

Curriculum Vitae – Larry Fennigkoh, Ph.D., P.E., CCE

B. H. Barkalow & Associates, LLC
65 West State Rd., Suite C
Newaygo, Michigan 49337-8129
231-652-2228 (phone)
231-652-2299 (fax)
www.bhbi.com
Info@bhbi.com

Educational Background:

Ph.D. Industrial Engineering (human factors & biomechanics)	University of Wisconsin, Milwaukee Milwaukee, Wisconsin	1995
M.S. Engineering Management	Milwaukee School of Engineering Milwaukee, Wisconsin	1986
B.S. Electrical Engineering Technology	Milwaukee School of Engineering Milwaukee, Wisconsin	1974
A.A.S. Electronic Communications	Milwaukee School of Engineering Milwaukee, Wisconsin	1974

Continuing Education:

International Nursing Association for Clinical Simulation & Learning – Orlando, FL, 2014
Symposium on Human Factors and Ergonomics in Healthcare – Baltimore, MD, 2013
AAMI Medical Device Alarms Summit – Herndon, VA, 2011
Undersea and Hyperbaric Medicine Society – Milwaukee, WI, 2010
American Academy of Forensic Sciences – San Antonio, TX, 2007
Great Lakes Biomedical Conference – Racine, WI, 1999-2013, 2015
Integrating Design in the Engineering Curriculum – Dallas, TX, 2003
Medical Device Design – Minneapolis, MN, 2003
National Center for Medical Rehabilitation Research – Rockville, MD, 2001
Research to Aid Persons with Disabilities – Washington, DC, 2001
American Society for Engineering Education – St. Louis, MO, 2000
American Society of Biomechanics – Pittsburgh, PA, 1999
Annual meetings of the Association for the Advancement of Medical Instrumentation – 1978-2010, 2015
Annual meetings of IEEE Engineering in Medicine & Biology Society, 1982-1995
Annual meetings of the American Society for Hospital Engineering, 1982-1995

Curriculum Vitae – Larry Fennigkoh, Ph.D., P.E., CCE

Registration / Certification:

Professional Engineer (electrical), Wisconsin
Certified in Clinical Engineering

Professional Experience:

2015 to Present: [*B. H. Barkalow & Associates, LLC*](#), Newaygo, MI. **Clinical Engineering Fact Expert** for hospitals, medical device companies, legal firms, insurance carriers, Federal Food and Drug Administration (FDA), and other biomedical engineering consultants or firms.

1998 to Present: [*Milwaukee School of Engineering*](#), Milwaukee, WI. **Professor, Biomedical Engineering.** Faculty member within the Electrical Engineering & Computer Science department teaching undergraduate and graduate courses in medical instrumentation, biomedical engineering design, biomechanics, biostatistics, electrical circuits, and human physiology. Institutional Review Board member. Adjunct teaching appointment from 1983-1997.

- Chaired or committee member on over 40 Master of Science theses in Perfusion or Cardiovascular Sciences Program.
- Short Course on Medical Instrumentation and Physiology – developed and teach an annual, 4 ½-day course for biomedical engineers and technicians. 2006-2011.
- Visiting Professor – Technological University of Monterrey, Chihuahua, Mexico – Seminar in Neurophysiology and Biomedical engineering, March 2009.

2007-2012: [*Robson Forensic, Inc.*](#), Lancaster, PA. **Biomedical and Electrical Engineering Expert Consultant.** Provided technical investigations, failure analysis, reports, and testimony towards the resolution of commercial and personal injury litigation involving medical devices, systems, and consumable products from scientific, engineering, and clinical perspectives.

Summer 2006-Present: [*Medical College of Wisconsin*](#), Milwaukee, WI. Teach a summer course on Biostatistics and the Design of Experiments to the department's Ph.D. students.

Spring 2005: [*Marquette University*](#), Milwaukee, WI. Taught a one semester senior / graduate level course in Biomedical Instrumentation Design within the Biomedical Engineering Department.

1982-1997: [*Aurora St. Luke's Medical Center*](#), Milwaukee, WI. **Director, Clinical Engineering.** Responsible for directing and managing a 54-person technical support department. Oversaw the maintenance, installation, and management of virtually all: diagnostic, therapeutic, and imaging technologies; non-clinical equipment and systems; telecommunications, computer equipment, and network infrastructure. Further involved in the testing, evaluation, and selection of new equipment; investigation of equipment-related incidents; equipment modifications; service contract management; and biomedical engineering student internship programs.

1978-1982: [*University of Nebraska Medical Center*](#), Omaha, NE. **Director, Biomedical**

Curriculum Vitae – Larry Fennigkoh, Ph.D., P.E., CCE

Instrumentation. Directed and managed a technical staff of 18 responsible for clinical and non-clinical equipment repair and maintenance, product evaluation, and extensive support of biomedical research.

Other full and part-time positions between 1974 and 1978 have included:

Adjunct Instructor - University of Nebraska, College of Engineering & Technology

Head, Clinical Engineering - Lakeland Hospital - Elkhorn, WI

Consulting Experience:

Consultant: Aurora St. Luke's Medical Center – Hyperbaric Medicine Dept. Evaluation and testing of medical devices for use in hyperbaric environments, October 2014-Present.

Consultant: Design & development of an ultra-low force measuring mechanical stimulator and precision positioning system for mechanoreceptor research. Department of Cell Biology, Neurobiology & Anatomy, Medical College of Wisconsin, January-October 2014.

Consultant: Fatal outcome involving an infant during a CPAP titration study, May 2014.

Consultant: FDA 510(k)-required testing and performance analysis for a new cardiopulmonary resuscitation assist device, March 2013.

Consultant: Failure of an Automated External Defibrillator, March 2014.

Expert Witness: Ventilator-related infant death (plaintiff), November 2012.

Expert Witness: Personal injury involving infusion pump free-flow incident (defense), June 2011-February 2012.

Consultant: Electrical performance testing for a novel Ag-AgCl automated external defibrillator electrode, October 2012.

Consultant: Product evaluation of a child's electric toothbrush for potential overheating issues. Equipment manufacturer, June 2011.

Expert Witness: Fatal outcome involving a cardiopulmonary heart-lung bypass machine (defense), May 2011-January 2012.

Expert Witness: Fatal outcome involving an insulin pump administration set (plaintiff), January 2011-May 2011.

Expert Witness: Fatal air embolism delivered by radiographic contrast injector (plaintiff), April 2011-December 2011.

Expert Witness: Fatal complication due to a ventilator disconnect (defense), December 2010.

Expert Witness: Fatal outcome involving an interpretive electrocardiograph (plaintiff), October 2010-2012.

Electrical Engineering Consultant: Product evaluation – explosion potential from an underground piezoelectric soil compaction sensor. Equipment manufacturer (WI), March 2010.

Expert Witness: Urethrorectal fistula during a transurethral microwave therapy treatment of the prostate (defense), December 2009.

Expert Witness: Fatal fall from a reclining wheelchair (plaintiff), December 2009-September

Curriculum Vitae – Larry Fennigkoh, Ph.D., P.E., CCE

2010.

Expert Witness: Non-freezing cold injury to the knee (plaintiff), November 2009.

Expert Witness: Fatal complication from a laparoscopic burn (plaintiff). August 2009-May 2011.

Consultant: Evaluation of an alleged insulin pump failure (plaintiff), June 2009.

Consultant: Evaluation of biphasic defibrillator waveforms. Aurora Healthcare, June 2009.

Expert Witness: Biomechanical evaluation of a surgical hand piece for the delivery of RF energy to the skin (defense), March 2009-July 2010.

Expert Witness: Hyperthermia-related death involving an over-heated air mattress (plaintiff), July 2008-October 2010.

Expert Witness: Alleged ventilator-related infant death (plaintiff), April 2008-January 2009.

Electrical Engineering Consultant – Hyperbaric wound care facility - Aurora St. Luke's Medical Center, October 2007-July 2009.

Expert Witness: Taser-related death, (plaintiff), September 2006-2007.

Expert Witness: Biomechanical analysis and comparison of ankle braces, (plaintiff), December 2003-March 2004.

Evaluation of a gravity-compensating IV flow controller (medical device manufacturer), March 2003.

Consultant: Evaluation of an explosives timing device designed by terrorists: (Federal public defender, Seattle, WA), February 2001.

Evaluation & Report: Laboratory equipment maintenance & calibration program. Milwaukee, WI, January 2001-March 2001.

Expert Witness: Phacoemulsifier equipment failure, (plaintiff), November, 1999-October 2002.

Expert Witness: Evaluation of patient exam table failure, (defense), March 1998.

Ergonomic evaluation & report: Assembly line and work-related injuries analysis, General Motors Truck Division, Janesville, WI, March-April 1995.

Expert Witness: Implantable infusion pump catheter failure, (plaintiff), March 1992.

Expert Witness: Pressure-induced skin injury, (plaintiff), June 1990.

Program evaluation & report: Medical Equipment Maintenance Options, (hospital), August 1987.

Consultant: Review of the hazards, incidents, and recalls associated with surgical bone drills & burs, (defense), March 1987.

Report & Presentation: Establishing a shared-biomedical services division, (materials management organization), November 1985.

Product evaluation & report: Pre-market assessment of a disposable blood pressure transducer, (medical equipment manufacturer), November 1985.

Expert Witness: Patient burn from an electrosurgical unit, (plaintiff), July 1982.

Curriculum Vitae – Larry Fennigkoh, Ph.D., P.E., CCE

Funded Research:

MSOE Faculty Development Grant – Design and development of a pneumo / hemothorax simulator for chest tube drainage training with patient simulation manikins. June-September, 2014.

Physics and biomechanics of golf putting. June 2006 – May 2009.

National Science Foundation, No. 81028, Co-principal investigator – Undergraduate design projects to aid persons with disabilities. 1999-2001.

Professional Affiliations and Activities:

Member, [Association for the Advancement of Medical Instrumentation](#) (AAMI)
Editorial Board Member, *Biomedical Instrumentation & Technology* (2000-Present)
Board of Directors Nominating Committee Member (2009-2012)

Treasurer & Founding Member, [American College of Clinical Engineering](#) (ACCE) (1990-1992); member (2015-Present)

Member, [Institute of Electrical & Electronic Engineers](#) (IEEE) / [Engineering in Medicine & Biology Society](#)

Member, [American Society for Engineering Education](#)

Board Member, [Healthcare Technology Certification Commission](#) (2014-Present)

Member, International Nursing Association for Clinical Simulation & Learning (2014)

Editorial Board, *Journal of Ergonomics* (2011-2013)

Fellow, American Institute for Medical and Biological Engineering (2009)

Board Member, Healthcare Technology Foundation (2009-2011)

Member, Undersea and Hyperbaric Medicine Society (2010-2011)

Director, IEEE Milwaukee Section (1987-1990)

National Chairman, IEEE Engineering in Medicine & Biology Standards Committee (1982-1987)

Chairman, Milwaukee Section IEEE EMBS (1985-1986)

Evaluator, Accreditation Board of Engineering & Technology (1988-1991)

Member, Clinical Engineering Board of Examiners, Intl. Certification Commission (1989-1992)

Publications:

Fennigkoh, L. (2015) Invited presentation: The complexities of the patient-machine interface: human factors challenges for autonomous medical devices. FDA Public Workshop on Physiological Closed-loop Controlled Devices. October. Silver Springs, MD.

Fennigkoh, L. (2015) Managing medical equipment risks. In J.D. Bronzino and D.R. Peterson (eds.), *The Biomedical Engineering Handbook*, 4th ed. Boca Raton, FL: CRC Press.

Curriculum Vitae – Larry Fennigkoh, Ph.D., P.E., CCE

- Fennigkoh, L. (2014) Human factors and forensic engineering in the control of medical error. MD Expo, Orlando, FL.
- Cohen, B.; Fennigkoh, L.; Borowicz, J.K.; Hassemer, E. (2014) Biomedical engineering ethics and professional responsibility career imperative. Is it legal? Is it ethical? IEEE EMBS Annual Meeting, Chicago, IL.
- Fennigkoh, L.; Paige, J.; Raczynski, K.; Schuster, J. (2014) A pressurized and wireless-activated urinary bladder and bleeding device. 13th Annual Conference of the International Nursing Association for Clinical Simulation & Learning, Lake Buena Vista, FL.
- Ridgway, M.; Fennigkoh, L. (2014) Metrics for equipment-related patient safety. *Biomedical Instrumentation & Technology*, 2014 May/June; 48(3): 197-200.
- Fennigkoh, L. (2013) Visual, perceptual and cognitive factors in human-computer interface design and use. *Biomedical Instrumentation & Technology*, AAMI Horizons special issue on Information Technology in Healthcare. 2013 Fall; Suppl: 18-23.
- Fennigkoh, L. (2010) Human factors and device design in the control of medical error. Florida International Medical Expo, Miami, FL.
- Fennigkoh, L. (2011) The complexities of the human-medical device interface: issues affecting device use and safety. *Biomedical Instrumentation & Technology*, 2011 Jan/Feb; 45(1): 39-43.
- Fennigkoh, L.; D. Haro (2009) Human factors and the control of medical device-related error. *Beyond Bits*, 4th ed. – Freescale Semiconductor. 2009 May; 39-43.
- Fennigkoh, L. (2008) Letter to the Editor, re: How a taser works. *IEEE Spectrum*, 2007 Dec; 45(1): 32.
- Fennigkoh, L. (2007) Letter to the Editor, re: MRI evaluation of the contralateral breast in women with recently diagnosed breast cancer. *New England Journal of Medicine*, 2007 July 12; 357(2): 191-193.
- Gassert, J.D.; Blessing, J.; Schmedeman, L.; Fennigkoh, L. (2007) Converting engineering faculty to educators of entrepreneurs. ASEE Annual Meeting, Honolulu, Hawaii.
- Blessing, J.; Gassert, J.D.; Schmedeman, L.; Fennigkoh, L. (2007) Integrating entrepreneurship into an already ambitious curricula through a collaboration of business and engineering programs. ASEE Annual Meeting, Honolulu, Hawaii.
- Fennigkoh, L. (2005) Human factors and the control of medical error. *Biomedical Instrumentation & Technology*, 2005 Jul/Aug; 39(4): 307-312.
- Fennigkoh, L. (2004) Cost-effectiveness and productivity. In J.F. Dyro (ed.) *Clinical Engineering Handbook*. Amsterdam: Elsevier Academic Press.
- Mrotek, L.A.; Hart, B.A.; Schot, P.; Fennigkoh, L. (2004) Grip responses to object load perturbations are stimulus and phase sensitive. *Experimental Brain Research*, 2004 Apr; 155(4): 413-420.
- Brown, S.M.; Fennigkoh, L.; Gerrits, R.; Hietpas M.; Tritt, C. (2003) A model of venous return while utilizing vacuum assist during cardiopulmonary bypass. *Journal of Extracorporeal Technology*, 2003 Sep; 35(3), 224-229.

Curriculum Vitae – Larry Fennigkoh, Ph.D., P.E., CCE

- Mrotek, L.A.; Hart, B.A.; Schot, P.; Fennigkoh, L. (2001) Grip force response to object load changes during a precision grip lift task. Society for Neuroscience Annual Conference, San Diego, CA.
- Fennigkoh, L.; Garg, A.; Hart, B. (1999) Mediating effects of wrist reaction torque on grip force production. *International Journal of Industrial Ergonomics*, 1999 Mar; 23(4): 293-306.
- Fennigkoh, L. (1994) Maintenance predictors available from an equipment classification system. Annual Meeting of the Association for the Advancement of Medical Instrumentation, Washington, DC.
- Nardizzi, A.; Fennigkoh, L. (1992) The Biomedical Engineer's role in selecting medical technology from a cost-of-ownership perspective. Annual Meeting of the Association for the Advancement of Medical Instrumentation, Los Angeles, CA.
- Fennigkoh, L. (1992) Medical equipment replacement model. *Journal of Clinical Engineering*, 1992 Jan/Feb; 17(1): 43-47.
- Fennigkoh, L. (1991) Management courses for clinical engineering curricula. Annual Meeting of the IEEE Engineering in Medicine & Biology, Orlando, FL.
- Fennigkoh, L. (1991) Human factors and the control of operator error. Annual Meeting of the Colorado Biomedical Association, Colorado Springs, CO.
- Fennigkoh, L. (1991) Training medical device users. Pan American Health Organization Workshop, Washington, DC.
- Fennigkoh, L. (1990) A medical equipment inventory classification system. International Clinical Engineering Workshop; Weimar, East Germany.
- Fennigkoh, L.; Traner, M.; Reimer, D.; (1990) Characteristics & performance lithotripter electrodes. *Journal of Clinical Engineering*, 1990 Jan/Feb; 15(1): 23-28.
- Fennigkoh, L. (1990) *Clinical Engineering and the Management of Operator Error*. Chicago, IL: American Society for Hospital Engineering of the American Hospital Association.
- Fennigkoh, L.; Smith, B.J. (1989) *Clinical Equipment Management*. JCAHO Plant, Technology, and Safety Management Series, No. 2, (Reprinted, 1997).
- Fennigkoh, L. (1988) A survey of persons certified in clinical engineering and their thoughts on the profession. *Medical Instrumentation*, 1988 Aug; 22(4): 189-200.
- Fennigkoh, L. (1988) A profile of certified clinical engineers. World Congress on Medical Physics & Biomedical Engineering, San Antonio, TX.
- Fennigkoh, L. (1987) Monitoring employee performance. Pennsylvania Hospital Association, Hershey, PA.
- Fennigkoh, L. (1987) The use of spreadsheets & graphics in clinical engineering management. 3rd ASHE Clinical Engineering Symposium, Denver, CO.
- Fennigkoh, L. (1987) The BMET in transition to management. Proceedings of the Annual Meeting, American Society for Hospital Engineering, San Diego, CA.
- Fennigkoh, L. (1987) *Management of the Clinical Engineering Department: How to Convert a Cost Center into a Profit Center*. Brea, CA: Quest Publishing Co.

Curriculum Vitae – Larry Fennigkoh, Ph.D., P.E., CCE

- Fennigkoh, L. (1986) Clinical engineering performance measures. IEEE Engineering in Medicine & Biology Conference, Fort Worth, TX.
- Fennigkoh, L. (1986) *Medical Equipment Maintenance Performance Measures*. ASHE Technical Document Series, No. 055880.
- Fennigkoh, L. (1986) Clinical engineering support of an artificial heart program. 2nd Annual ASHE Clinical Engineering Symposium, Baltimore, MD.
- Gonnering, R.S.; Fennigkoh, L. (1985) Decreased muscle sounds after treatment with botulinum-A toxin, in blepharospasm and related disorders: a historical review of etiology and treatment. In S.L. Bosniak (ed.) *Advances in Ophthalmic Plastic and Reconstructive Surgery*. 4. *Blepharospasm*. New York: Pergamon, Press.
- Fennigkoh, L. (1985) Factors influencing BMET job performance. 7th Annual Conference, Frontiers of Engineering & Computing in Health Care, Chicago, IL.
- Fennigkoh, L. (1985) Financial considerations for a magnetic resonance imaging facility. *IEEE Engineering in Medicine and Biology Magazine*, 1985 Sep; 4(3): 21-24.
- Fennigkoh, L. (1985) Controlling medical equipment maintenance costs. 20th Annual Meeting of the Association for the Advancement of Medical Instrumentation, Boston, MA.
- Fennigkoh, L. (1984) Monitoring medical equipment maintenance costs. 6th Annual Conference, Frontiers of Engineering and Computing in Health Care, Los Angeles, CA.
- Fennigkoh, L. (1984) The clinical engineering/health care mismatch: its effect on personnel management. *Medical and Biological Engineering and Computing*. 1984 Mar; 22(2): 113-114.
- Fennigkoh, L. (1982) Essential elements of an effective equipment control program. Annual Meeting of the American Society for Hospital Engineering, New York, NY.
- Fennigkoh, L. (1982) Managing career induced stress. 17th Annual Meeting of the Association for the Advancement of Medical Instrumentation, San Francisco, CA.
- Fennigkoh, L. (1981) The burned-out clinical engineer. *Medical Instrumentation*, 1981 Nov/Dec; 15(6): 375-379.
- Fennigkoh, L. (1981) Clinical engineering burnout. 16th Annual Meeting of the Association for the Advancement of Medical Instrumentation, Washington, DC.
- Fennigkoh, L. (1981) Simple technique for determining a recorder's lower 3dB point. *Medical Instrumentation*, 1981 May/June; 15(3): 195-196.
- Ornato, J.P.; Fennigkoh, L.; Jaeger, C. (1981) The electronic clipboard: an automated system for accurately recording events during a cardiac arrest. *Annals of Emergency Medicine*, 1981 Mar; 10(3): 138-141.
- Fennigkoh, L. (1974) Binocular fixation feedback in the reeducation of oculomotor imbalance. 29th Annual Conference on Engineering in Medicine & Biology, Philadelphia, PA.

Patents:

- Ornato, J.P.; Fennigkoh, L.; Jaeger, C.S. (1984) Method and apparatus for providing records of events during a cardiac arrest. [No. 4,457,312](#).

Curriculum Vitae – Larry Fennigkoh, Ph.D., P.E., CCE

Awards:

Karl O. Werwath Engineering Research Award, MSOE, April 2009.

Inducted, College of Fellows, American Institute for Medical and Biological Engineering, February 2009.

American College of Clinical Engineering Patient Safety Advocacy Award, June 2006.

UWM Outstanding Alumni Award, March 2003.

AAMI Clinical Engineering Achievement Award, May 1994.

MSOE Outstanding Alumni Award, October 1989.

Professional and Character References:

Available upon request