishi Sariapalle Knath**

- XXVIII. K. Rivera Sánchez, Y., and Demurjian, S., Baihan, M., Gnirke, L., “An Intercepting API-based Access Control Approach for Mobile Applications”, in *Proceedings of 13<sup>th</sup> International Conference on Web Information Systems and Technologies, WEBIST 2017*, April 2017, Porto, Portugal, <http://www.webist.org/>
- XXIX. De La Rosa Algarin, A., and Demurjian, S “Extending the UML Standards to Model Tree-Structured Data and their Access Control Requirement”, *Proc. of SSR 2016: Security Standardisation Research*, NIST, Gaithersburg, MD, December 2016.
- XXX. Sanzi, E. and Demurjian, S., “Identification and Adaptive Trust Negotiation in Interconnected Systems,” Chapter 2 in *Innovative Solutions for Access Control Management*, A. Malik, A. Anjum, and B. Raza (eds.), (pages 33-65), May 2016. <http://www.igi-global.com/book/innovative-solutions-access-control-management/146981>
- XXXI. K. Rivera Sánchez, Y. and Demurjian, S., “Towards User Authentication Requirements for Mobile Computing,” Chapter 6 in *Innovative Solutions for Access Control Management*, A. Malik, A. Anjum, and B. Raza (eds.), (pages 160-196), May 2016. <http://www.igi-global.com/book/innovative-solutions-access-control-management/146981>
- XXXII. Berhe, S., Demurjian, S., Pavlich-Mariscal, J., Saripalle, R., and De la Rosa Algarin, A., “Leveraging UML for Access Control Engineering in a Collaboration on Duty and Adaptive Workflow Model that Extends NIST RBAC,” Chapter 4 in *Innovative Solutions for Access Control Management*, A. Malik, A. Anjum, and B. Raza (eds.), (pages 96-124), May 2016. <http://www.igi-global.com/book/innovative-solutions-access-control-management/146981>
- XXXIII. Sariapalle, Demurjian, Blechner, Agresta, “HOD2MLC: Hybrid Ontology Design & Development Model with Lifecycle,” *International Journal of Information Technology and Web Engineering (IJITWE)*, Vol. 10, No. 2, pp 16-42, June 2015, <http://www.igi-global.com/article/hod2mlc/138293> and <http://www.igi-global.com/journals/abstract-announcement/11846>.
- XXXIV. Pavlich-Mariscal, J., Berhe, S., De La Rosa Algarin, A. and Demurjian, S., “Chapter 15: An Integrated Secure Software Engineering Approach for Functional, Collaborative, and Information Concerns,” in *State-of-the-Art Concepts and Future Directions in Software Engineering*, IGI Global, I. Ghani, M. Kadir, and M. Ahmad (eds.), December 2014, pp 330-368, <http://www.igi-global.com/book/handbook-research-emerging-advancements-technologies/97389>
- XXXV. De La Rosa Algarin, A., Ziminski, T., Demurjian, S., Rivera Sanchez, Y. K., “Generating XACML Enforcement Policies for Role-Based Access Control of XML Documents,” in *Web Information Systems and Technologies, Revised Selected Papers*, Lecture Notes in Business Information Processing, Springer-Verlag, Vol. 189, September 2014, pp 21-36 [link.springer.com/chapter/10.1007%2F978-3-662-44300-2\\_2](http://link.springer.com/chapter/10.1007%2F978-3-662-44300-2_2)
- XXXVI. Knath Sariapalle, R. and Demurjian, S., “Attaining Semantic Interoperability through Ontology Architectural Patterns”, in: *Revolutionizing Enterprise Interoperability through Scientific Foundations*, Y. Charalabidis, F. Lampathaki, and R. Jardim-Goncalves (eds.), IGI Global, February 2014, Chapter 10, pp. 216-251. Book: <http://www.igi-global.com/book/revolutionizing-enterprise-interoperability-through-scientific/90542> Article <http://www.igi-global.com/chapter/attaining-semantic-enterprise-interoperability-through-ontology-architectural-patterns/101112>
- XXXVII. De La Rosa Algarin, A. and Demurjian, S., “An Approach to Facilitate Security Assurance for Information Sharing and Exchange in Big Data Applications,” in *Emerging Trends in Information and Communication Technologies Security*, B. Akhgar and H. Arabnia (eds.), Elsevier, Chapter 4, pg. 65-83. February 2014. Book: <http://www.sciencedirect.com/science/book/9780124114746> Article: <http://www.sciencedirect.com/science/article/pii/B9780124114746000049>
- XXXVIII. Knath Sariapalle, R., Demurjian, S., De La Rosa Algarin, A., and Blechner, M., “A Software Modeling Approach to Ontology Design via Extensions to ODM and OWL,” *International Journal On Semantic Web and Information Systems*, 9 (2), pp. 62-97, December 2013, see: Journal: <http://www.igi-global.com/journal/international-journal-semantic-web-information/1092> Article: <http://www.igi-global.com/article/a-software-modeling-approach-to-ontology-design-via-extensions-to-odm-and-owl/94599>
- XXXIX. De La Rosa Algarin, A., Demurjian, S., Ziminski, T., Rivera Sanchez, Y. K., and Kuykendall, R., “Chapter 13: Securing XML with Role-Based Access Control: Case Study in Health Care,” in *Architectures and Protocols for Secure Information Technology*, pp. 334-365, A. Ruiz-Martínez, F. Pereñíguez-García and R. Marín-López (eds.), IGI Global, September 2013, see: Book: <http://www.igi-global.com/book/architectures-protocols-secure-information-technology/76712> Article: <http://www.igi-global.com/chapter/securing-xml-with-role-based-access-control/78879> . Article also published as Chapter 25 in: *E-Health and Telemedicine: Concepts, Methodologies, Tools, and Applications (3 Volumes)*, Information Resources Management Association, IGI, 2016: <http://www.igi-global.com/book/health-telemedicine-concepts-methodologies-tools/127616>.
- XL. Demurjian, S., De La Rosa Algarin, A., and Saripalle, R., “Granular Computing, Information Models for,” in *Encyclopedia of Complexity and Systems Science*, R. Meyers (Editor-in-Chief), Granular Computing Section, T. Y. Lin (ed.), revision and substantial update of June 2009 article Springer, July 2013, <http://www.springerreference.com/docs/mypage/book61.html> for *Encyclopedia* and see: <http://www.springerreference.com/docs/html/chapterdbid/60424.html> for article; online pub only.

**Biomedical Informatics at UConn Storrs and UCHC Farmington**

**Prof. Steven A. Demurjian and Thomas Agresta**

**steven.demurjian@uconn.edu and agresta@uchc.edu**

**Current Ph.D. Students: David Etim, Zion Emmanuel and Timo Ziminski**

**Recently Completed Ph.D. Students: Yaira K. Rivera-Sanchez, Eugene Sanzi, Mohammed Baihain,  
Alberto De La Rosa Algarin, and Rishi Sariapalle Knath**

- XXI. De La Rosa Algarin, A., Ziminski, T., Demurjian, S., Kuykendall, R., and Rivera Sanchez, Y. K., "Defining and Enforcing XACML Role-Based Security Policies within an XML Security Framework", *Proc. of the 9th Intl. Conf. on Web Information Systems and Technologies (WEBIST2013)*, May 2013.
- XLII. Ziminski, T., De La Rosa Algarin, A., Knath Sariapalle, R., and Demurjian, S., "SMARTSync: Towards Patient-Driven Medication Reconciliation Using the SMART Framework", *Proc. of 2012 Intl. Wksp. on Biomedical and Health Informatics (BHI 2012)*, October 2012.
- XLIII. De La Rosa Algarin, A., Demurjian, S., Berhe, S., Pavlich-Mariscal "A Security Framework for XML Schemas and Documents for Healthcare", *Proc. of 2012 Intl. Wksp. on Biomedical and Health Informatics (BHI 2012)*, October 2012.
- XLIV. Blechner, M., Knath Sariapalle, R., and Demurjian, S., "A Proposed Star Schema and Extraction Process to Enhance the Collection of Contextual and Semantic Information for Clinical Research Data Warehouses" *Proc. of 2012 Intl. Wksp. on Biomedical and Health Informatics (BHI 2012)*, October 2012.
- XLV. Knath Sariapalle, R., and Demurjian, S., "Towards a Hybrid Ontology Design and Development Life Cycle". *Proc. of 11th Intl. Conf. on Semantic Web and Web Services (SWWS12)*, July 2012.
- XLVI. Knath Sariapalle, R., and Demurjian, S., "Semantic Patterns using OWL Domain Profile". *Proc. of 11th Intl. Conf. on Information and Knowledge Engineering (IKE12)*, July 2012.
- XLVII. Knath Sariapalle, R. Knath, Demrjian, S., and Berhe, S., "Towards a Software Design Process for Ontologies," *Proc. of 2011 Intl. Conf. on Software and Intelligent Information (ICSII 2011)*, October 2011.
- XLVIII. Berhe, S., Demurjian, S., Gokhale, S., Saripalle, R., and Pavlich-Mariscal, J., "Leveraging UML for Security Engineering and Enforcement in a Collaboration on Duty and Adaptive Workflow Model That Extends NIST RBAC," in *Research Directions in Data and Applications Security XXV*, Y. Li (ed.), LNCS 6818, Springer, July 2011, pp. 293-300.
- XLIX. Sanzi, E. and Demurjian, S., "Trust Profile Based Trust Negotiation for the FHIR Standard," *Proceedings of 9th International Conference on Data Science, Technologies, and Applications (DATA2020)*, July 2020.
- L. Demurjian, S., Knath Sariapalle, R., and Berhe, S., "An Integrated Ontology Framework for Health Information Exchange," *Proceedings of 21<sup>st</sup> International Conference on Software Engineering and Knowledge Engineering (SEKE09)*, pp. 575-580, July 2009.

**Biomedical Informatics at UConn Storrs and UCHC Farmington**  
**Prof. Steven A. Demurjian and Thomas Agresta**  
**steven.demurjian@uconn.edu and agresta@uchc.edu**  
**Current Ph.D. Students: David Etim, Zion Emmanuel and Timo Ziminski**  
**Recently Completed Ph.D. Students: Yaira K. Rivera-Sanchez, Eugene Sanzi, Mohammed Baihain,**  
**Alberto De La Rosa Algarin, and Rishi Sariapalle Knath**

1. De La Rosa Algarin, A., Ziminski, T., Demurjian, S., Kuykendall, R., and Rivera Sanchez, Y. K., "Defining and Enforcing XACML Role-Based Security Policies within an XML Security Framework", *Proc. of the 9th Intl. Conf. on Web Information Systems and Technologies (WEBIST2013)*, May 2013.
2. De La Rosa Algarin, A., Demurjian, S., Berhe, S., Pavlich-Mariscal "A Security Framework for XML Schemas and Documents for Healthcare", *Proc. of 2012 Intl. Wksp. on Biomedical and Health Informatics (BHI 2012)*, October 2012.

**Other Biomedical Publications:**

3. Ziminski, T., Demurjian, S., Sanzi, E., Agresta, T., "Toward Integrating Healthcare Data and Systems: A Study of Architectural", Chapter 16 in *Maximizing Healthcare Delivery and Management through Technology Integration*, T. Iyamu and D. Tatnall (eds.), (pages 270-304), September 2015, <http://www.igi-global.com/chapter/toward-integrating-healthcare-data-and-systems/137590>
4. Knath Sariapalle, R. and Demurjian, S., "Attaining Semantic Interoperability through Ontology Architectural Patterns", in: *Revolutionizing Enterprise Interoperability through Scientific Foundations*, Y. Charalabidis, F. Lampathaki, and R. Jardim-Goncalves (eds.), IGI Global, February 2014, Chapter 10, pp. 216-251. Book: <http://www.igi-global.com/book/revolutionizing-enterprise-interoperability-through-scientific/90542> Article <http://www.igi-global.com/chapter/attaining-semantic-enterprise-interoperability-through-ontology-architectural-patterns/101112>
5. Berhe, S., Demurjian, S., Pavlich-Mariscal, J., Sariapalle, R., and De la Rosa Algarin, A., "Leveraging UML for Access Control Engineering in a Collaboration on Duty and Adaptive Workflow Model that Extends NIST RBAC," Chapter 4 in *Innovative Solutions for Access Control Management*, A. Malik, A. Anjum, and B. Raza (eds.), (pages 96-124), May 2016. <http://www.igi-global.com/book/innovative-solutions-access-control-management/146981>
6. Blechner, M., Knath Sariapalle, R., and Demurjian, S., "A Proposed Star Schema and Extraction Process to Enhance the Collection of Contextual and Semantic Information for Clinical Research Data Warehouses" *Proc. of 2012 Intl. Wksp. on Biomedical and Health Informatics (BHI 2012)*, October 2012.
7. Ziminski, T. , De La Rosa Algarin, A., Knath Sariapalle, R., and Demurjian, S., "SMARTSync: Towards Patient-Driven Medication Reconciliation Using the SMART Framework", *Proc. of 2012 Intl. Wksp. on Biomedical and Health Informatics (BHI 2012)*, October 2012.
8. Knath Sariapalle, R., and Demurjian, S., "Towards a Hybrid Ontology Design and Development Life Cycle". *Proc. of 11th Intl. Conf. on Semantic Web and Web Services (SWWS12)*, July 2012.
9. Knath Sariapalle, R., and Demurjian, S., "Semantic Patterns using OWL Domain Profile". *Proc. of 11th Intl. Conf. on Information and Knowledge Engineering (IKE12)*, July 2012.
10. Knath Sariapalle, R. Knath, Demurjian, S., and Berhe, S., "Towards a Software Design Process for Ontologies," *Proc. of 2011 Intl. Conf. on Software and Intelligent Information (ICSII 2011)*, October 2011.
11. Berhe, S., Demurjian, S., S Knath ariapalle, R., Agresta, T., Liu, J., Cusano, A., Fequiere, A, and Gedarovich, J., "Secure, Obligated and Coordinated Collaboration in Health Care for the Patient-Centered Medical Home," in *Proceedings of AMIA 2010 Annual Symposium*, November 2010.