# Family Planning with LDS

AN INTERACTIVE GUIDE BROUGHT TO YOU BY THE LOEYS-DIETZ SYNDROME FOUNDATION CANADA




FOR MORE INFORMATION ABOUT LDS VISIT
WWW.LOEYSDIETZCANADA.ORG

# What is this booklet for?

## WELCOME!

This guide is for any individual with questions about Loeys-Dietz syndrome (LDS) and family planning, pregnancy, delivery, and postpartum care – whether they're curious about parenthood, seeking to become a parent, or are already a parent.

This guide also serves as a resource for friends, family, and partners of those with LDS.

Our goal is to promote education, awareness, and empowerment for individuals and families so that they can make choices that are right for them.

We would like to express our sincere gratitude to Dr. Melissa Russo, MD, for her generous input in the creation of this eBook. Dr. Russo is a maternal-fetal medicine and clinical genetics specialist with expertise in prenatal genetics, reproductive and pregnancy outcomes in women with connective tissue disorders.

Should you ever need additional support or guidance throughout this process, we hope you will not hesitate to reach out to us at the number provided below.

Sincerely,

*Your Loeys-Dietz Syndrome Foundation Canada Team*

**LDS HELPLINE**
**1-888-LDS-FCAN**

# MEDICAL DISCLAIMER

The information provided here is meant to empower individuals to make informed decisions – it does not, however, replace a reader's relationship with their doctor.

The information outlined in this booklet is for general use only. Please speak with a qualified healthcare professional before making medical decisions.

This resource has been researched, reviewed, and vetted by subject experts who have worked hard to ensure that the information provided is accurate and reliable; however, we cannot guarantee that it is error-free or complete.

Research for LDS is ongoing.

The Loeys-Dietz Syndrome Foundation Canada is not responsible for the quality of the information or services provided by organizations mentioned on loeysdietzcanada.org, nor do we endorse any service, product, treatment, or therapy.

# Table of Contents

# TLDR

"TOO LONG; DIDN'T READ" — A SUMMARY OF CONTENT

## 01. FAMILY PLANNING

Family planning empowers individuals to determine the number of children they wish to have. It is vital that you reach out to a medical professional at the pre-conception stage in order to assess your health and discuss options.

## 02. MENTAL HEALTH & EXPECTATIONS

It is important to recognize that family planning with LDS can take a toll on mental health for both individuals with LDS and their loved ones. Connecting with medical professionals, LDS community, and/or arming yourself with the right information can help combat feelings of isolation, depression, and anxiety.

## 03. LDS & FAMILY RISK

With the right support, individuals with LDS can have successful pregnancies and deliveries. It is, however, important to note that pregnancy poses high maternal risk and LDS is hereditary.

## 04. FAMILY OPTIONS

Individuals with LDS have a variety of family planning options available to them, including: fertility preservation treatments, surrogacy, gamete & embryo donation, adoption, and natural pregnancy.

## 05. NATURAL PREGNANCY

Collaborating with a specialized medical team is necessary if desirable pregnancy outcomes are to be attained. The earlier you speak with your doctor, the better.

**UNPLANNED PREGNANCY?**

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# What is LDS?

Loeys-Dietz syndrome (LDS) is a rare, genetic condition that effects the body's connective tissue. LDS was first described in 2005 by Dr. Bart Loeys and Dr. Hal Dietz, hence the name.

Symptoms may range from mild to severe and effect many areas of the body. LDS can effect individuals differently, even when they have the same type (types 1-6) or are from the same family.

## LDS & GENETICS

LDS is caused by a mutation (change) in the SMAD2, SMAD3, TGFB2, TGFB3, TGFBR1, or TGFBR2 genes.

There are 6 types of LDS and each type is caused by mutations in a different gene. Learn more about LDS and genetic mutations.

## STATS TO CONSIDER WHEN FAMILY PLANNING

Approximately 25% have a parent with an LDS-causing mutation and inherited the mutation. [34]

Approximately 75% are the first in their family to have an LDS-causing mutation. This mutation is called de novo (new) or spontaneous. [34]

# What is family planning?

## A BRIEF SUMMARY

Family planning is a crucial aspect of reproductive health, allowing individuals and couples to make informed decisions about if, when, and how to have children. People with LDS have the same rights as anyone else when it comes to building families but are often faced with challenges that include:

## LACK OF ACCESSIBILITY

Many healthcare facilities are not fully equipped to accommodate individuals with specific types of family planning needs as in the case with LDS, making it challenging for them to access crucial services.

## STIGMA & DISCRIMINATION

People with LDS can face societal stigma and discrimination when family planning, which can lead to their sexual and reproductive health needs being disregarded or overlooked.

## INADEQUATE INFORMATION

There is a lack of accessible and inclusive sexual and reproductive health information tailored to the specific needs of people with LDS, resulting in limited knowledge about their options and rights.

## ASSUMPTIONS & STEREOTYPES

Healthcare providers may hold assumptions or stereotypes about the sexual capabilities of people with LDS, leading to the neglect of their reproductive health concerns.

This eBook seeks to bridge this gap and cover key terms as well as map out important things to consider when family planning with LDS.

# Pregnancy stages

## 01. PRECONCEPTION

Time period before a maternal body experiences pregnancy. Health is assessed during this time and the effects of pregnancy are considered.

## 02. PRENATAL

Time period after conception but before birth.

## 03. PERIPARTUM

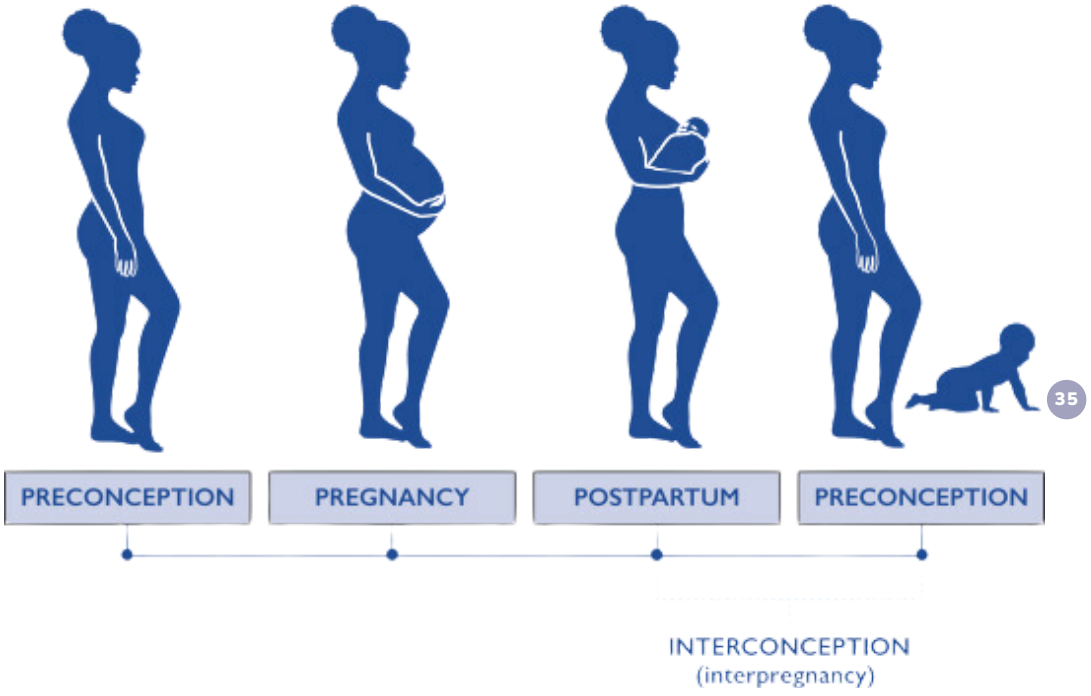
Time period during the last month of gestation and the first few weeks after delivery.

## 04. POSTPARTUM

Time period following childbirth where a maternal body returns to a non-pregnant state.

## 05. INTERCONCEPTION

Time period between pregnancies (between postpartum and preconception).



# LDS & Pregnancy

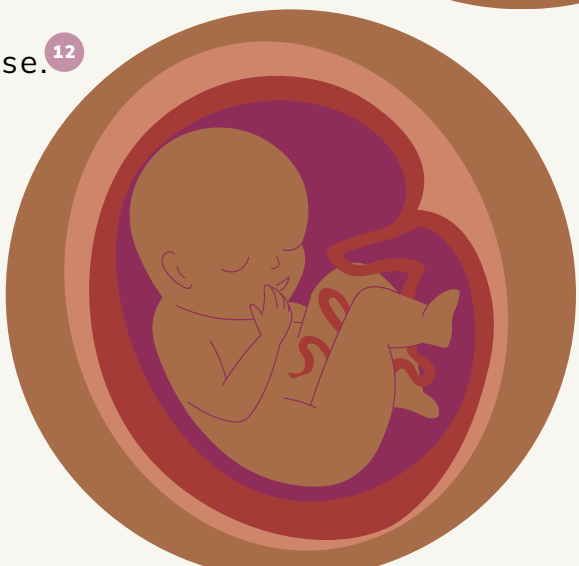
## SUCCESSFUL PREGNANCIES

- Close monitoring by a multidisciplinary team is needed for individuals seeking pregnancy with LDS. [01]
- Pregnancy with LDS should be classified as high risk. [04] [08]
- Medical processes and decision-making should be individualized and made through shared decision-making between patients and their medical team. [16]

INDIVIDUALS WITH LDS ARE ABLE TO HAVE SUCCESSFUL PREGNANCIES AND DELIVERIES GIVEN THE RIGHT CONDITIONS. [01] [15]

## WHAT HAPPENS TO THE BODY DURING PREGNANCY?

- Pregnancy increases heart rate, stroke volume, cardiac output, and volume of maternal blood in the body. [06] [07]
- Neurohormones levels are increased during pregnancy and are at their highest during the third trimester and peripartum period. [06]
- Estrogen, progesterone, T3, T4, cortisol, proactin, and relaxin increase. [12]



# Unplanned pregnancy?

If you suspect you are pregnant and have LDS we urge you to contact a medical professional as soon as possible in order to increase your odds of a successful pregnancy.

Pregnant individuals with LDS who have not received preconception evaluation and counselling should seek an assessment of risks and counselling from a pregnancy heart team ASAP.

Lack of knowledge of the diagnosis of LDS prior to pregnancy is a high risk factor for undesirable pregnancy outcomes.

**Recommended options include:**

01. Reaching out to a medical professional and connecting with a pregnancy heart team.

02. Discussing pregnancy termination with a doctor.

It's important to note that while abortion is not necessarily linked to mental health problems, restricted access to safe and legal abortions are shown to pose a risk to mental and physical health. [36]

Please speak with a trusted healthcare provider to learn more about your options. You can also call the LDS helpline for support.

LDS HELPLINE 1-888-LDS-FCAN

# Preconception checklist

A preconception plan is vital to the success of family planning with LDS. Close monitoring by a multidisciplinary pregnancy heart team will help ensure desirable outcomes.

## PRECONCEPTION CARE

- ☐ Assemble a multidisciplinary medical team.
- ☐ Assess maternal, fetal (in womb), and newborn risks.
- ☐ Plan for conception, pregnancy, and discussing available options.

## MULTIDISCIPLINARY TEAM MEMBERS

- ☐ Cardiologist
- ☐ Anesthesiologist
- ☐ Obstetrician
- ☐ Geneticist

## ADDITIONAL REQUIREMENTS

- ☐ Team should be familiar with connective tissue disorders.
- ☐ Team should include or be able to involve cardiothoracic surgeons with experience in aortic surgery.
- ☐ Team should use shared-decision making in collaboration with patient and provide individualized care.

## CONSULT WITH GENETIC COUNSELLOR

- ☐ Family planning goals and options.
- ☐ Heritability of LDS.
- ☐ Benefits and limitations of diagnostic testing options depending on what stage of pregnancy the individual is at.

# Maternal medical assessments

## CARDIOVASCULAR IMAGING & ASSESSMENT

- Recommended for all non-pregnant patients with LDS.
- Receive echocardiogram of aorta to determine size of aortic root. [01]
- MRA or CT scan of vasculature (head to pelvis) is also recommended. [01] [16]

## SPINAL IMAGING & ASSESSMENT

- Recommended for all patients with LDS.
- Receive MRI of spine. [01]
- During a confirmed or suspected pregnancy, it is recommended to use an MRI ***without*** contrast (gadolinium). [02] [06]
  - Contrast poses potential risks to fetus and is only recommended: 1) If the results of MRI with contrast can benefit the mother or 2) If the MRI cannot be delayed until after delivery and the benefits and risks have been discussed with the patient and the patient has consented to its use.
  - Additionally, it is recommended that pregnant individuals ***avoid*** CT scan to avoid radiation of fetus. [06]

# ARBs vs beta-blockers

## MEDICAL THERAPY

Medical experts highly recommend a safe titration off of Angiotensin Receptor Blockers (ARBs) and a switch to Beta Blockers. [01] [06]

## WHY?

Angiotensin Converting Enzyme (ACE) inhibitors and Angiotensin II Receptor Blockers (ARB) are teratogens (cause abnormality when a fetus is exposed) and thus pose potential harm to the pregnancy. [05]

When beta blockers are used during pregnancy, they may cause the fetus to grow and weigh less than if beta blockers were not taken. [01] [06]

The timing of titration off of ARBs and starting beta blockers should be an individualized decision and may take place during the preconception period or once a pregnancy test is positive. [16]

## NOTE

As the preconception period can be longer than expected, the use of ARBs may be more effective than beta blockers in some cases. Thus, it is recommended to continue ARB use during preconception so long as pregnancy tests are taken frequently and ARB is switched to beta blockers once a pregnancy test proves positive. [16]

Additionally, Metropolol is thought to affect the fetus the least, and is therefore recommended. [01] Labetalol is recommended to treat hypertension in pregnancy.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# Maternal risks & offspring considerations

## PRECONCEPTION & PREGNANCY RISKS (MATERNAL)

- Dilated ascending aorta-Prophylactic surgery
- Aortic dissection
- Severe valve disease

## SOME ADVICE AGAINST PREGNANCY

- Pregnancy is not advised if aortic root is greater than 4.5 cm;
- Or if it is greater than 4 cm ***but*** coupled with a family history of sudden aortic dissection and/or related death. 04 05

## OFFSPRING CONSIDERATIONS

- Transmission of LDS
- Early delivery
- Birth weight
- Manifestations of LDS that may not be visible through fetal screening during pregnancy. 16

## VITAMINS & SUPPLEMENTS

- Recommended to take folic acid for 3 months during preconception. 05
- Talk to doctor and pharma about dosing and duration, and other vitamins or supplements. Discuss LDS and all medication you are taking.

NATURAL PREGNANCY FOR THOSE WITH LDS CAN POSE A HIGH MATERNAL RISK

# Pregnancy

ENSURE PRECONCEPTION EVALUATIONS ARE COMPLETED & RISKS DISCUSSED

SEE PRECONCEPTION CHECKLIST IF NOT ALREADY DONE

## 1ST TRIMESTER

- [ ] Complete preconception evaluations & discussions of risk if not already done.
- [ ] Discuss care plan for pregnancy and postpartum period with medical team.
- [ ] Discuss and decide on delivery method and timing with medical team.
- [ ] Have a plan in place in case of aortic dissection.
- [ ] Discuss all medication (including pain management medication) with medical team to ensure none pose harmful maternal or fetal side effects

## 2ND TRIMESTER

- [ ] Echocardiogram (imaging) of aorta every 4-8 weeks to monitor root size.

## 3RD TRIMESTER

- [ ] Image fetus every 4 weeks (growth scan to monitor fetal growth).
- [ ] Continue imaging of aorta every 4-8 weeks to monitor root size.
- [ ] Meet with anesthesiologist to discuss anesthesia for delivery.

# Delivery logistics

## ANESTHESIA

- Should be planned in 3rd trimester with anesthesiologist. [01]
- If pregnant individual has scoliosis, spondylolisthesis, cervical spine instability, or dural ectasia, regional anesthesia (epidural anesthesia) may be difficult. [01] [04] [05] [06]
- Medical practitioners to consider potential interactions between anesthesia and beta blockers, anesthesia and anticoagulants. [04]

## SCARS & WOUND HEALING

- LDS may affect wound healing and scar formation from a caesarian section or episiotomy after vaginal delivery. [08] [14]

INDIVIDUALS WITH LDS CAN EXPERIENCE POOR OR SLOW WOUND HEALING.

SCARS CAN TAKE MORE TIME TO FORM AND BE ABNORMAL OR WIDE.

## DELIVERY TIMING

- Early delivery recommended at 37-39 weeks. [15]
- Recommended to decide on individual basis. [05]

## DELIVERY LOCATION

- Recommended to deliver at a medical center with experience in cardiothoracic surgery [01] [05] [06] and vascular services and a unit for special neonatal care. [05]

# Delivery

IF AORTIC DISSECTION OCCURS DURING DELIVERY, IT IS RECOMMENDED TO CONDUCT EMERGENCY CAESARIAN SECTION AND THEN PROMPTLY REPAIR AORTA.

## DELIVERY METHOD

Recommended that multidisciplinary team decide on delivery method on a case-by-case basis in collaboration with patient.

## MEDICAL THERAPY

At delivery, synthetic oxytocin is often used to help in placental delivery and decrease risk of postpartum haemorrhage. It may be recommended to avoid synthetic oxytocin when possible as there is a potential risk of oxytocin increasing the risk of aortic dissection. 05 16

## ANTICOAGULANTS

- Coumadin can cause anatomical abnormalities in the fetus if taken during weeks 7-11 of pregnancy. During pregnancy, heparin should be used instead of Coumadin.
- Heparin should be stopped 24-48 hours before birth. After birth, restart heparin and coumadin (heparin and coumadin ok for breast feeding). 34

IF BETA BLOCKERS WERE USED DURING PREGNANCY, CONTINUE USE DURING DELIVERY.

# Postpartum

## BREASTFEEDING

- Breastfeeding has benefits but there are potential risks of aortic dissection linked to breastfeeding (lactation-related oxytocin release). [16] [17]
- The decision to breastfeed should be made on a case-by-case basis, and should be made with shared-decision making (medical recommendations and informed decision from patient). [16]
- During breastfeeding period, ARB is ***not*** recommended; instead, beta blockers are recommended. [01] [06] [16]
- ACE inhibitors can also be used during breastfeeding. [05]

## CONTRACEPTION

- Recommended that patient and medical team discuss contraception after delivery, before discharge. [01]
- Minimal data on use of contraceptives in women with LDS. [01]

## DISCUSS DISSECTION SYMPTOMS

LDS patients should be alerted about the increased risk of aortic dissection postpartum and encouraged to present promptly for evaluation and imaging should symptoms of persistent chest or back discomfort occur. [01] [05]

PERSISTENT CHEST AND/OR BACK DISCOMFORT SHOULD BE FOLLOWED UP WITH IMMEDIATE EXAMINATION

# Surrogacy: gamete & embryo donation

**Gamete** donation is the donation of eggs or sperm and **embryo** donation is the donation of an embryo (a fertilized egg).

## HOW CAN DONATIONS HELP THOSE WITH LDS?

Gamete donation can help couples and individuals to conceive by providing missing gametes to same-sex partners or individuals conceiving alone.

Gamete donation can also replace the gamete of a partner with infertility or fertility problems, or replace the gamete of a partner with Loeys-Dietz syndrome.

Using gamete donation instead of the gamete of a partner with Loeys-Dietz syndrome prevents the child from inheriting LDS from the parent. However, the child still has the same risk as the general population of having LDS through a spontaneous mutation.

Embryo donation is also an option and results in a child that is not biologically related to its parent(s). This prevents the child from inheriting LDS from the parent. However, the child still has the same risk as the general population of having LDS through a spontaneous mutation.

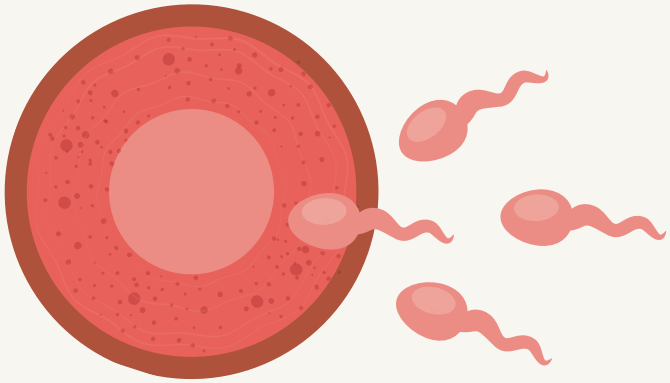
GAMETE & EMBRYO DONATION ARE RELATIVELY SAFER OPTIONS FOR PEOPLE WITH LDS.

# What happens after donation?

After an egg donation, the donated eggs are fertilized with sperm, creating embryos, and embryos are transferred into the woman who will be carrying the pregnancy through in vitro fertilization (IVF).

After a sperm donation, the donated sperm are either transferred into a woman through intra uterine insemination (IUI), or are used to fertilize eggs, create embryos and are implanted into a woman through in vitro fertilization (IVF).

After an embryo donation, the embryo is implanted into a woman through in vitro fertilization (IVF).



## WHO IS IT FOR?

- Donations can help couples with fertility problems/infertility.
- Donations can help same-sex couples or individuals to become pregnant.
- Donations can help couples and individuals to conceive a child that is biologically related to one parent (gamete donation) or neither parent (gamete and embryo donation).
- For both gamete and embryo donation, a mother in the couple can experience being pregnant with the child.

# LDS & FERTILITY PRESERVATION

## WHAT IS FERTILITY PRESERVATION?

- Fertility preservation is the process of preserving eggs, sperm, embryos, ovarian tissue, or testicular tissue for future reproductive use. This often involves extracting, freezing, and storing the reproductive materials as well as future thawing and reimplantation.[18][19]
- IVF and certain medications can be used as part of the fertility preservation process.[23] See the **IVF section** for more information

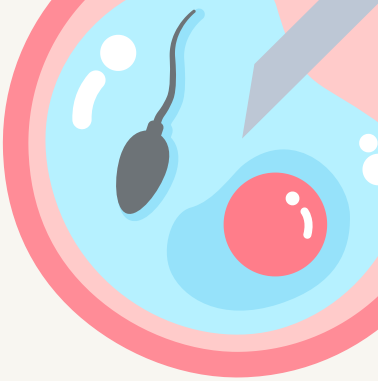
## WHO CAN BENEFIT FROM FERTILITY PRESERVATION?

- Fertility preservation is most commonly used by individuals who have doubts about their future fertility. Future fertility can be affected by age, medical therapies such as cancer therapy, transgender care, and health conditions such as an autoimmune disease, endometriosis, or uterine fibroid.[18][19]

## IS INFERTILITY A FEATURE OF LDS?

- Cases of infertility and fertility problems have been observed in individuals with LDS.[20][21]
- If fertility preservation is not available to you, speak with your doctor about other available options re: family planning.

# IVF & IVM



## WHAT IS IVF?

- In vitro fertilization (IVF) is a process whereby a sperm fertilizes an egg outside of the body, in a laboratory (in vitro).
- Once fertilized, the egg becomes an embryo.[23]
- IVF involves removing mature eggs from the ovaries, fertilizing them, and implanting them into a uterus.[23]
- Certain medications are used during this process to promote pregnancy, including to help collect eggs and implant embryos.[23]
- Helpful to individuals and couples experiencing infertility/fertility issues and can also be used as part of the fertility preservation process.[23]
- Useful to individuals and couples with LDS who would like to have a biological child without passing on the condition. In this case, IVF is used with preimplantation genetic testing (PGD), where the embryos are tested for LDS before implantation and only embryos without LDS are implanted into a uterus.[23]
- IVF may be used after egg or embryo donation or for surrogacy.[31][32][33]

## WHAT IS IVM?

- In vitro maturation (IVM) is a process whereby immature oocytes are removed from the ovaries, matured and fertilized by sperm in a laboratory, and implanted into the uterus.[26]
- Certain medications may be used to help implant embryos and promote pregnancy.[26][28]

## WHAT IS IVM FOR?

- IVM can help individuals and couples experiencing infertility/fertility issues.[23]
- Because IVM does not use ovary-stimulating medication to help retrieve mature eggs (as IVF does), IVM is recommended as an option for women seeking to avoid ovarian stimulation.

## WHAT IS THE DIFFERENCE BETWEEN IVM & IVF?

- Individuals who undergo IVM do not need to use medications to produce mature eggs for removal, as people undergoing IVF do.[26]
- IVM is a faster process, is less expensive, and may pose less health risks due to less medication ***but*** is less likely to be successful (about half as successful per cycle) when compared to IVF.[02][06][27]

# LDS & IUI

## WHAT IS IUI?

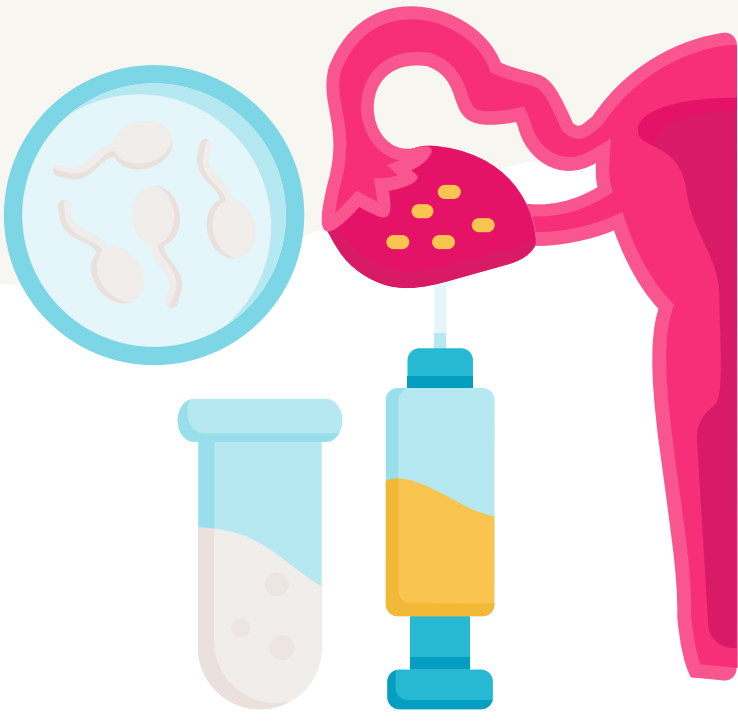
- Intrauterine insemination (IUI) is a process where a small tube is used to insert sperm into the uterus.[24]
- Some individuals will be given medication to stimulate ovulation and promote pregnancy.[25]

## WHAT IS IUI FOR?

- IUI can help individuals and couples experiencing infertility or suffering from fertility issues.[24]
- IUI can also be used by same-sex couples or female individuals trying to conceive with donor sperm.[24]

## WHAT IS THE DIFFERENCE BETWEEN IUI, IVF & IVM?

- With IUI, fertilization happens inside the uterus, compared to IVF where it occurs outside the body in a laboratory.[23][24][26]
- IUI is generally less invasive, and less expensive ***but*** each cycle is less likely to result in a pregnancy than IVF.[25]



# LDS & Adoption

## WHAT IS ADOPTION?

- Adoption means to take a child born to other parents voluntarily as their own child. The parent does not personally experience pregnancy or delivery and the child is not biologically related to the parents (assuming adoption is done outside of the family).
- Adoption prevents the child from inheriting LDS from the parents. However, the child still has the same risk as the general population of having LDS through a spontaneous mutation.

## WHO IS ADOPTION FOR?

- Adoption is for anyone who cannot have or does not wish to have a biological child. Adoption is a wonderful opportunity to grow your family and provide a home to a child without one.

# LDS & Surrogacy

## WHAT IS SURROGACY?

- Surrogacy is an arrangement where a woman (the surrogate) carries and delivers a baby for an individual or couple (the parent(s)).[33]
- Eggs and sperm are collected from the parents and transferred to the surrogate through IVF.
- Gamete or embryo donation can also be used in conjunction with surrogacy.[33]

## WHO IS IT FOR?

- Surrogacy is an option for individuals and couples who do not want to or cannot safely carry and deliver a baby.[33]
- For an individual with LDS who does not wish to go through pregnancy and delivery, for medical reasons or otherwise, surrogacy is a safe option.

# References


01 Russo, M. L., Sukhavasi, N., Mathur, V., & Morris, S. A. (2018). “Obstetric management of Loeys-Dietz syndrome.” *Obstetrics and gynecology*, 131(6), 1080.

02 Gatta, G., Di Grezia, G., Cuccurullo, V.,et al. (2021). “MRI in pregnancy and precision medicine: A review from literature.” *Journal of Personalized Medicine*, 12(1), 9.

03 British Columbia College of Nurses and Midwives. (2017). "Standards, limits and conditions for prescribing, ordering and administering therapeutics." *BCCNM* (formerly *College of Midwives of BC*).www.bccnm.ca/Documents/standards_practice/rm/RM_Guideline_for_Managing_the_Second_Stage_of_Labour.pdf

04 European Reference Network. (2021) “VASCERN Do's and Don'ts factsheets forrare vascular disease patients facing frequent situations.” https://loeysdietzcanada.org/wp-content/uploads/2023/01/VASCERN_Loeys-Dietz-syndrome_Dos-and-Donts_EN_2021-1.pdf

05 Thomas, K. E., Hogan, J., Pitcher, A., Mackillop, L., Blair, E., & Frise, C. J. (2021). “Loeys–Dietz syndrome in pregnancy.” *Obstetric Medicine*, 14(1), 42-45.

06 Isselbacher, E. M., Preventza, O., Hamilton Black III, J., Augoustides, J. G., et al. (2022). “2022 ACC/AHA Guideline for the Diagnosis and Management of Aortic Disease: a Report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines.” *Journal of the American College of Cardiology*, 80(24), e223-e393.

07 Lansman, S. L., Goldberg, J. B., Kai, M., Tang, G. H., Malekan, R., & Spielvogel, D. (2017). “Aortic surgery in pregnancy.” *The Journal of Thoracic and Cardiovascular Surgery*, 153(2), S44-S48.

08 MacCarrick, G., Black, J. H., Bowdin, S., El-Hamamsy, et al. (2014). “Loeys–Dietz syndrome: a primer for diagnosis and management.” *Genetics in Medicine*, 16(8), 576-587.

09 Niwa, K. (2018). “Adult congenital heart disease with pregnancy.” *Korean Circulation Journal*, 48(4), 251.

10 Gomes, C. F., Sousa, M., Lourenço, I., Martins, D., & Torres, J. (2018). “Gastrointestinal diseases during pregnancy: what does the gastroenterologist need to know?.” *Annals of Gastroenterology*, 31(4), 385.

11 Women's Medicine Collaborative. "Gastrointestinal Issues During Pregnancy." *Multidisciplinary Obstetric Medicine Service (MOMS)*. www.lifespan.org/centers-services/multidisciplinary-obstetric-medicine-service-moms/gi-issues-pregnancy

12 Fiat, F., Merghes, P. E., Scurtu, A. D., Almajan Guta, B., Dehelean, C. A., Varan, N., & Bernad, E. (2022). “The main changes in pregnancy—therapeutic approach to musculoskeletal pain.” *Medicina*, 58(8), 1115.


13. Kesikburun, S., Güzelküçük, Ü., Fidan, U., Demir, Y., Ergün, A., & Tan, A. K. (2018). “Musculoskeletal pain and symptoms in pregnancy: a descriptive study.” *Therapeutic Advances in Musculoskeletal Disease*, 10(12), 229-234.

14. Loeys BL, Dietz HC. (2008) "Loeys-Dietz Syndrome." In: Adam MP, Mirzaa GM, Pagon RA, et al.,editors. *GeneReviews*. www.ncbi.nlm.nih.gov/books/NBK1133/

15. Melissa L. Russo. (2020) “Considerations in Pregnancy for Women with Marfan & Loeys-Dietz Syndrome,” *Marfan Pregnancy Webinar*. https://dokumen.tips/documents/considerations-in-pregnancy-for-women-with-marfan-loeys-webinarrusso-considerations.html?page=1

16. Frise, C. J., Pitcher, A., & Mackillop, L. (2017). “Loeys–Dietz syndrome and pregnancy: The first ten years.” *International Journal of Cardiology*, 226, 21-25.

17. Habashi, J. P. et al. (2019). “Oxytocin antagonism prevents pregnancy-associated aortic dissection in a mouse model of Marfan syndrome.” *Science Translational Medicine*, 11(490). www.science.org/doi/full/10.1126/scitranslmed.aat4822.

18. National Institute of Child Health and Human Development. (2017) "What is fertility preservation?" *National Institute of Health*. www.nichd.nih.gov/health/topics/infertility/conditioninfo/fertilitypreservation

19. Yale Medicine. "Fertility Preservation." www.yalemedicine.org/conditions/fertility-preservation

20. Lim, C. T., Bertalan, R., Davies, C., McElreavey, K., & Korbonits, M. (2018). “A novel case of primary hypogonadism in female associated with Loeys-Dietz syndrome type 5.” In “Endocrine Abstracts.” *Bioscientifica,* 59.

21. LDS Families Facebook Group. https://www.facebook.com/LDSFamilies

22. Meijboom, L. J., Drenthen, W., Pieper, P. G., Groenink, et al. (2006). “Obstetric complications in Marfan syndrome.” *International Journal of Cardiology*, 110(1), 53-59.

23. Mayo Clinic. "In vitro fertilization (IVF)". www.mayoclinic.org/tests-procedures/in-vitro-fertilization/

24. John Hopkins Medicine. "Intrauterine Insemination (IUI) Treatment." John Hopkin University. www.hopkinsmedicine.org/gynecology-obstetrics/specialty-areas/fertility-center/infertility-services/intrauterine-insemination.

25. Cleveland Clinic. "IUI (Intrauterine Insemination)." https://my.clevelandclinic.org/health/treatments/22456-iui-intrauterine-insemination.

26. MUHC Reproductive Centre. "In Vitro Maturation (IVM)." *McGill University Health Centre (MUHC)*. https://muhc.ca/reproductivecentre/page/vitro-maturation-ivm-0.

27. TFP Fertility Group. "Mild IVF & IVM (in vitro maturation)." https://tfp-fertility.com/en-gb/fertility-treatment/ivm-in-vitro-maturation#

28. Tennessee Reproductive Medicine. “Progesterone Supplements after IUI (Intrauterine Insemination).” https://trmbaby.com/library/getting-pregnant/progesterone-after-iui


29 Science Direct. www.sciencedirect.com/topics/medicine-and-dentistry/gamete-donation.

30 American Society for Reproductive Medicine. “Gamete (eggs and sperm) and embryo donation.” *Reproductive Facts*. www.reproductivefacts.org/news-and-publications/fact-sheets-and-infographics/gamete-eggs-and-sperm-and-embryo-donation/

31 MUHC Reproductive Centre. “Egg and Sperm Donation.” *McGill University Health Centre*. https://muhc.ca/reproductivecentre/page/egg-sperm-donation

32 The Montreal Fertility Centre. (2019). “Egg Donation FAQ.” www.montrealfertility.com/egg-donation/

33 Yale Medicine. “Surrogacy” www.yalemedicine.org/conditions/gestational-surrogacy

34 The Marfan Foundation. (2021) "Family Planning and Pregnancy." https://marfan.org/wp-content/uploads/2021/04/Family_Planning__Pregnancy.pdf

35 Loeys BL, Dietz HC. (2008) "Loeys-Dietz Syndrome." In: Adam MP, Mirzaa GM, Pagon RA, et al.,editors. GeneReviews. www.ncbi.nlm.nih.gov/books/NBK1133/

36 S. Michelle Ogunwole et al. "Interconception Care for Primary Care Providers: Consensus Recommendations on Preconception and Postpartum Management of Reproductive-Age Patients With Medical Comorbidities," *Mayo Clinic Proceedings: Innovations, Quality & Outcomes*, 5(5), 872-890.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