

# A Retrospective evaluation of the impact of fetal MR imaging on prognosis and referral patterns for intrauterine fetal anomalies

Tharakeswari Selvakumar PhD,

Farhana R. Riaz MD,

Jean-Marc Gauguet MD PhD and

Carolynn M. DeBenedectis MD

Department of Radiology, University of Massachusetts Medical School

Worcester, MA

# Disclosures

The authors have no conflict of interest in relation to this presentation

# Background

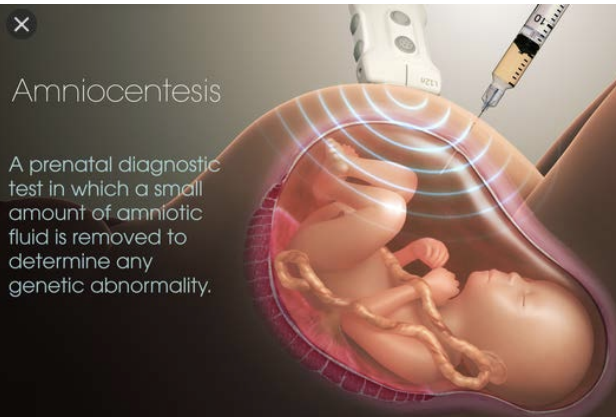
Fetal anomalies detected by ultrasound (US) during routine prenatal anatomic surveys have huge implications in:

- >> predicting prognosis
- >> postnatal care
- >> in critical decisions (e.g., pregnancy termination)



# Background

- Abnormalities seen by US are usually followed up
  - amniocentesis
  - blood tests (Triple screen, Quad screen etc)



Scientificanimations.com



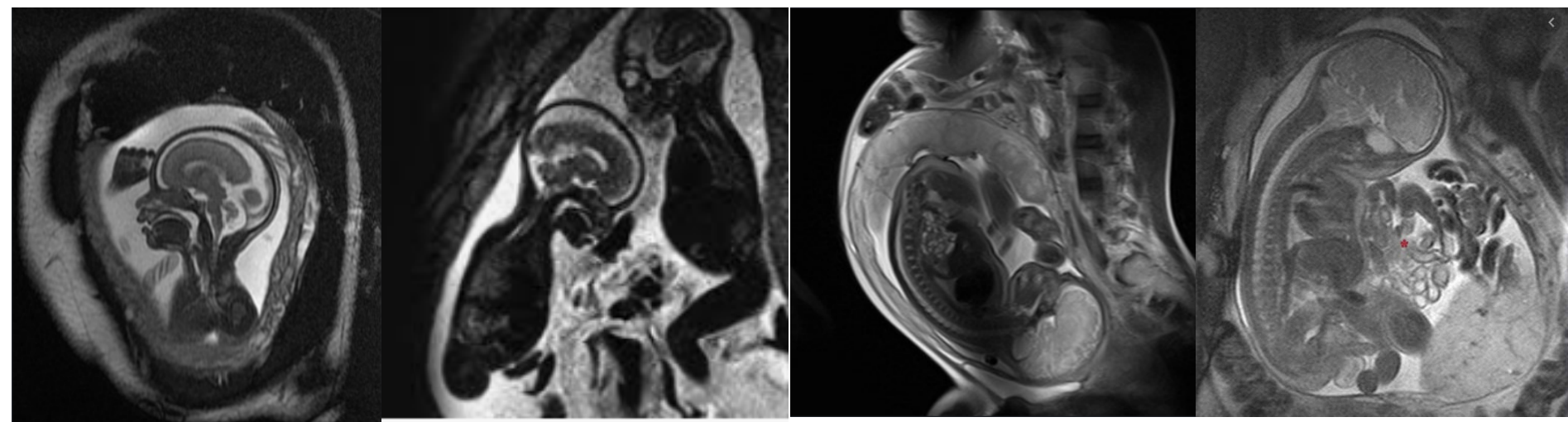
Ucsfhealth.org



Asa.org.uk

# Background

- Fetal MRI makes it possible for us to re-evaluate the indications suggested by US & serum tests



[pedrad.org](http://pedrad.org)

[Consultqd.clevelandclinic.org](http://Consultqd.clevelandclinic.org)

[Auntminnieeurope.com](http://Auntminnieeurope.com)

[renaissance.stonybrookmedicine.edu](http://renaissance.stonybrookmedicine.edu)

# Background

A case-by case evaluation comparing the relative impact of each testing modality on fetal outcomes and prognosis is valuable

# Purpose

To evaluate the impact of fetal MR imaging on:  
Patient referral patterns & prognosis

Patient Population:

Pregnant patients with prior ultrasound diagnoses  
of fetal anomalies



# Methods

## Study type

Retrospective study using electronic medical records

## Study size

42 pregnant patients

## Center

UMass Memorial Medical Center, Worcester MA

## Study duration

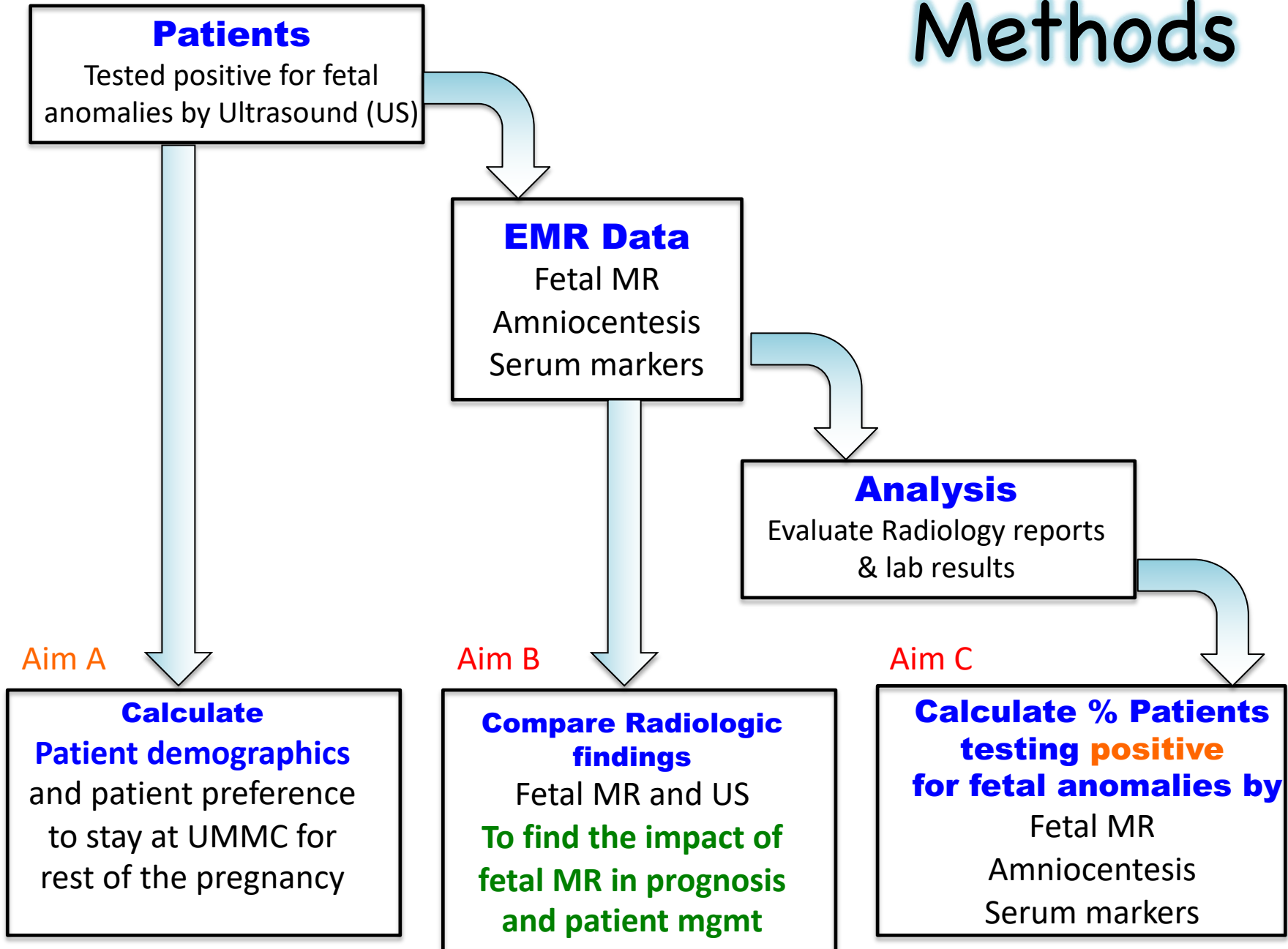
4-years (Nov 2013-Aug2017)

## Inclusion criterion

Patients who had initial ultrasound diagnosis of fetal anomalies

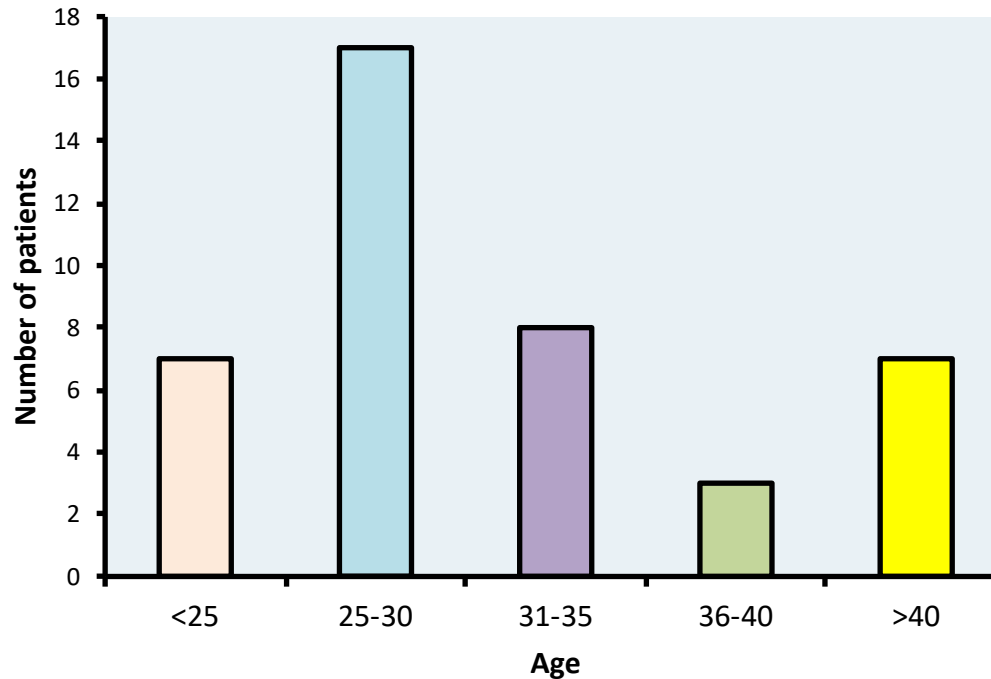


# Methods



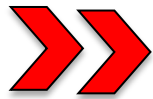
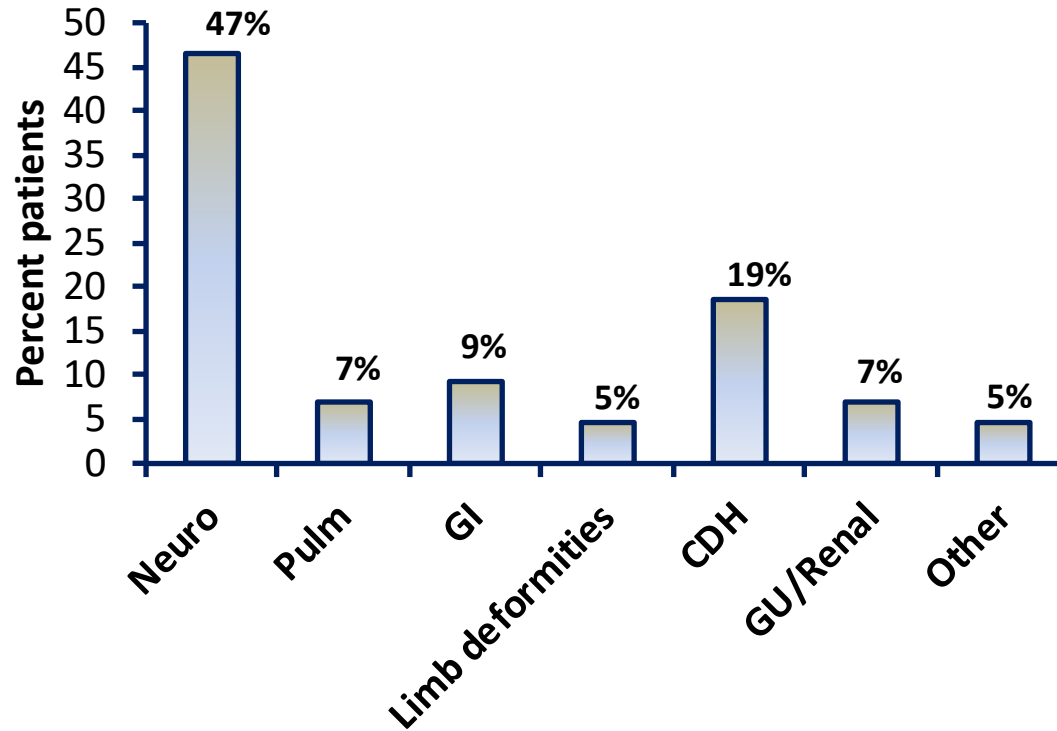
# Aim A: Patient Demographics

Patients Age



**Majority of patients were in the age range of 25-30 years**

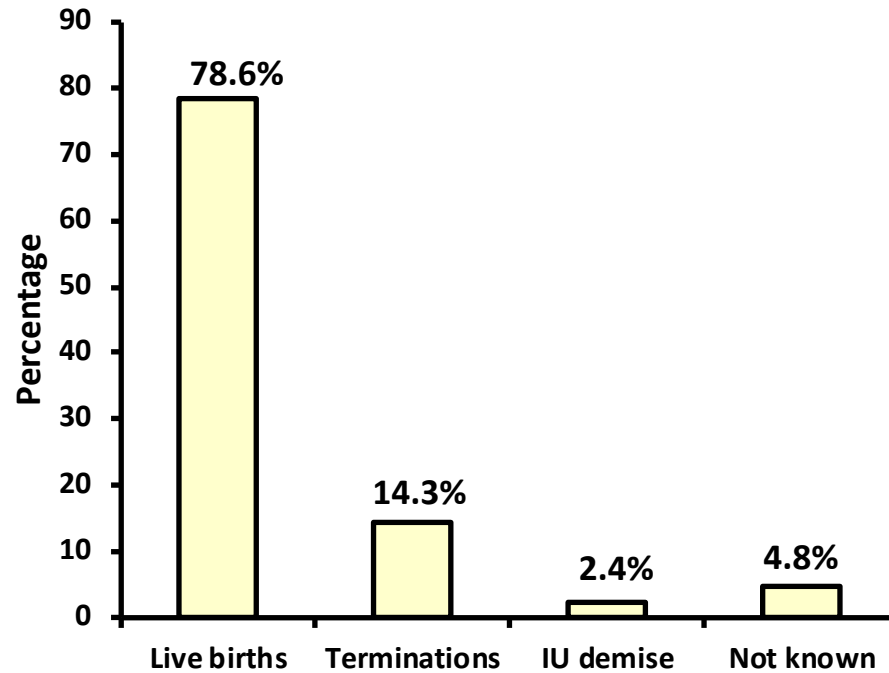
# Fetal Anomalies represented in this study



**Most common fetal anomalies were:**

**Neurological Disorders (47%) &  
Congenital Diaphragmatic Hernia (19%)**

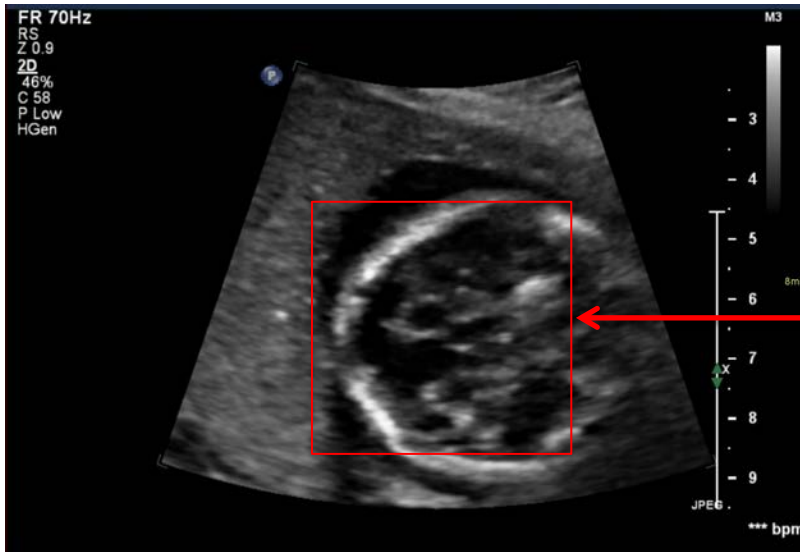
# Pregnancy outcomes in this study population



**The most common pregnancy outcome in the study was live birth (78.6%)**

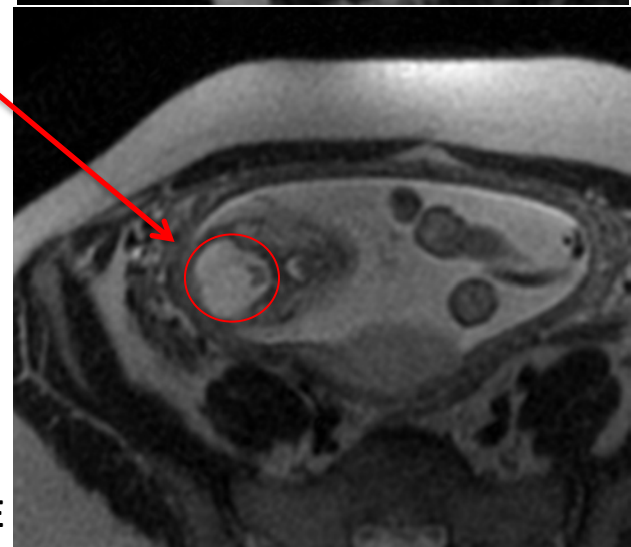
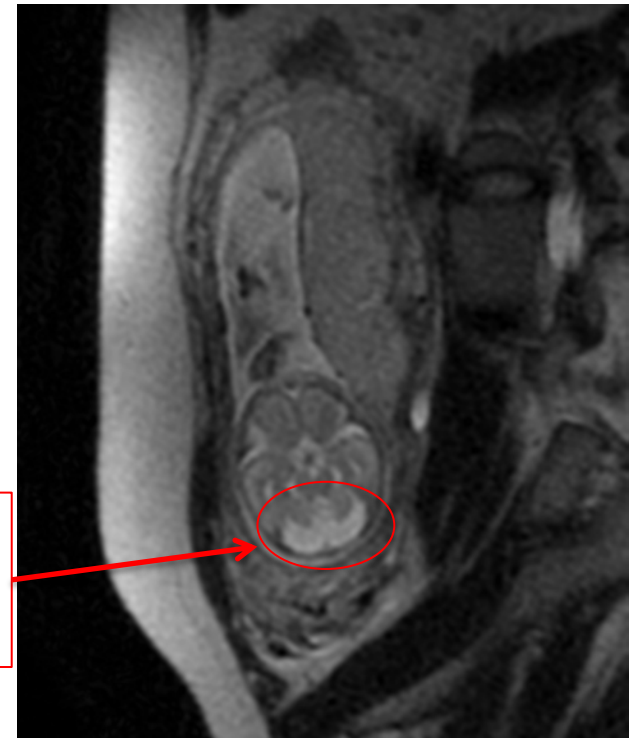
# Selected Case 1: Dandy Walker Malformation

Ultrasound image



Dilated 4<sup>th</sup> ventricle &  
Absence of cerebellar  
vermis

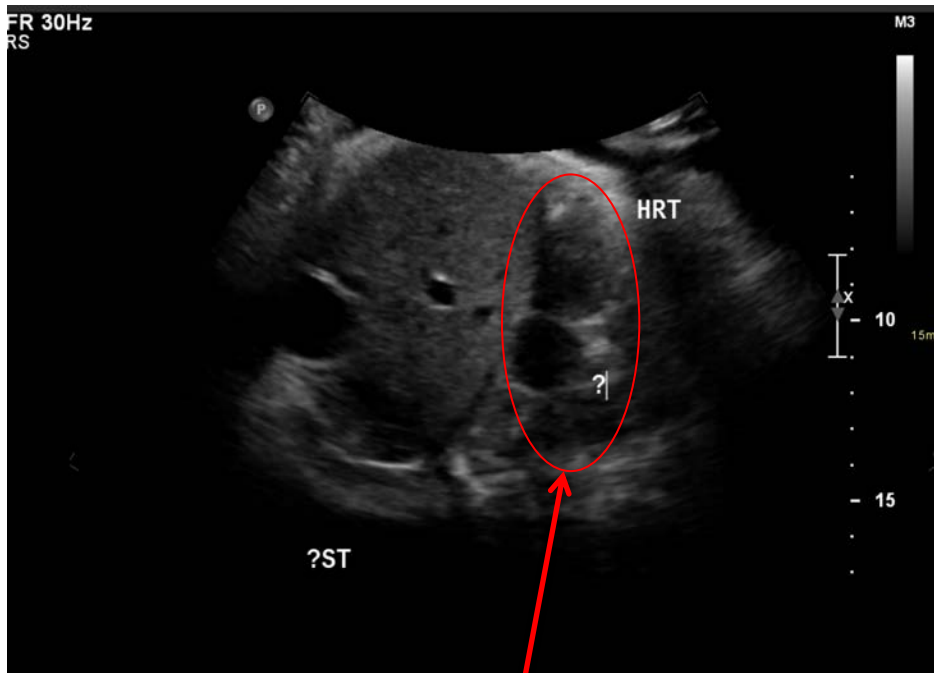
Fetal MR images



MR images are SSF FE

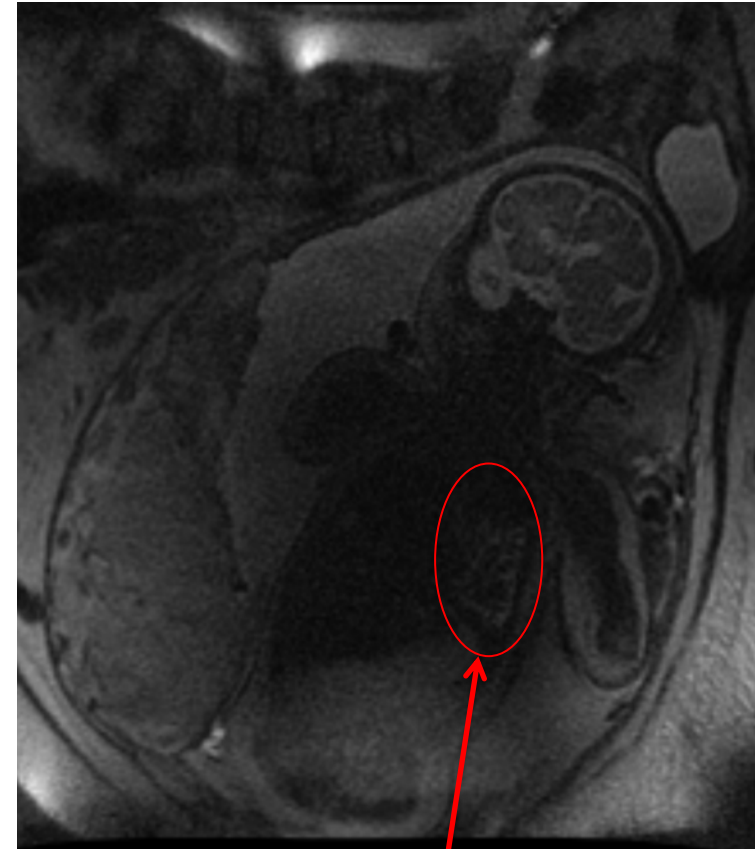
# Selected Case 2: Congenital Diaphragmatic Hernia (CDH)

Ultrasound image



Ultrasound imaging showing  
Cystic mass in the left hemithorax

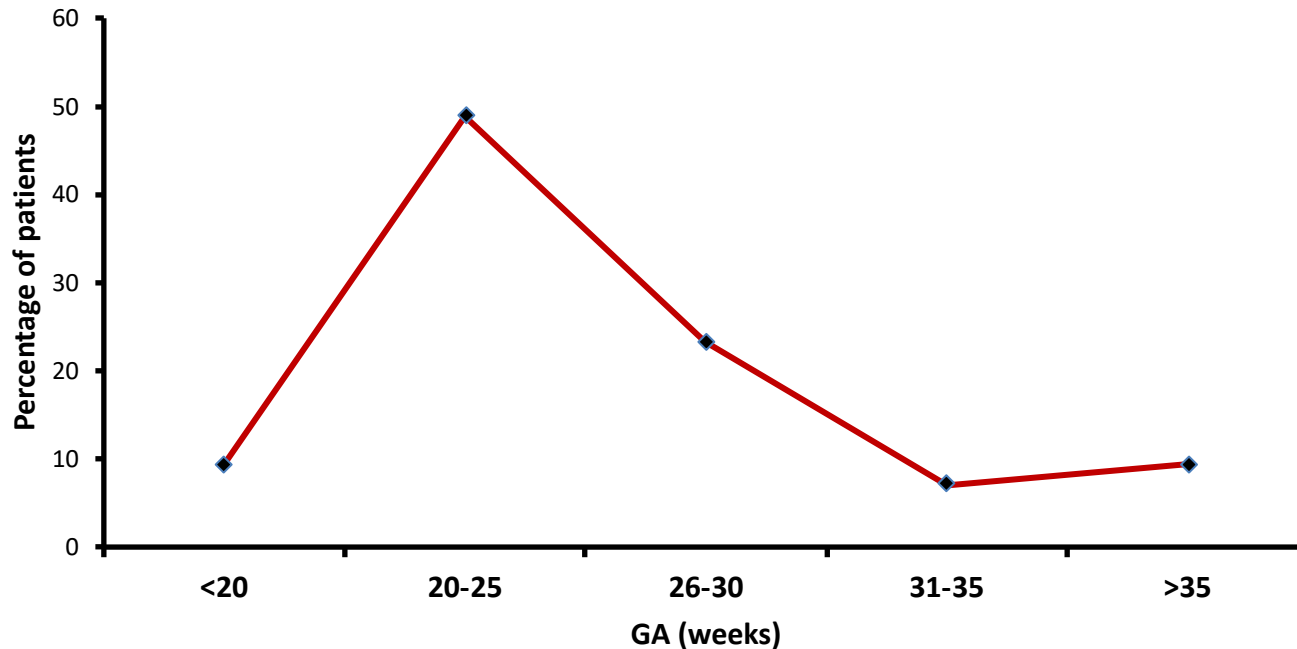
Fetal MR image



Fetal MR showing Left CDH with  
bowel in the left hemithorax

# Patient Management Trends

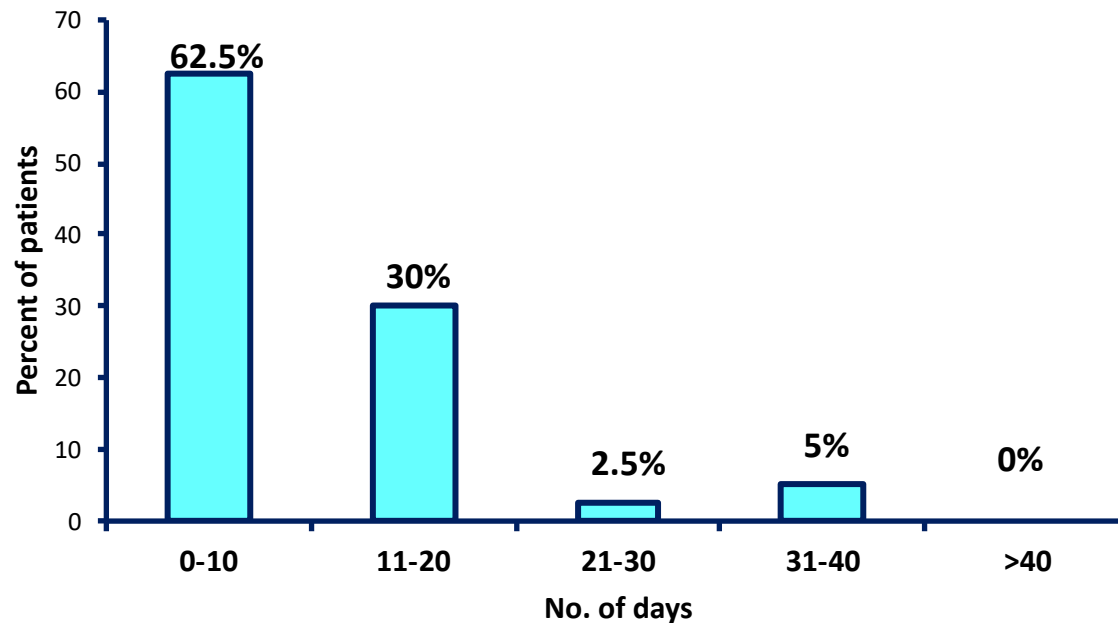
Percentage of patients at given Gestational Age (GA) at first MR



Majority of the patients (49%) were between 20-25 weeks of gestation at the time of first fetal MR imaging

# Patient Management Trends

Number of days between prior US and MRI

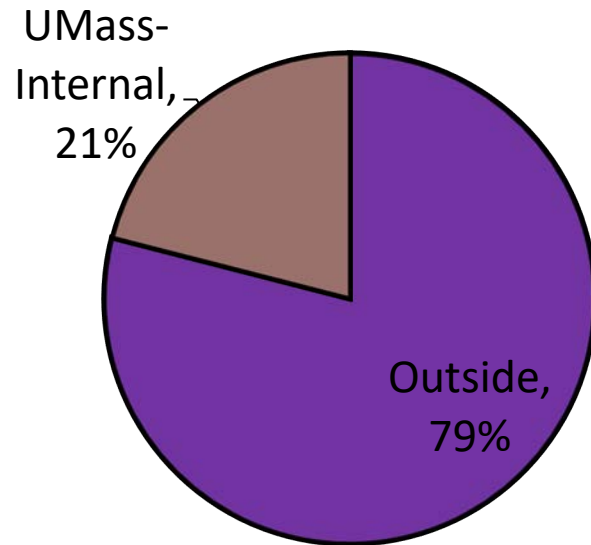


**Majority of the patients (62.5%) got fetal MR imaging done within 10 days of ultrasound finding of congenital abnormalities.**

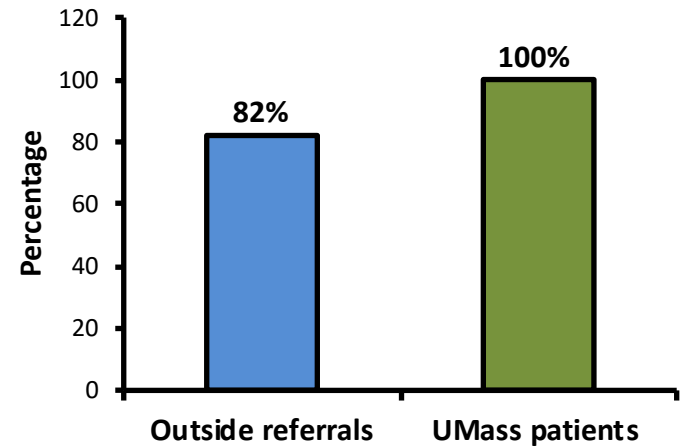


# Aim A: Patient Demographics

## Patient Referral Source

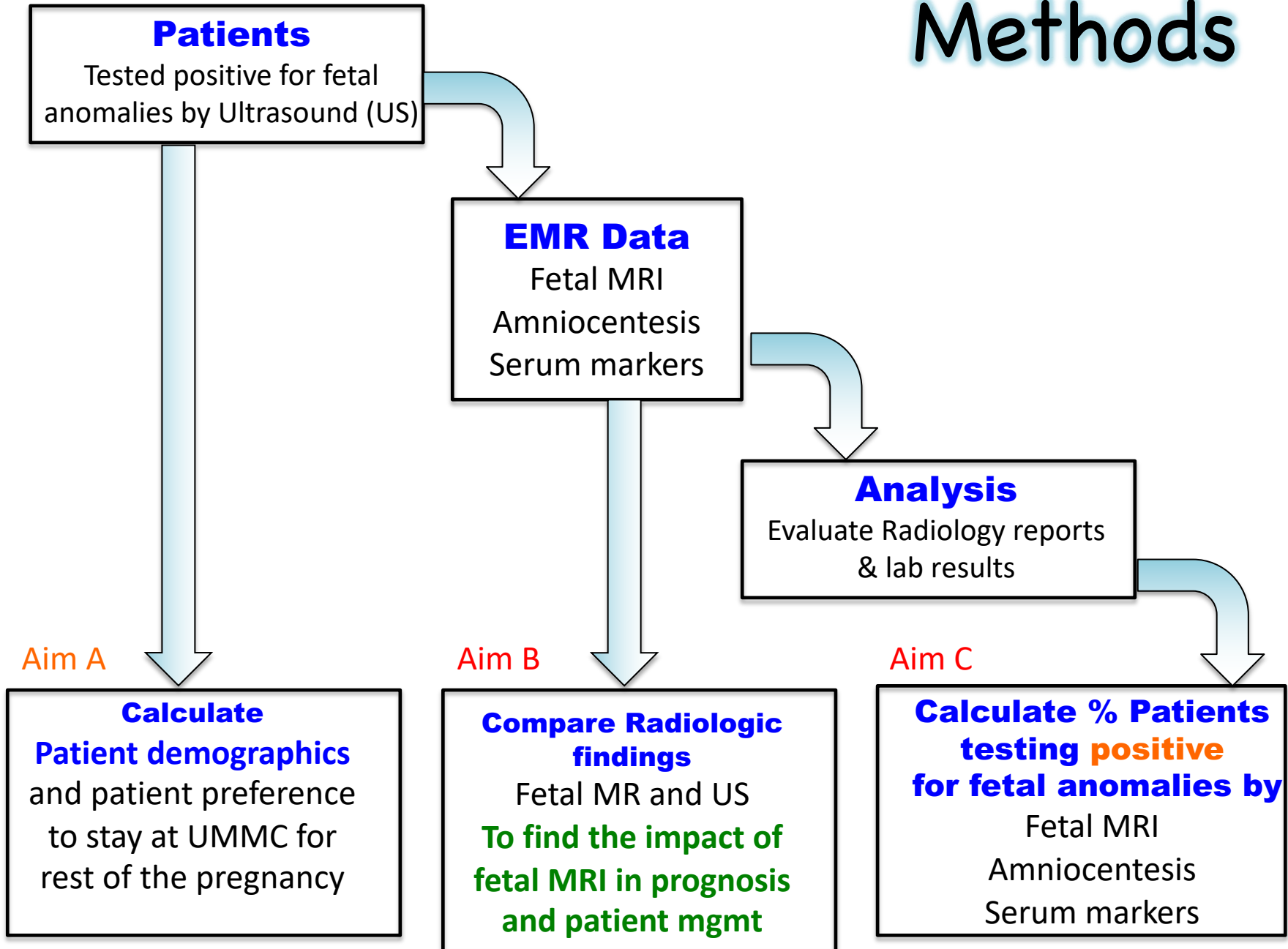


## Patients staying at UMass after diagnosis



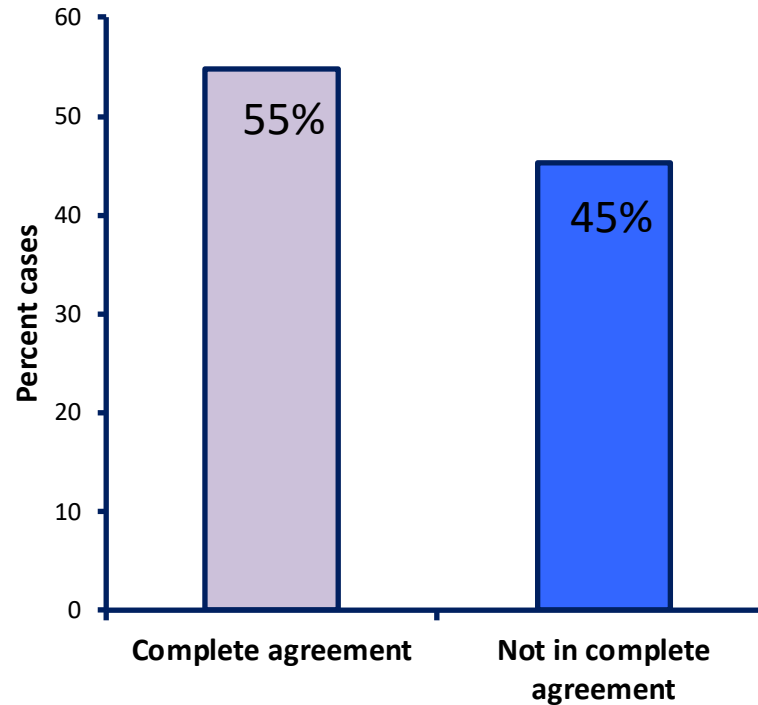
**All internally referred patients from UMass and 79% patients from outside referrals decided to stay at UMass after fetal MR**

# Methods



# Aim B: Results

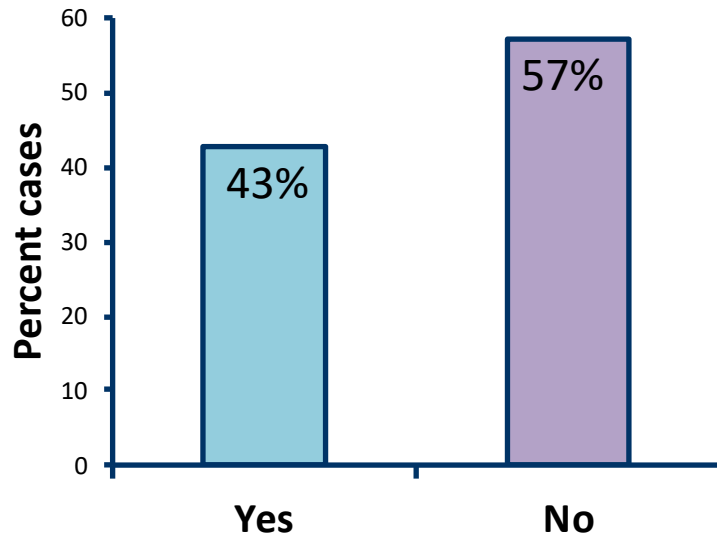
Agreement between fetal MRI and Ultrasound



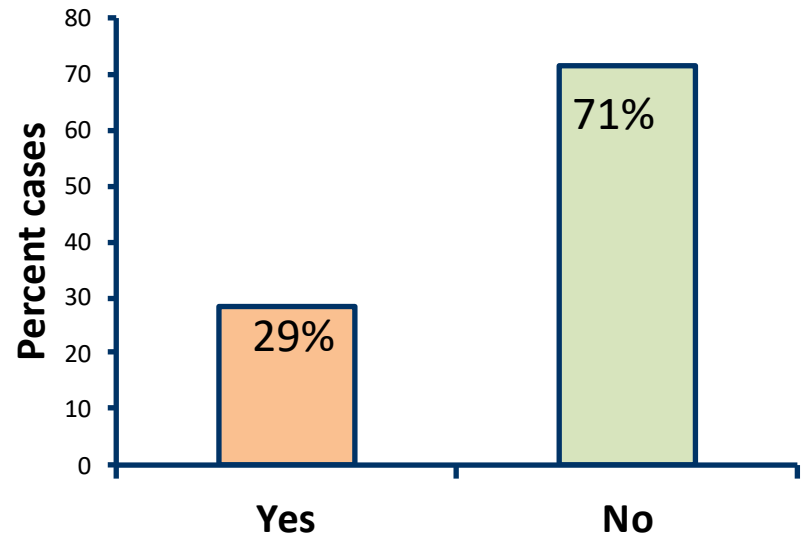
The diagnosis made by fetal MR and Ultrasound were in complete agreement in only 55% of patients

# Aim B: Results

Did MRI refute any US findings ?



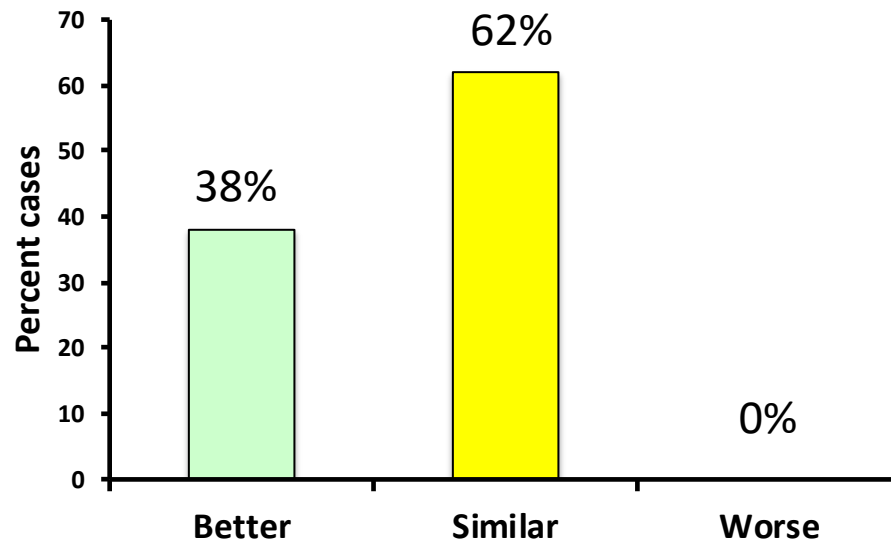
Did MRI add new findings ?



Fetal MR refuted US findings in 43% cases and added new findings in 29%

# Aim B: Results

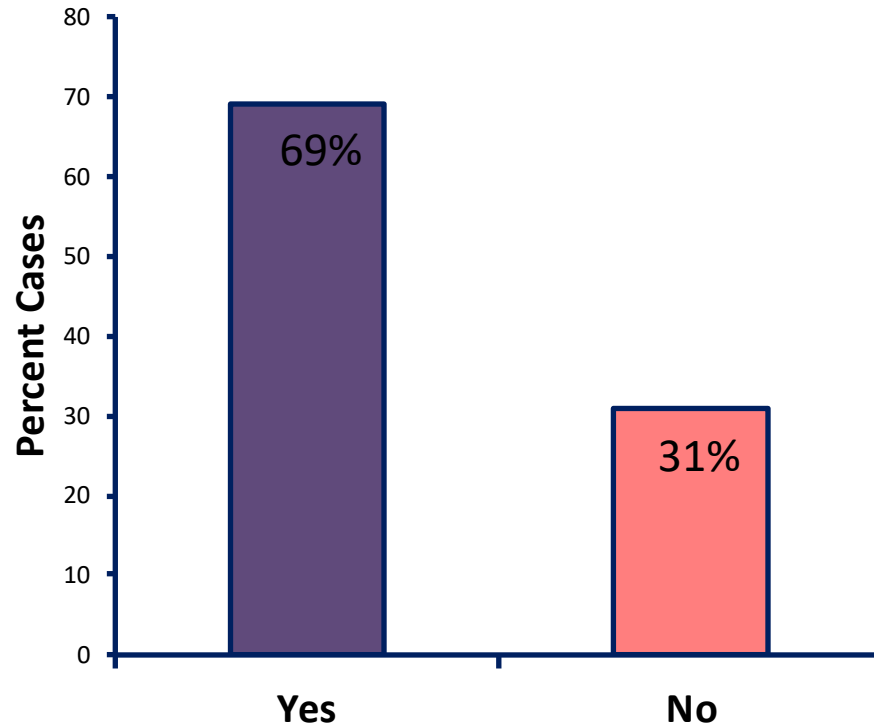
Prognosis predicted by fetal MR compared to US



**In comparison to Ultrasound, fetal MR gave, better prognosis in 38%, similar prognosis in 62% and worse prognosis in none of the patients.**

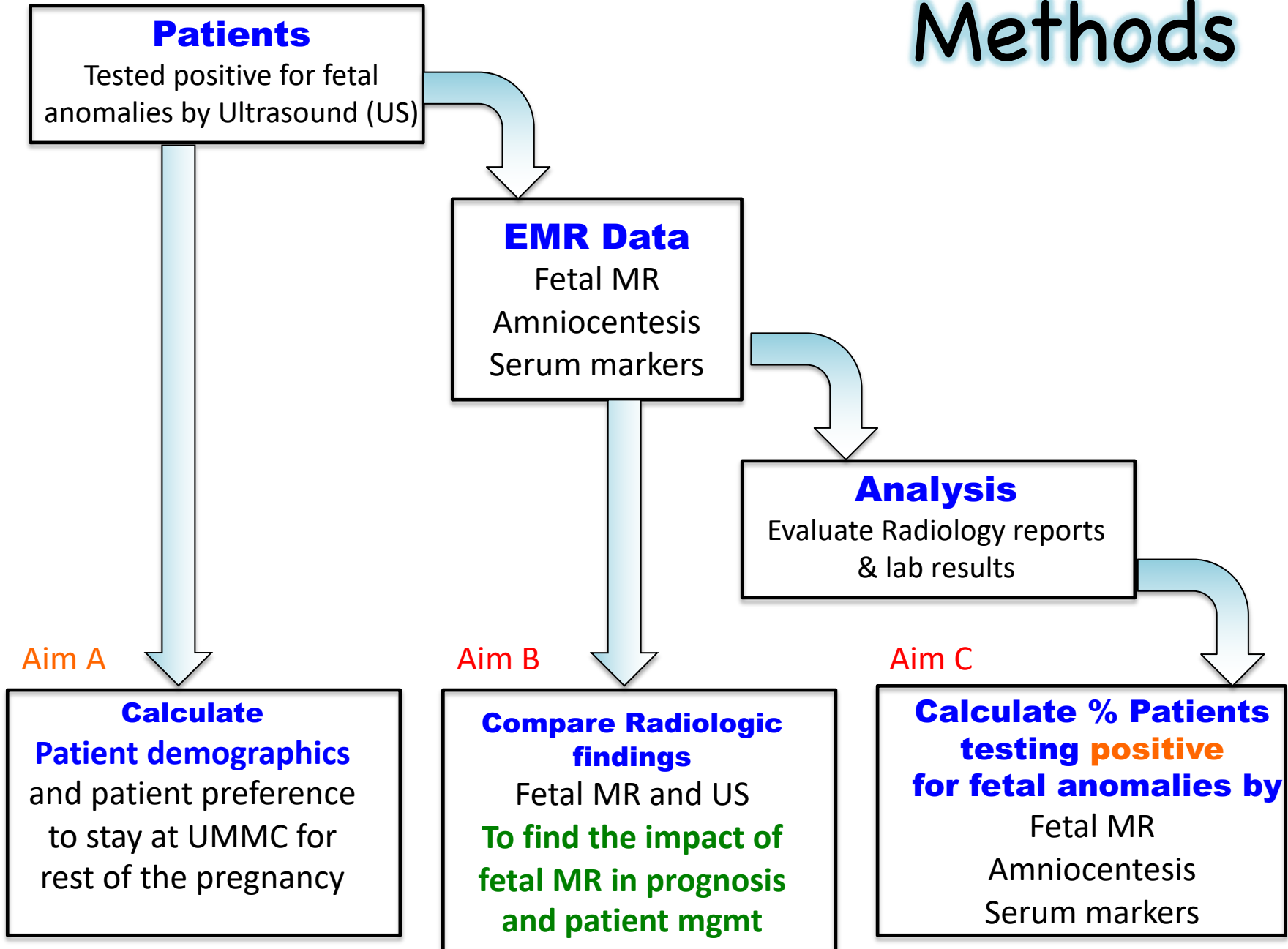
# Aim B: Results

Did fetal MR lead to significant changes in management?



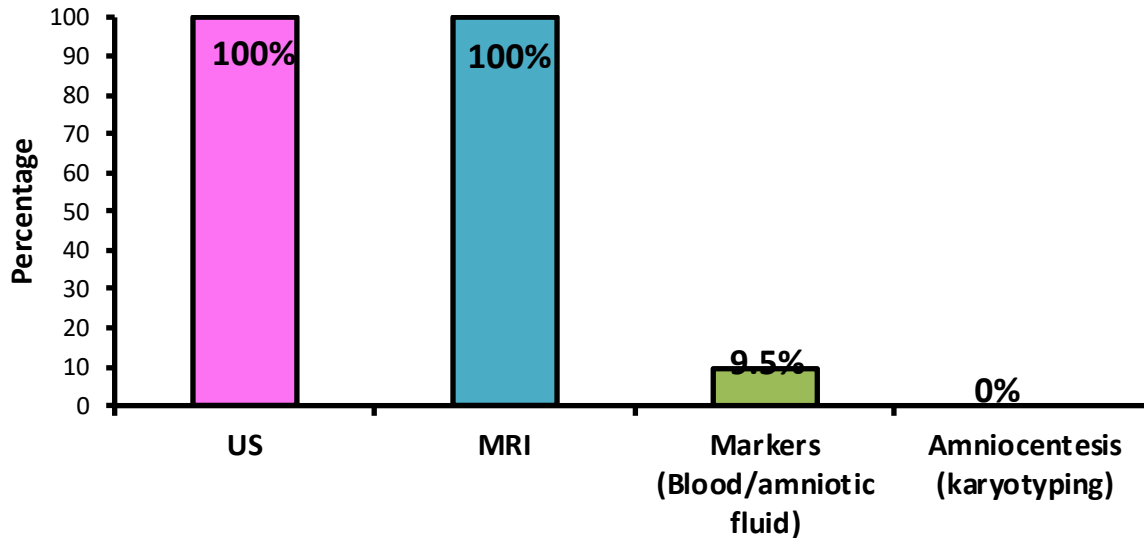
**Fetal MRI led to significant changes in pre and peri-natal management in 69% of cases.**

# Methods

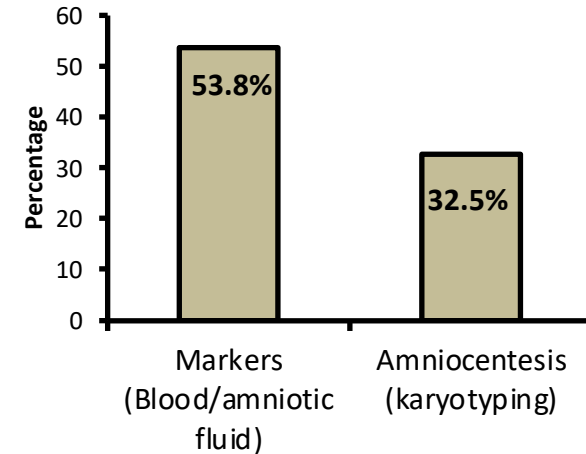


# Aim C: Results

Percentage of patients who tested positive for fetal abnormalities



Percentage of patients who got tested (markers/karyotyping)



**None** of the patients who got karyotyping (amniocentesis) and only **9.5%** of patients who got pregnancy markers tested had results **positive** for suspected fetal abnormalities



# Results Summary

- **Fetal MR** imaging demonstrated positive outcomes in patient management in a majority of cases
- **Karyotyping** and **pregnancy marker tests**: did not contribute significant impact in prenatal diagnosis in most cases in this study
- **UMass** was a patient-preferred site in managing pregnancies complicated by fetal anomalies

# Discussion

## Prior studies by others

- **The MERIDIAN trial:** 565 cases, 3 years, multicenter, prospective cohort study [1,2]
    - compared the diagnostic accuracy of US vs fetal MRI
    - diagnostic accuracy in fetal brain abnormalities:  
**US (68%) and MRI (93%)**
- 

**Our study was largely in corroboration with the above mentioned larger study**

In our study,

- Fetal MR and US were in complete agreement **in only 55% cases**
- Fetal MR refuted US findings **in 43% cases**
- Fetal MR added new findings **in 29% cases**

# Discussion

## Correlation with other prior studies

- **Anatomic subgroup analysis of the cohort from the MERIDIAN study [3,4,5] showed that:**
    - MRI had especially better diagnostic accuracy in neurological abnormalities (ventriculomegaly, posterior fossa abnormalities and failed commissuration)
- 

- In our study, neurological abnormalities were by far the most represented (47%)
- This makes fetal MR imaging a suitable and accurate diagnostic platform to re-evaluate US findings in our study

# Discussion

## Amniocentesis versus Fetal MRI- From the patients' perspective

- **Amniocentesis is more widely used than fetal MRI:**
  - However, it is an invasive test and there is relative patient reluctance in opting for amniocentesis
  - MRI was perceived as positive by pregnant women and found to be very useful in demystifying the uncertainties [6]

---

➤ **In our study:**

The majority patients (67.5%) did not choose to get amniocentesis.

In comparison,

100% of all patients who got initial US diagnosis, consented and received fetal MR imaging

# Discussion

## Diagnostic accuracy of Pregnancy marker testing & Karyotyping

- **Prior studies have shown that a large number of fetuses with congenital defects are diagnosed to be chromosomally normal [7]**
  - **Consistent with this, in our study,**
    - only 9.5% of patients who got serum marker testing &**
    - 0% of those patients who got amniocentesis**
    - tested positive for fetal anomalies**
  - (despite 100% of patients in this study being already diagnosed with congenital anomalies by US and fetal MR)*

# Future Considerations

- Recommendations for follow up MRIs

Diagnostic accuracy of US tends to get less optimal with increasing gestational age,

Whereas in the case of MRI, it gets better with increasing gestational age

- Health economics analyses

Considering costs of ultrasound, blood tests, amniocentesis and fetal MRI

For the most accurate, cost-effective and least invasive patient management strategy

# Future Considerations

- Evaluate the possibility of performing fetal MRI on fetuses at increased risk of brain abnormalities (or other organ system anomalies) despite normal ultrasound findings
- Future studies where postnatal outcomes information is also available to evaluate the impact of using the different testing modalities

# References

- 1. Use of MRI in the diagnosis of fetal brain abnormalities in utero (MERIDIAN): a multicentre, prospective cohort study.** Griffiths PD, Bradburn M, Campbell MJ, Cooper CL, Graham R, Jarvis D, Kilby MD, Mason G, Mooney C, Robson SC, Wailoo A; **MERIDIAN collaborative group.** *Lancet.* 2017 Feb 4;389(10068):538-546.
- 2. Change in diagnostic confidence brought about by using in utero MRI for fetal structural brain pathology: analysis of the MERIDIAN cohort.** Griffiths PD, Bradburn M, Campbell MJ, Connolly DJA, Cooper CL, Jarvis D, Kilby MD, Mason G, Mooney C, Robson SC, Wailoo A; **MERIDIAN Collaborative Group.** *Clin Radiol.* 2017 Jun;72(6):451-457.
- 3. Anatomical subgroup analysis of the MERIDIAN cohort: failed commissuration.** Griffiths PD, Brackley K, Bradburn M, Connolly DJA, Gawne-Cain ML, Griffiths DI, Kilby MD, Mandefield L, Mooney C, Robson SC, Vollmer B, Mason G. *Ultrasound Obstet Gynecol.* 2017 Dec;50(6):753-760.
- 4. Anatomical subgroup analysis of the MERIDIAN cohort: posterior fossa abnormalities.** Griffiths PD, Brackley K, Bradburn M, Connolly DJA, Gawne-Cain ML, Kilby MD, Mandefield L, Mooney C, Robson SC, Vollmer B, Mason G. *Ultrasound Obstet Gynecol.* 2017 Dec;50(6):745-752.



# References

- 5. Anatomical subgroup analysis of the MERIDIAN cohort: ventriculomegaly.** Griffiths PD, Brackley K, Bradburn M, Connolly DJA, Gawne-Cain ML, Griffiths DI, Kilby MD, Mandefield L, Mooney C, Robson SC, Vollmer B, Mason G. *Ultrasound Obstet Gynecol.* 2017 Dec;50(6):736-744.
- 6. MRI for Fetal Developmental Brain Abnormalities: Perspectives From the Pregnant Patient.** Lie MLS, Graham RH, Robson SC, Griffiths PD; MERIDIAN Collaborative Group. *Qual Health Res.* 2018 Jul;28(8):1295-1307.
- 7. Prenatal diagnosis of congenital anomalies.** T Todros, E Capuzzo, and P Gaglioti. *Images Paediatr Cardiol.* 2001 Apr-Jun; 3(2): 3–18.
- 8. Should we perform in utero MRI on a fetus at increased risk of a brain abnormality if ultrasonography is normal or shows non-specific findings?** Griffiths PD, Mooney C, Bradburn M, Jarvis D. *Clin Radiol.* 2018 Feb;73(2):123-134. doi: 10.1016/j.crad.2017.09.007. Epub 2017 Oct 16. Review.