



# Lois Jovanovič, MD, MACE: Pioneer in the Field of Diabetes and Pregnancy and Beyond

Diabetes Care 2019;42:359–363 | <https://doi.org/10.2337/dci18-0056>

David J. Pettitt<sup>§</sup> and  
Alison Okada Wollitzer<sup>§</sup>

Lois Jovanovič is a name that has become synonymous with good pregnancy outcomes for women with type 1 diabetes. Having type 1 diabetes herself and experiencing the challenges it poses for the pregnant woman, Dr. Jovanovič devoted her career to helping women with diabetes prepare for pregnancy and experience successful outcomes. She always emphasized the importance of being in excellent metabolic balance before becoming pregnant and always told her patients that they were “not allowed to get pregnant until she gave them permission.”

As newer insulin analogs became available, they were only approved for use outside of pregnancy. Dr. Jovanovič pioneered testing these analogs in pregnancy, proving that not only were they safe for pregnant women and their babies but resulted in improved diabetes control throughout the pregnancy. Dr. Jovanovič developed an algorithm for insulin use that she taught her patients so they could more easily manage their diabetes during the stress of pregnancy (1). She was very proud of how successful the outcome could be when a pregnancy was meticulously managed and for years kept a picture of each newborn whose mother she had worked with through the pregnancy.

Dr. Jovanovič was passionate about her patients—more than one was

overheard saying “Dr. Lois is the first diabetes doctor who really understood what I’m going through.” Others swore they are only mothers because of Dr. Lois; she was their devoted “cheerleader” (her term) as she kept in close touch with her moms throughout their pregnancies, including through daily faxed glucose diaries and phone calls. Dr. Jovanovič authored or coauthored numerous texts and monographs to help women and their physicians better understand the diabetic pregnancy. These included *Diabetes & Pregnancy: What to Expect* (2) and *Gestational Diabetes: What to Expect* (3), which the American Diabetes Association relied on for years along with updates as new methods of treatment and management became available.

Dr. Jovanovič died at her home in Santa Barbara, California, on 18 September 2018. She would wish to be remembered for her passion and determination, and that goes without saying. She was a pioneer, an advocate, and a mentor to many.

## Early Life and Training

Lois Gretchen Blaustone was born 2 May 1947 in Minneapolis, Minnesota. She grew up in a working-class Orthodox Jewish neighborhood. After losing her father at a young age to the ravages of type 1 diabetes, she was raised by her single mother.



Lois Blaustone (Jovanovič) as a young girl in Minnesota.

Early on, Lois showed her determination: she honed her legendary memorization skills as a young girl to ensure that she would always be prepared. Lois could always memorize anything and would remember it always!

Sansum Diabetes Research Institute, Santa Barbara, CA

Corresponding author: David J. Pettitt, [djpettittret@gmail.com](mailto:djpettittret@gmail.com)

<sup>§</sup>Retired

This article is part of a special article collection available at <http://care.diabetesjournals.org/gdm-new-evidence>.

© 2019 by the American Diabetes Association. Readers may use this article as long as the work is properly cited, the use is educational and not for profit, and the work is not altered. More information is available at <http://www.diabetesjournals.org/content/license>.

Her dream was to be a ballerina, and she was classically trained at the American Ballet Theatre. Her diminutive height was a barrier, so she moved on to medicine, her second-choice career, while maintaining a lifelong love of ballet.

Lois earned a bachelor of science degree in biology from Columbia University in 1969, while simultaneously earning a bachelor's degree in Hebrew literature from The Jewish Theological Seminary. The following year, she began and completed a master's degree in Hebrew literature, also from The Jewish Theological Seminary, while simultaneously enrolled in the Albert Einstein College of Medicine. She earned her doctor of medicine degree in 1973.

Dr. Jovanovič then trained at the New York Hospital–Cornell University Medical College, completing her internal medicine residency in 1975. She stayed on for a senior resident year and then an endocrinology fellowship, which she completed in 1978.

During this time, she became a mother, hiding her pregnancies as long as possible because motherhood was not readily accommodated for doctors-in-training in those days. She would tell stories of tucking her babies under the nursing station while she conducted rounds.

### Choice of Diabetes and Pregnancy

Lois's interest in finding a cure for diabetes began with watching her father



Lois Blaustone (Jovanovič) during her medical school years.



Lois Jovanovič, MD, at her graduation.

suffer, but after she developed type 1 diabetes herself as a young woman she focused on treating diabetes in women during pregnancy. Her groundbreaking work began with the premise that a woman with diabetes should have the same chance of having a healthy baby as a healthy woman without diabetes, as long as she could achieve normoglycemia prior to and throughout pregnancy. During her fellowship at the New York Hospital–Cornell University Medical College, she conducted a study showing that strict monitoring and absolute normalization of blood glucose could yield healthy babies (4). A year later, she published a larger trial of 52 women that showed conclusively that women with diabetes, even those with severe disease, could have healthy babies (5).

Dr. Jovanovič served as the original principal investigator for the New York Hospital–Cornell University Medical College site of the Diabetes in Early Pregnancy Study (DIEP) (6). This landmark study, which enrolled women after they became pregnant, showed that even without pregnancy stabilization, intervention early in pregnancy reduced the rate of malformations (7). It also demonstrated that, among the changes in insulin requirement during the course of pregnancy, there was a decreased need for insulin in the late first trimester (8).

She was also the original principal investigator for the New York Hospital–Cornell University Medical College center of the Diabetes Control and Complications Trial (DCCT), a decade-long

multicenter clinical trial that showed that strict glucose control could reduce the risk of long-term complications (9–11).

Dr. Jovanovič was interested early on in automating insulin delivery. While in New York, she pioneered the use of the original Glucose-Controlled Insulin Infusion System (Biostator) in labor and delivery (12), a prototype for her later work on the artificial pancreas. She was also one of the creators of the Pocket Doc insulin dosage calculator (13).

### Sansum Diabetes Research Institute

In 1984, Dr. Jovanovič joined what is now Sansum Diabetes Research Institute in Santa Barbara, California. In 1996, she was appointed Chief Executive Officer and Chief Scientific Officer, a post she held until 2013. During her tenure, Sansum Diabetes Research Institute became known worldwide as a center of excellence, thanks to her tireless work to improve the lives of people with diabetes through research, education, and care.

Although the rapid-acting insulin analogs had only been tested in nonpregnant



Dr. Jovanovič, Chief Executive Officer and Chief Scientific Officer of Sansum Diabetes Research Institute (1996–2013).

individuals when first approved for use, Dr. Jovanović was convinced that they would be safe for use during pregnancy. Her first studies, randomized trials of the analog versus standard recombinant insulin, were conducted in women with gestational diabetes mellitus. As expected, outcomes with the analogs were just as good as with standard insulins, and the women enjoyed the flexibility of use (14,15). Working with other investigators in a multicenter retrospective study of women who had used a rapid-acting insulin analog before pregnancy and throughout the first trimester, she helped demonstrate that rates of congenital anomalies were not increased (16).

She was also one of the principal investigators on a trial using a long-acting basal insulin analog during pregnancy. This study again demonstrated the safety of the analog for use during pregnancy and, because of the greater stability of the analog, women experienced fewer hypoglycemic events (17). Because of this work, many pregnant women with diabetes now enjoy the convenience and improved control that comes with the use of these analogs.

Dr. Jovanović and two of her close international colleagues drafted a study design to test the impact of continuous glucose monitoring (CGM) on outcomes of pregnancies in women with type 1 diabetes, which became the basis for the Continuous Glucose Monitoring in Women with Type 1 Diabetes in Pregnancy Trial (CONCEPTT) (18). This multicenter international study randomized women with type 1 diabetes to either CGM along with capillary glucose monitoring or to capillary glucose monitoring alone and demonstrated that with CGM women spent more time within their glucose target range and had fewer hyperglycemic episodes. This resulted in a modest but significant improvement in A1C and, importantly, was associated with better neonatal outcomes. The newborns of the CGM group were less likely to be large for gestational age, spent less time in the neonatal intensive care unit, had fewer hypoglycemic episodes, and left the hospital an average of 1 day earlier (19). Once again, Dr. Jovanović was at the forefront of demonstrating that better diabetes control results in better pregnancy outcomes.

Dr. Jovanović also advocated for and treated pregnant women with type 2 diabetes or with gestational diabetes mellitus. Throughout her career in Santa Barbara, she attended the weekly diabetes-in-pregnancy clinic at the Santa Barbara County health facility. Many of her patients spoke only Spanish, and although Dr. Jovanović always said that her Spanish was rudimentary, she was clearly fluent enough to run the clinic. Like her patients with type 1 diabetes, these women with type 2 diabetes or gestational diabetes mellitus, many of whom were low-income minority women, had improved pregnancy results (20).

### Artificial Pancreas

Dr. Jovanović's dream, short of a cure, was to be able to automate insulin delivery. She participated in numerous industry trials that tested various methods of continuous glucose sensing and automated insulin delivery, including early versions of an implantable pump. She tested run-to-run control algorithms as a potential key in automating insulin delivery in type 1 diabetes (21,22). She was principal investigator and later coinvestigator at the Santa Barbara site of the JDRF- and National Institutes of Health-funded Artificial Pancreas Project (23–29). She was named in nine U.S. patent submissions related to insulin dosage algorithms and automated insulin delivery devices, of which four were granted (30–33).

### Legacy

Dr. Jovanović was the recipient of multiple awards and tributes (Table 1). Of all her awards, the ones she cherished the most were her honorary membership in the Diabetic Pregnancy Study Group of the European Association for the Study of Diabetes and all the awards that acknowledged her as a teacher. In addition to keeping a very busy clinical and research schedule, Dr. Jovanović made time to serve on the *Diabetes Care* editorial board from 1982 to 1990 as well as from 2000 to 2002, and she served as an associate editor for *Diabetes Care* from 2002 to 2008.

Always committed to her role as mentor/teacher, Dr. Jovanović helped train generations of medical students, residents, and endocrine fellows. She was especially proud of her young protégées who chose to specialize in diabetes and pregnancy, whom she fondly referred to as "Little Loises." She was sought after as a lecturer at symposia and grand rounds throughout the world. At the time of her death, she had commitments to speak in the coming months.

Dr. Jovanović's legacy also includes generations of babies, many of whom were named Lois by their grateful parents.

Both of her children, Kevin Jovanovic, MD, and Larisa Taylor, MD, entered the medical field in obstetrics and gynecology. She left behind four cherished



Dr. Jovanović with one of numerous grateful mothers who gave birth to a healthy baby.

**Table 1—Awards and honors**

## Scientific and medical honor societies

Honorary member, Diabetic Pregnancy Study Group of the European Association for the Study of Diabetes, 1989–2018  
Member, Royal Academy of Medicine, Spain, 1994

## American Diabetes Association

Outstanding Physician-Clinician Award, 1995  
The Norbert Freinkel Award for scholarship in the field of diabetes and pregnancy, 2001

## Teacher/scientist

Andrew W. Mellon Teacher-Scientist Award, 1978  
Outstanding Teacher of the Year, Santa Barbara Cottage Hospital, 1990, 1991, 1992, 1994, 1995, 1997, 1998, 2001, 2005, 2008  
Pfizer Visiting Professorship Award, Temple University School of Medicine, 1997, and University of Texas Health Science Center at Houston, 1998  
Roche Diagnostics/The Zitter Group Diabetes Disease Management Leadership Award, 1998  
Josiah Kirby Lilly, Sr. Distinguished Service Award, 2006  
Jorgen Pedersen Lecturer (Lifetime Achievement Award from the Diabetic Pregnancy Study Group of the European Association for the Study of Diabetes), 2007  
W.D. Sansum Award for Excellence in Science, 2014

## Other

Santa Barbara Diabetes Association Tribute Dinner Awardee, 1992  
Clintec Award for Excellence in Clinical Nutrition, The American College of Nutrition, 1992  
Woman of Distinction Award in the Field of Health, Soroptimist International, 1994  
Distinguished Physician Award, Santa Barbara Cottage Hospital, 1994  
Mount Sinai School of Medicine Second Annual Stanley Mirsky, MD Lectureship Award, 2008  
Tres Condados Woman of Distinction Award in the Field of Health, 1996  
Santa Barbara Council on Alcoholism and Drug Abuse Woman of Distinction, 1996  
Women's Economic Ventures, Business Women of the Year Awards: Professional Services, 2002  
March of Dimes Agnes Higgins Award to honor distinguished achievement in maternal-fetal nutrition, 2003  
Albert Einstein College of Medicine Distinguished Alumnus/a Award, 2003  
The Ray A. and Robert L. Kroc Lectureship in the College of Medicine, The Ohio State University, 2004  
Honorary Member, Diabetes Treatment Centers of America, Advisory Board  
Santa Barbara Neighborhood Clinics Community Hero, 2005  
Distinguished Service Award, National Disease Research Interchange/JDRF, 2011  
Santa Barbara Region Chamber of Commerce Woman of the Year, 2011

grandchildren, one of whom, following in his grandmother's footsteps, enrolled in the School of American Ballet.

**Acknowledgments.** The authors wish to acknowledge the assistance of Dr. Jovanović's daughter Larisa Taylor, MD, private practice, and Jeannine Glockler, Sansum Diabetes Research Institute.

## References

- California Diabetes and Pregnancy Program. Insulin for gestational and pregestational diabetes [Internet], 2002. Available from <http://perinatology.com/Reference/CDAPP%20SS%20Guidelines%202002.pdf>. Accessed 13 October 2018
- American Diabetes Association. *Diabetes & Pregnancy: What to Expect*. 4th ed. Alexandria, VA, American Diabetes Association, 2000
- American Diabetes Association. *Gestational Diabetes: What to Expect*. 5th ed. Alexandria, VA, American Diabetes Association, 2005
- Jovanović L, Peterson CM, Saxena BB, Dawood MY, Saudek CD. Feasibility of maintaining normal glucose profiles in insulin-dependent diabetic women. *Am J Med* 1980;68:105–112
- Jovanović L, Druzin M, Peterson CM. Effect of euglycemia on the outcome of pregnancy in insulin-dependent diabetic women as compared with normal control subjects. *Am J Med* 1981;71:921–927
- Jovanović L, Singh M, Saxena BB, et al.; NICHD-DIEP Study Group. Verification of early pregnancy tests in a multicenter trial. *Proc Soc Exp Biol Med* 1987;184:201–205
- Mills JL, Knopp RH, Simpson JL, et al.; National Institute of Child Health and Human Development Diabetes in Early Pregnancy Study. Lack of relation of increased malformation rates in infants of diabetic mothers to glycemic control during organogenesis. *N Engl J Med* 1988;318:671–676
- Jovanović L, Knopp RH, Brown Z, et al.; National Institute of Child Health and Human Development Diabetes in Early Pregnancy Study Group. Declining insulin requirement in the late first trimester of diabetic pregnancy. *Diabetes Care* 2001;24:1130–1136
- The DCCT Research Group. The Diabetes Control and Complications Trial (DCCT): design and methodologic considerations for the feasibility phase. *Diabetes* 1986;35:530–545
- The DCCT Research Group. Diabetes Control and Complications Trial (DCCT): results of feasibility study. *Diabetes Care* 1987;10:1–19
- Nathan DM, Genuth S, Lachin J, et al.; Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med* 1993;329:977–986
- Chanoch L, Jovanović L, Peterson CM. The evaluation of a pocket computer as an aid to insulin dose determination by patients. *Diabetes Care* 1985;8:172–176
- Jovanović L. The Pocket Doc: how computers may prescribe insulin doses. *Diabetes Self-Management*, November/December 1986: p. 8–9
- Jovanović L, Ilic S, Pettitt DJ, et al. Metabolic and immunologic effects of insulin lispro in gestational diabetes. *Diabetes Care* 1999;22:1422–1427
- Pettitt DJ, Ospina P, Kolaczynski JW, Jovanović L. Comparison of an insulin analog, insulin aspart, and regular human insulin with no insulin in gestational diabetes mellitus. *Diabetes Care* 2003;26:183–186
- Wyatt JW, Frias JL, Hoyme HE, et al.; IONS study group. Congenital anomaly rate in offspring of mothers with diabetes treated with insulin lispro during pregnancy. *Diabet Med* 2005;22:803–807
- Mathiesen ER, Damm P, Jovanović L, et al. Basal insulin analogues in diabetic pregnancy: a literature review and baseline results of a randomised, controlled trial in type 1 diabetes. *Diabetes Metab Res Rev* 2011;27:543–551
- Feig DS, Asztalos E, Corcoy R, et al.; CONCEPTT Collaborative Group. CONCEPTT: Continuous Glucose Monitoring in Women with Type 1 Diabetes in Pregnancy Trial: a multi-center,

multi-national, randomized controlled trial—study protocol. *BMC Pregnancy Childbirth* 2016;16:167–174

19. Feig DS, Donovan LE, Corcoy R, et al.; CONCEPTT Collaborative Group. Continuous glucose monitoring in pregnant women with type 1 diabetes (CONCEPTT): a multicentre international randomised controlled trial. *Lancet* 2017;390:2347–2359
20. Jovanovic-Peterson L, Bevier W, Peterson CM. The Santa Barbara County Health Care Services program: birth weight change concomitant with screening for and treatment of glucose-intolerance of pregnancy: a potential cost-effective intervention? *Am J Perinatol* 1997;14:221–228
21. Zisser H, Jovanović L, Doyle F III, Ospina P, Owens C. Run-to-run control of meal-related insulin dosing. *Diabetes Technol Ther* 2005;7:48–57
22. Owens C, Zisser H, Jovanović L, Srinivasan B, Bonvin D, Doyle FJ III. Run-to-run control of blood glucose concentrations for people with type 1 diabetes mellitus. *IEEE Trans Biomed Eng* 2006;53:996–1005
23. Palerm CC, Zisser H, Jovanović L, Doyle FJ III. A run-to-run control strategy to adjust basal insulin infusion rates in type 1 diabetes. *J Process Contr* 2008;18:258–265
24. Dassau E, Zisser H, Palerm CC, Buckingham BB, Jovanović L, Doyle FJ III. Modular artificial  $\beta$ -cell system: a prototype for clinical research. *J Diabetes Sci Technol* 2008;2:863–872
25. Dassau E, Palerm CC, Zisser H, Buckingham BA, Jovanović L, Doyle FJ III. In silico evaluation platform for artificial pancreatic  $\beta$ -cell development—a dynamic simulator for closed-loop control with hardware-in-the-loop. *Diabetes Technol Ther* 2009;11:187–194
26. Percival MW, Dassau E, Zisser H, Jovanović L, Doyle FJ III. Practical approach to design and implementation of a control algorithm in an artificial pancreatic beta cell. *Ind Eng Chem Res* 2009;48:6059–6067
27. Wang Y, Percival MW, Dassau E, Zisser HC, Jovanović L, Doyle FJ III. A novel adaptive basal therapy based on the value and rate of change of blood glucose. *J Diabetes Sci Technol* 2009;3:1099–1108
28. Finan DA, Doyle FJ III, Palerm CC, et al. Experimental evaluation of a recursive model identification technique for type 1 diabetes. *J Diabetes Sci Technol* 2009;3:1192–1202
29. Harvey RA, Wang Y, Grosman B, et al. Quest for the artificial pancreas: combining technology with treatment. *IEEE Eng Med Biol Mag* 2010;29:53–62
30. Doyle FJ III, Jovanović L, inventors; The Regents of the University of California, assignee. Method and apparatus for glucose control and insulin dosing for diabetics. U.S. patent 7,651,845, filed 12 May 2005 and issued 26 January 2010
31. Zivitz M, Galley P, Jovanović L, inventors; Roche Diagnostics Operations, Inc., assignee. Mask algorithms for health management systems. U.S. patent 7,998,069, filed 11 September 2007 and issued 16 August 2011
32. Zivitz M, Jovanović L, inventors; Roche Diagnostics Operations, Inc., assignee. Device and method for insulin dosing. U.S. patent 8,251,904, filed 7 June 2006 and issued 28 August 2012
33. Doyle FJ III, Grosman B, Dassau E, Jovanović L, Zisser H, inventors; The Regents of the University of California, assignee. Maintaining multiple defined physiological zones using model predictive control. U.S. patent 9,700,708, filed 2 April 2013 and issued 11 July 2017