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Management of Perinatal Infections
Third edition, 2022

First edition was published in 2002, a ended in 2006, second edition published 2014.

Published by th

EDITORS' NOTE

Infections in pregnancy represent a unique medical challenge as the management of both the infected woman and the developing fetus must be considered. Perinatal counselling requires a discussion of risks of transmission, interventions to prevent transmission in-utero or postnatally if possible or available, diagnosis of infection in the fetus or newborn and finally, postnatal management of the infant. Many congenital infections are asymptomatic at birth, but some can be associated with significant long-term sequelae. Some congenital infections can be successfully prevented provided adequate strategies are implemented in a timely manner. The anxiety for parents cannot be underestimated. Informed counselling aims to assist parents with the process.

These algorithms were developed to assist medical practitioners, including general practitioners, obstetricians, infectious diseases physicians and paediatricians, involved in the care of pregnant women and/or their newborn infants. The organisms were chosen as they represent infectious agents in pregnancy where information on transmission risks and maternal and perinatal management exist. Where possible, they each follow 4 themes: antenatal diagnosis, antenatal management, transmission risk and available interventions, and management of the newborn.

The algorithms are evidence based and, where data are limited, recommendations are by consensus. We sought feedback prior to finalisation from the Australasian Society for Infectious Diseases (ASID), the Australian and New Zealand Paediatric Infectious Diseases (ANZPID) group and the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG). They are only intended as guidelines. As this is a highly specialised area of obstetric and perinatal medicine, consultation of experts is recommended.

The first edition of this set of comprehensive, contemporary algorithms was published in 2002, with recommendations in 2006 and a second edition in 2014. This third edition now includes three additional infections, *Chlamydia trachomatis*, *Neisseria gonorrhoea* and Zika virus. It has been revised by the current editors, and after sourcing feedback from ASID/ANZPID and RANZCOG.

We are grateful for [illegible]

Chla

CHLAMY IA – ALGORITHM 1

DIAGN SIS F SUSPECTED MATERNA C AMYDIA TRAC MATIS INFECTI N

Routine antenatal testing in pregnancy is not reco ended[1] ut is so eti es done in high risk or high prevalence settings in Australia and New Zealand[1,2].

Risk factors for chla ydia infection which ay support testing include:

- Age < 0 years
- High risk sexual contact
- Use of illicit drugs
- A original or Torres Strait Islander or Maori or Pacific Peoples background

Test for other STIs
including HIV, syphilis and *N. go orrhoeae*

Advise to a stain fro sex or use condo s for a week fro start of treat ent and until 1 week after sexual contact(s) have been treated

IMMEDIATE TREATMENT
Azithromycin 1g orally as a single dose
Alternative regi ens include:
A oxicillin 500 g PO TDS for 7 days[d]
Erythro ycin base 500 g PO QID for 7 days

Ongoing antenatal care as planned

TEST OF CURE: 3 – 4 weeks post treatment
(to docu ent chla ydial eradication)
Repeat first-void urine or vaginal swab PCR

RETESTING 3 MONTHS POST-TREATMENT
(to rule out re-infection prior to delivery)[f]

COMMENTS

a. Chla ydia is the ost frequently reported sexually trans itted infection (STI) in Australia; and is ~ 10 ti es ore prevalent than *Neisseria go orrhoeae* infections in wo en of childbearing age (https://data.kirby.unsw.edu.au/STIs)[4] Si ilarly, in New Zealand, chla ydia is the co onest reported STI with prevalence about 4 -5 ti es higher than gonorrhoea (https://www.esr.cri.nz/our-services/consultancy/public-health/sti/)[5]

b. Most infections in wo en (~80%) are asy pto atic, and exa ination is nor al. The "

CHLA

Cytomegalovirus

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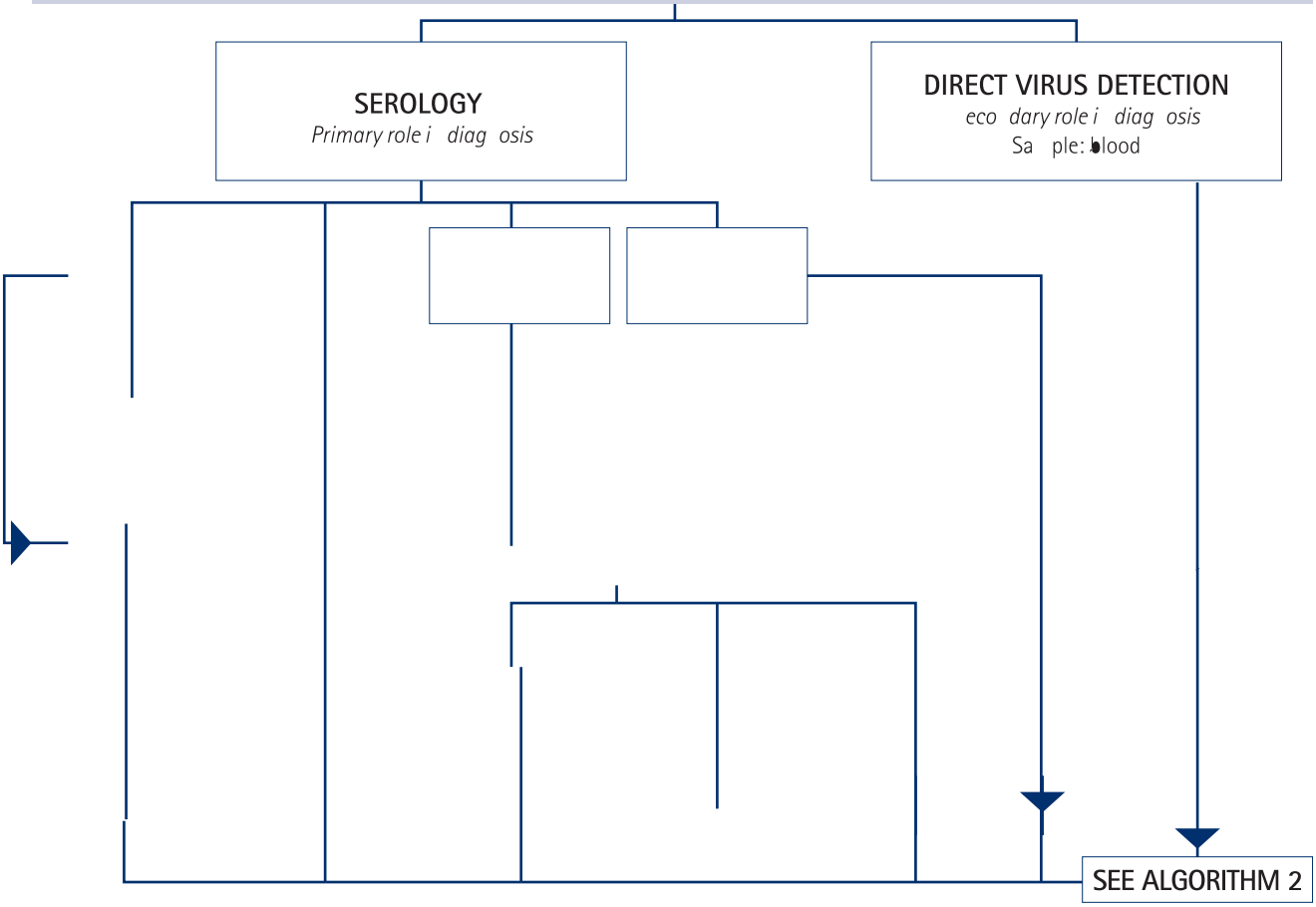
CYTOMEGALOVIRUS (CMV) – ALGORITHM 1

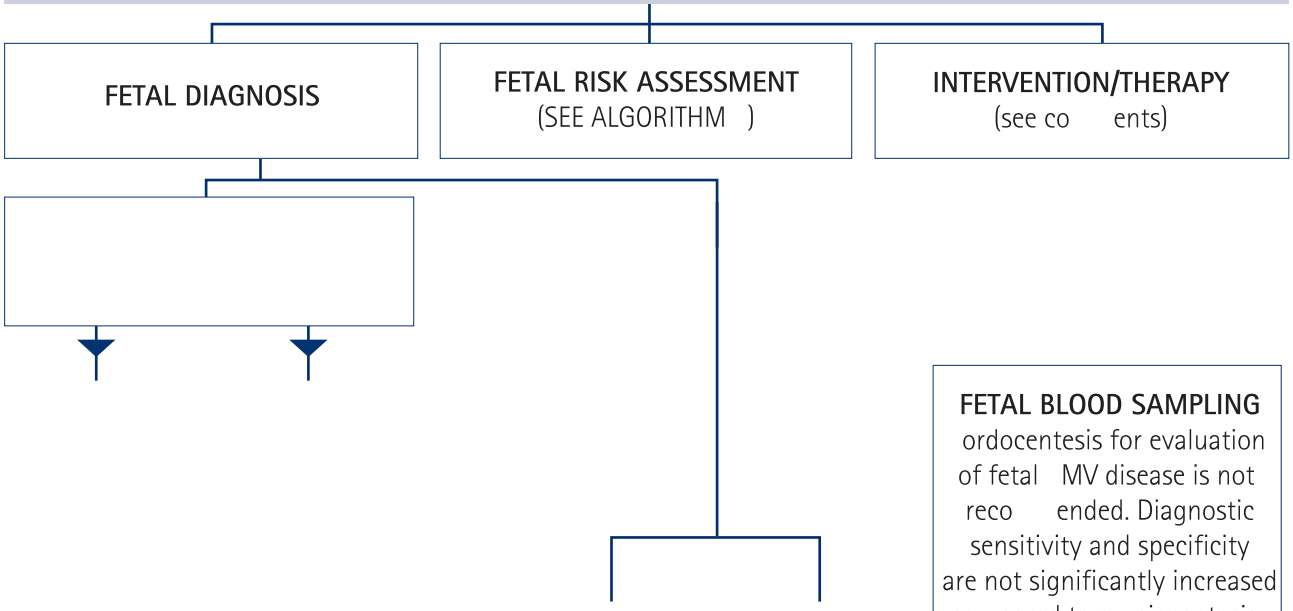
MATERNA DIAGN SIS[1]



Routine ant

CYTOMEGALOVIRUS – ALGORITHM 2

ANTENATA MANAGEMENT F MATERNA CMV INFECTI N



COMMENTS

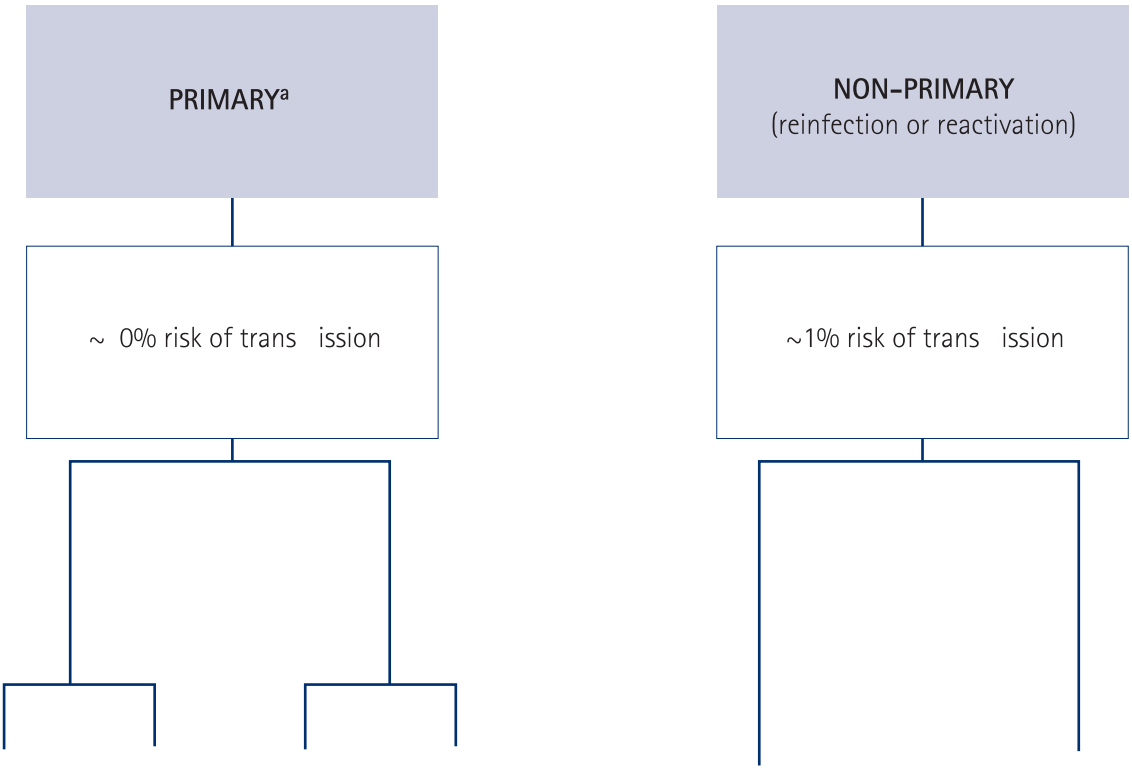
a. Fetal ultrasound:[14,15] Features associated with congenital MV infection (c MV) include
   - Microcephaly
   - ereb•ral ventriculo egaly
   - Intrauterine growth restriction (IUGR)
   - Ascites
   - Intracranial calcification
   - Pleural or pericardial effusions
   - A niotic fluid ab•nor alities (oligohydra nios or polyhydra nios)
   - Hydrops fetalis
   - Hepato egaly
   - Ab•do inal calcification
   - Pseudo econiu ileus
   - Hyperechoic b•owel

   aution is advised in interpretation of findings as presence of signs not always predictive of degree of fetal da age. The sensitivity of fetal ultrasound is difficult to evaluate fro the literature, with an overall esti ate of ~ 0–50% sensitivity for detecting sy pto atic congenitally infected infant. The risk of severe sequelae ay b•e significantly reduced if antenatal ultrasounds and MRI are nor al [15,16]

b. Fetal (in-utero) investigations: a niocentesis [1,15]
   - Sensitivity is increased b•y waiting ≥ 6 weeks after aternal infection
   - The ti ing of a niocentesis: If perfor ed ≥21 weeks of gestation and ≥ 6 after aternal infection, sensitivity is high (85 - 95%) and specificity approaches 100%. Reports of c MV after a negative MV P R are unco on (possib•le later MV trans ission) and significant sequelae in newb•orns unlikely.[17] Testing for MV at b•irth is reco ended
   - Diagnosis is b•est achieved b•y a co b•ination of fetal ultrasound + a niocentesis (for MV P R)
   - Positive results cannot predict degree of fetal da age
   - The value of quantitative P R to predict severity of c MV

CYTOMEGALOVIRUS – ALGORITHM 3

RIS ESTIMATES F FETA TRANSMISSI N



COMMENTS

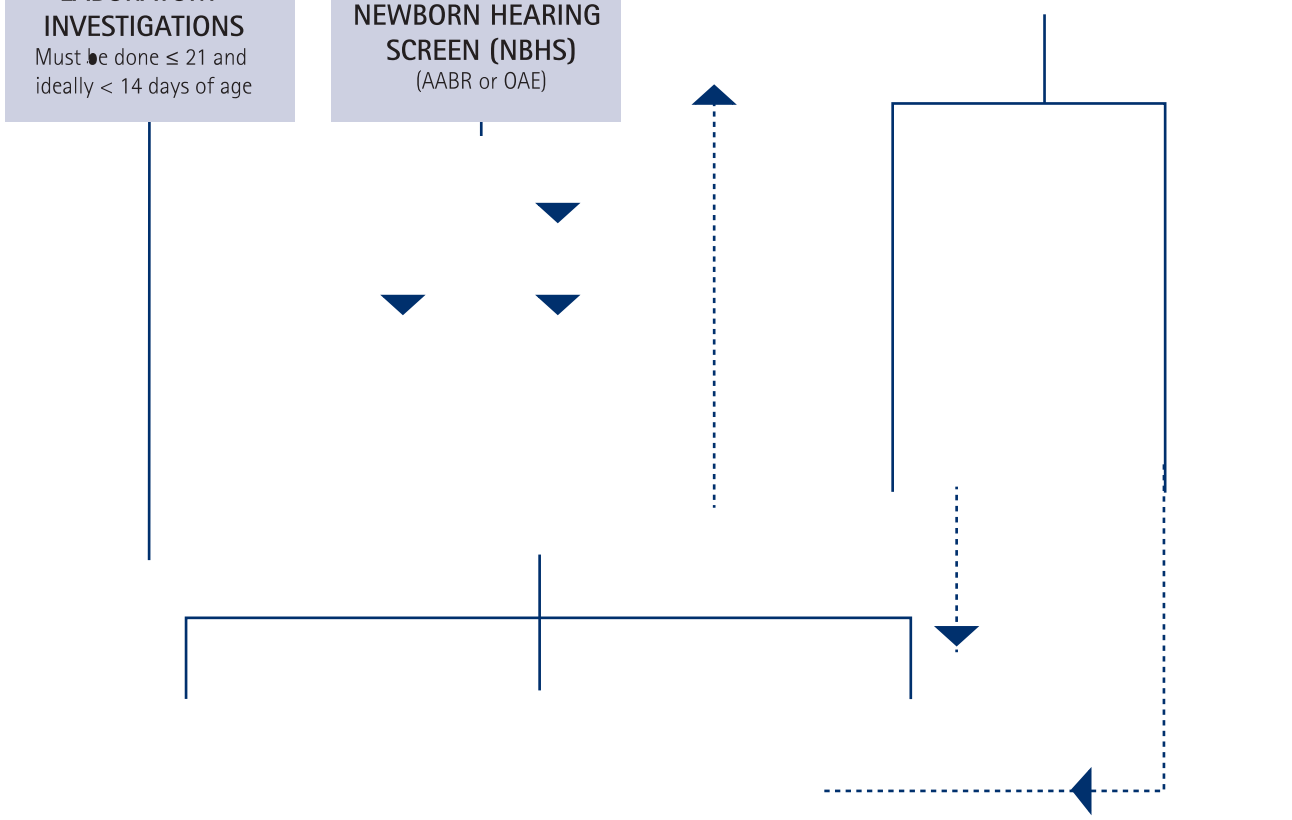
CYTOMEGALOVIRUS – ALGORITHM 4

NE NATA DIAGN SIS AND MANAGEMENT[1,35]

AABR: Auto ated Auditory Brainste Response
OAE: Otoacoustic E issions
ABR: Auditory Brainste Response

LABORATORY INVESTIGATIONS
Must be done ≤ 21 and ideally < 14 days of age

NEWBORN HEARING SCREEN (NBHS)
(AABR or OAE)



Suggested clinical follow-up:

- Audiological assess ents (6 onthly up to age 2)

COMMENTS

a. Other tests at birth: CMV IgM ay be helpful if positive but generally not done (low sensitivity test). The standard test is the urine CMV PCR +/- saliva CMV PCR FBE & differential, LFT if there are clinical concerns

b. In about half of cCMV infections, SNHL will not be identified at birth, but the infant is at risk of later onset SNHL

c. cCMV infected babies are high CMV shedders (urine), particularly in the first year of life

Table 2 : Symptoms associated with congenital CMV [1,35,36]

Moderately to severely sy pto atic congenital CMV disease

- Multiple anifestations attributable to congenital CMV infection: thro bocytopenia, petechiae, hepato egaly, spleno egaly, intrauterine growth restriction, hepatitis (raised transa inases or bilirubin), or
- Central nervous syste involve ent such as icrocephaly, radiographic abnor alities consistent with CMV central nervous syste disease (ventriculo egaly, intracerebral calcifications, periventricular echogenicity, cortical or cerebellar alfor ations), abnor al cerebrospinal fluid indices for age, chorioretinitis, sensorineural hearing loss, or the detection of CMV DNA in cerebrospinal fluid

Mildly sy pto atic congenital CMV disease

- Might occur with one or two isolated anifestations of congenital CMV infection that are ild and transient (eg, ild hepato egaly or a single easure ent of low platelet count or raised levels of alanine a inotransferase). These ight overlap with ore severe anifestations. However, the difference is that they occur in isolation

Asy pto atic congenital CMV infection with isolated sensorineural hearing loss

- No apparent abnor alities to suggest congenital CMV disease, but sensorineural hearing loss (≥21 decibels)

Asy pto atic congenital CMV infection

- No apparent abnor alities to suggest congenital CMV disease, and nor al hearing

CYT ME

Enterovirus

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N onatal inf ctions

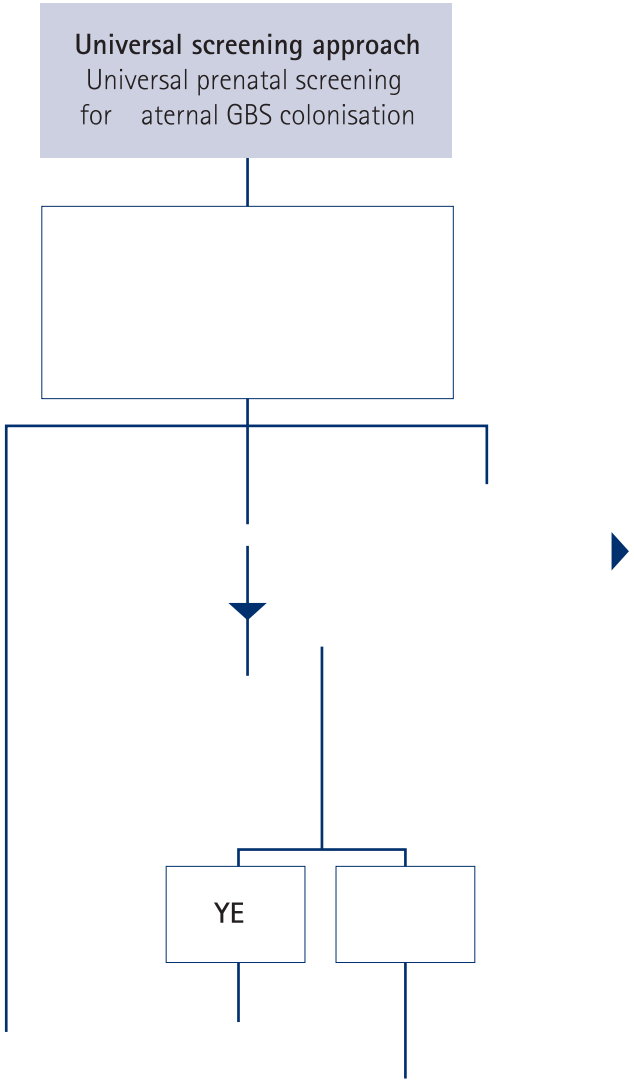
nt rovirus

- Wide spectru of clinical presentations, fro non-specific febrile illness to fatal ultisyste disease
-

Group B

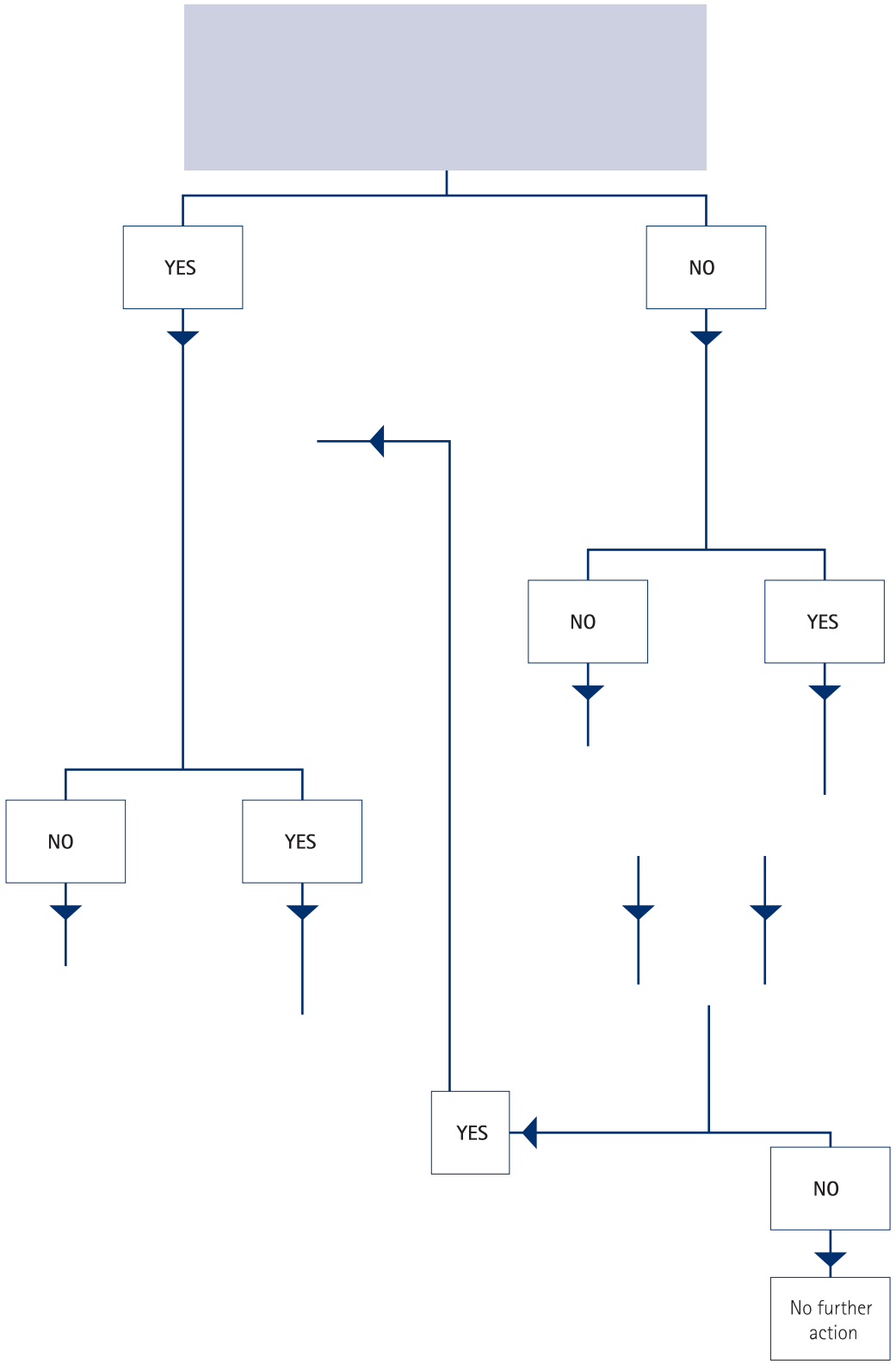
GROUP B STREPTOCOCCUS (GBS) – ALGORITHM 1

MANAGEMENT F PREGNANCY WIT RESPECT T GBS INFECTI N



GROUP B STREPTOCOCCUS – ALGORITHM 3

MANAGEMENT F INFANT AT RISK F GBS SEPSIS*



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Hepatitis B virus

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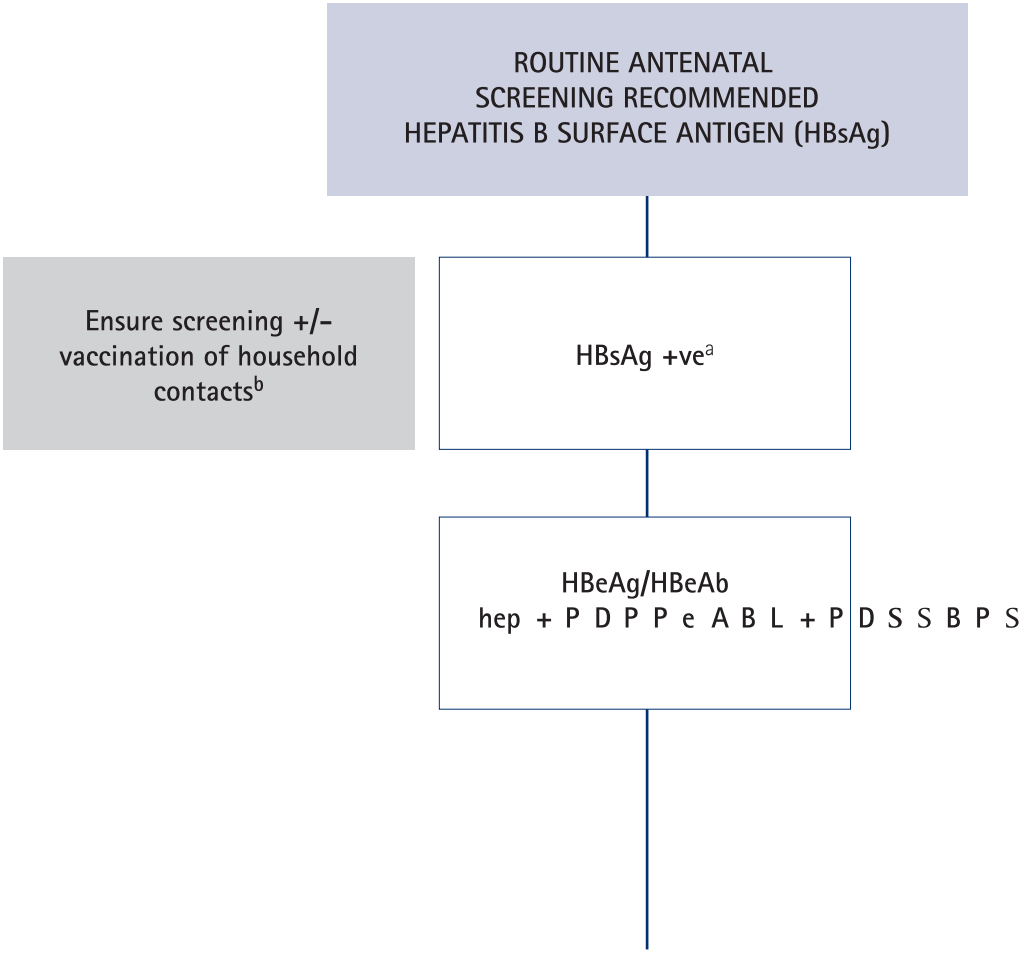
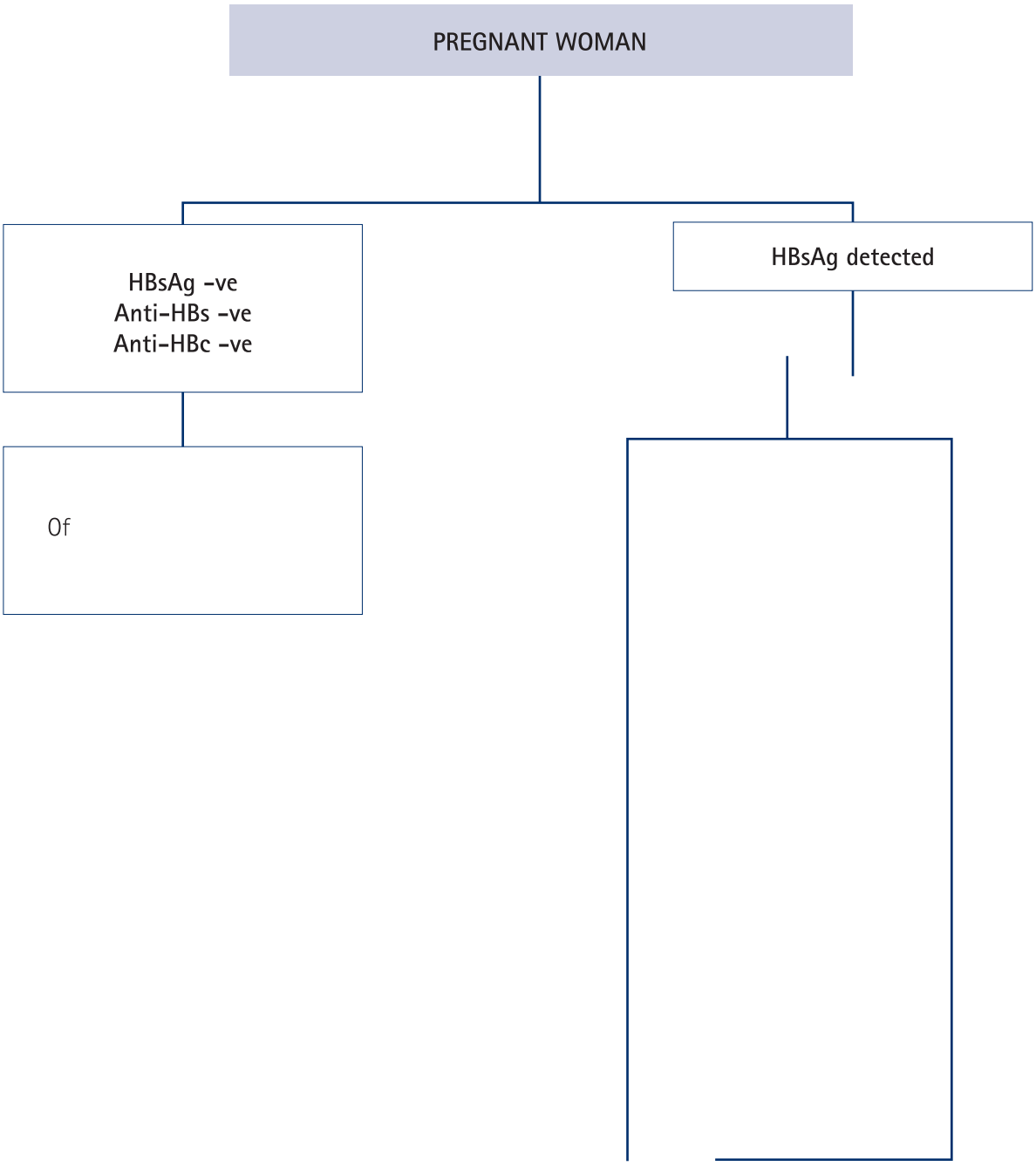
HEPATITIS B VIRUS – A GORITHM 1

MATERNA DIAGN SIS AND ASSESSMENT



HEPATITIS B VIRUS – ALGORITHM 2

ANTENATAL MANAGEMENT F EPATITIS B INFECTI N



HEPATITIS B VIRUS – ALGORITHM 3

NE NATA DIAGN SIS AND MANAGEMENT

MATERNAL SEROLOGY:
HBsAg positive
heck aternal records for H V and HIV

There is insuff

HEPATITIS B
RE ERENCES

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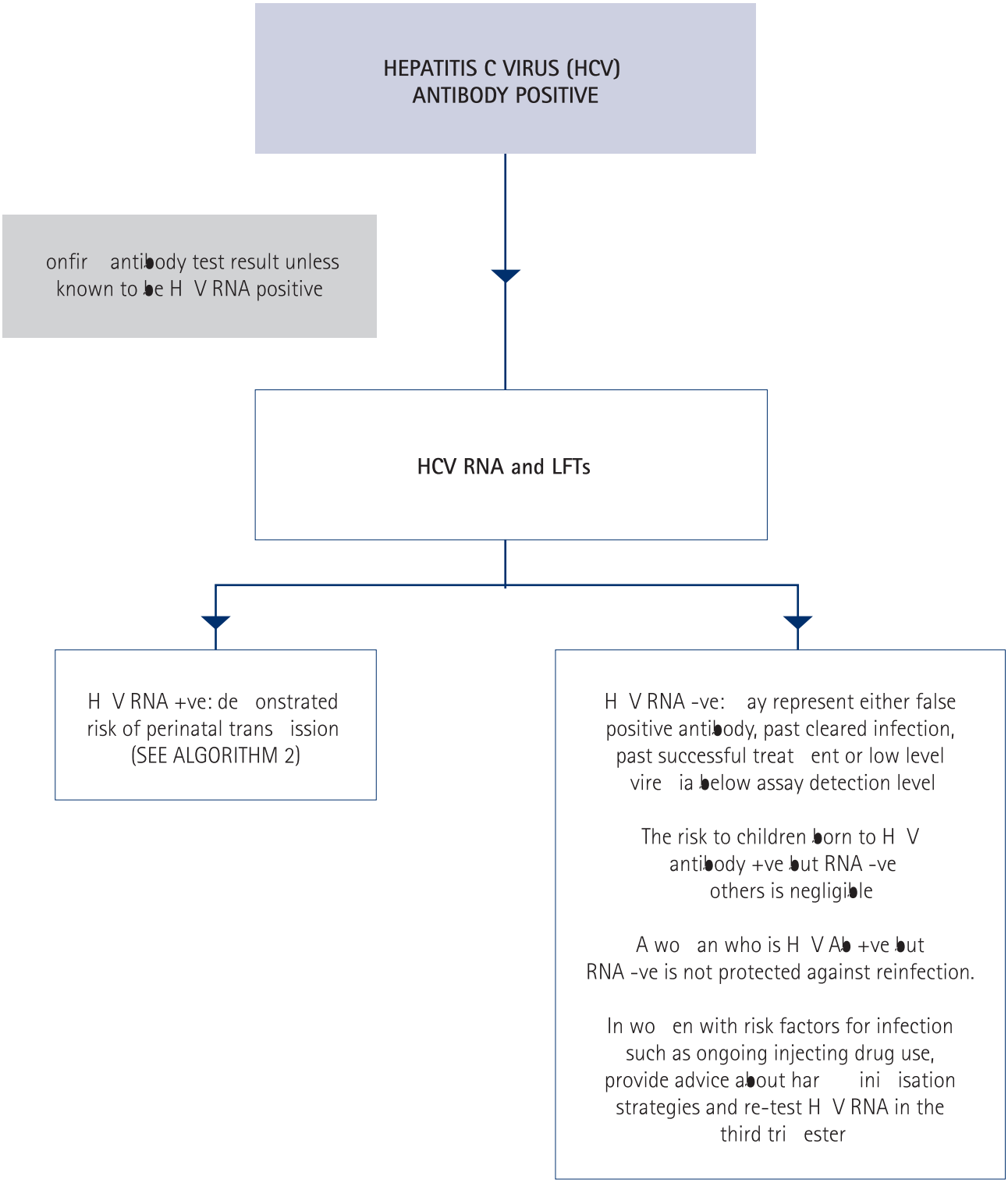
Hepatitis C virus

AUSTRALASIAN SOCIETY FOR INFECTIOUS DISEASES 2022

HEPATITIS C VIRUS – ALGORITHM 1

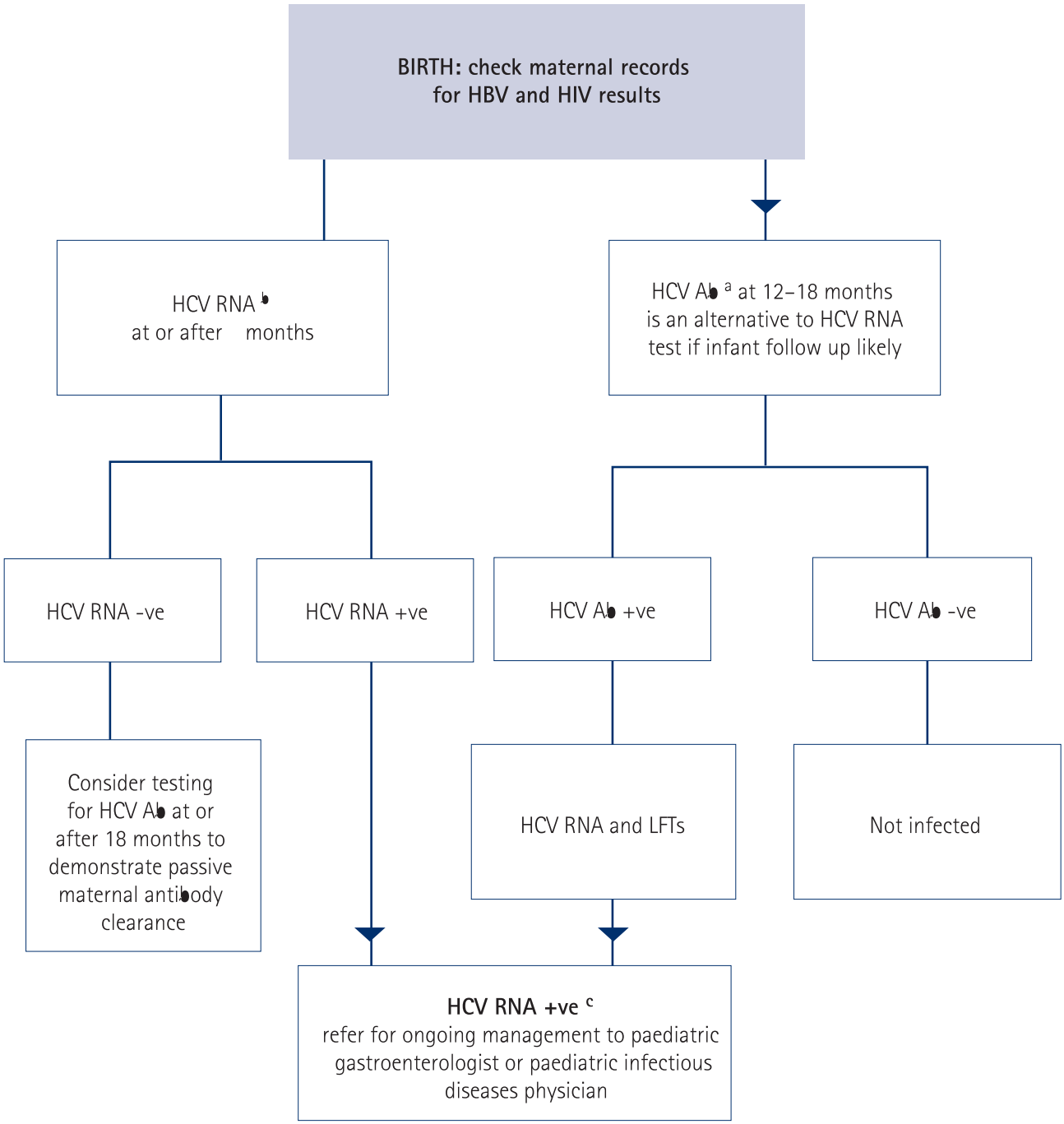
ANTENATA DIAGN SIS F EPATITIS C



HEPATITIS C VIRUS – ALGORITHM 2

HEPATITIS C VIRUS – ALGORITHM 3

MANAGEMENT AND F W UP F INFANTS F EPATITIS C INFECTED M T ERS



COMMENTS

a. Most uninfected infants are antibody negative by 12 months. In a prospective study on uninfected infants

HEPATITIS C
RE ERENCES

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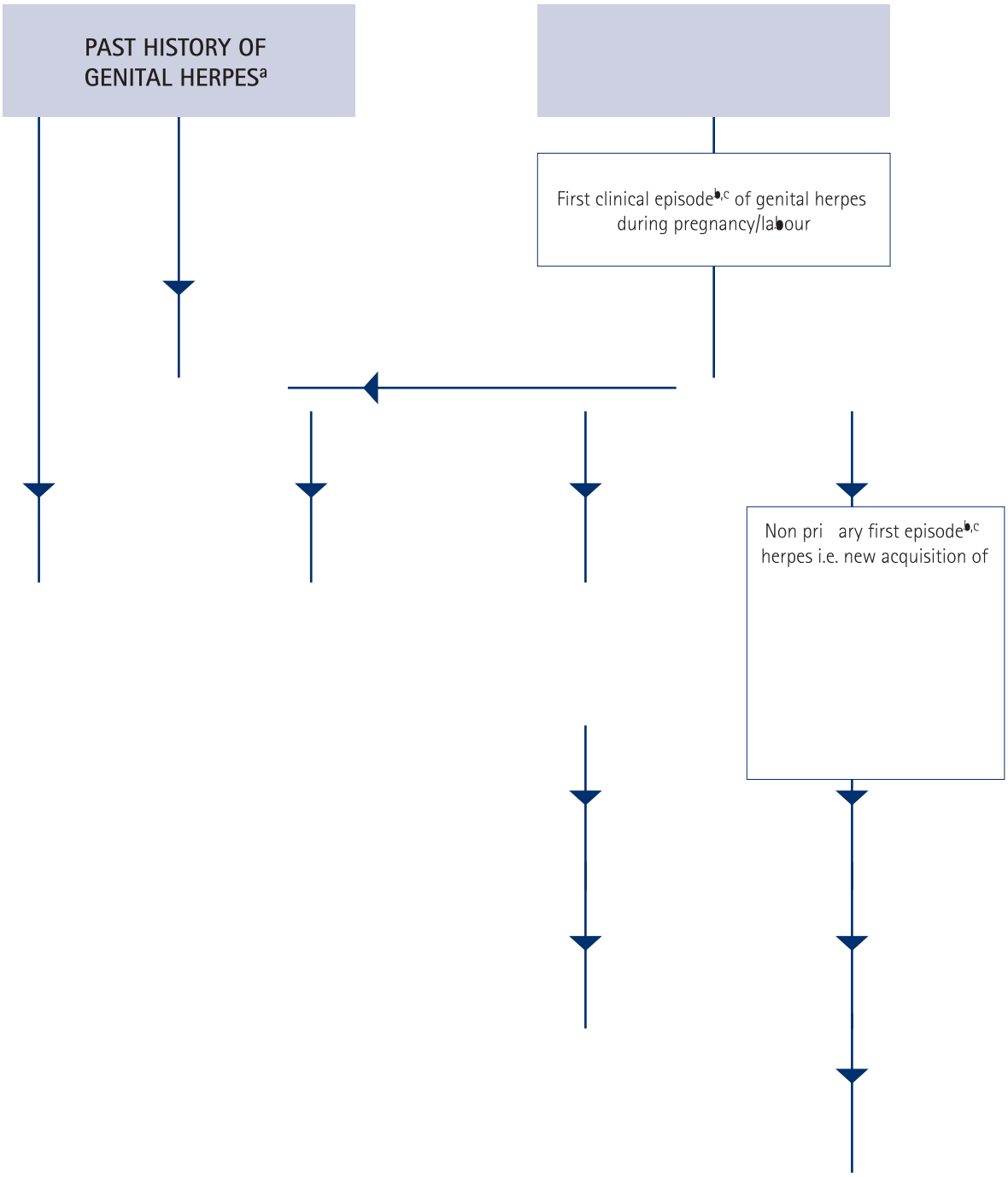
Herpes simplex virus

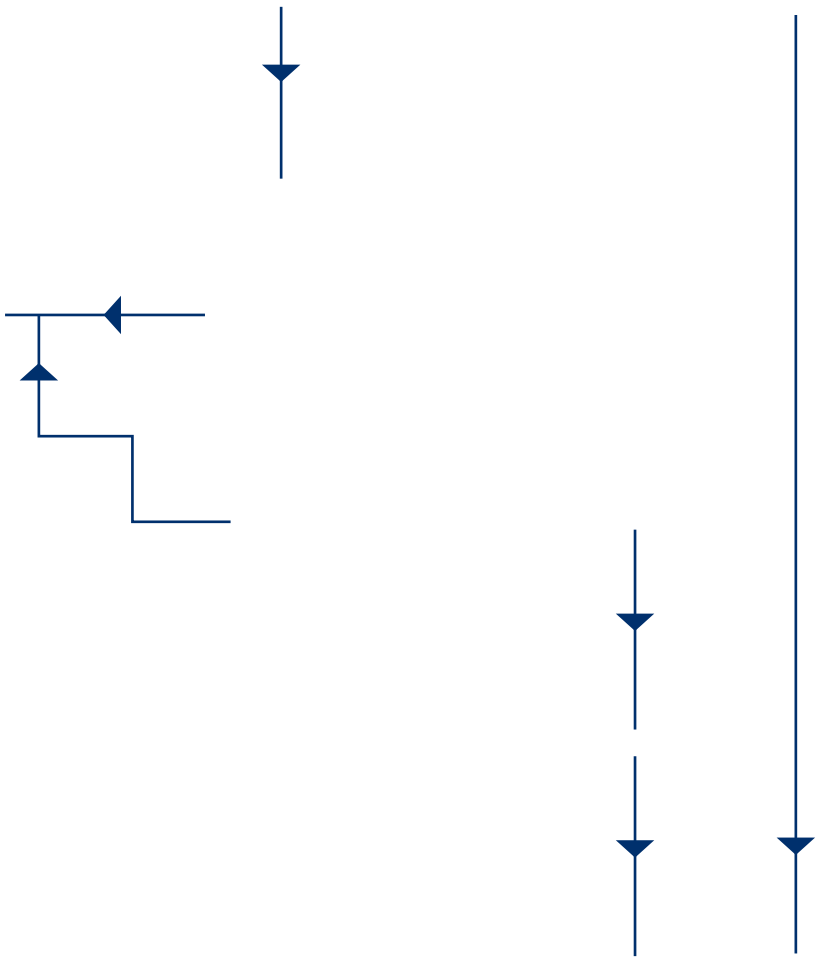
AUSTRALASIAN SOCIETY FOR INFECTIOUS DISEASES 2022

HERPES SIMPLEX VIRUS (HSV) – ALGORITHM 1

GENITAL V IN PREGNANCY: RI F M T ER T C ILD TRAN MI I N (MTCT)



HERPES SIMPLE VIRUS – ALGORITHM 2 2

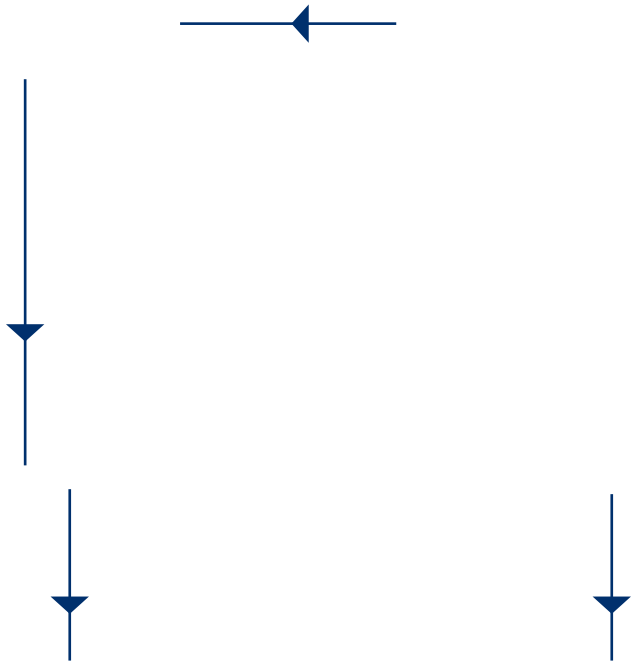


HERPES SIMPLE VIRUS – ALGORITHM 3

MANAGEMENT F ASYMPT MATIC NE NATE B RN T M T ER WI

HERPES SIMPLE VIRUS – ALGORITHM 4

SV INFECTI NS IN PREGNANCY: NE NATA MANAGEMENT



COMMENTS

HERPES SIMPLEX VIRUS
RE ERENCES

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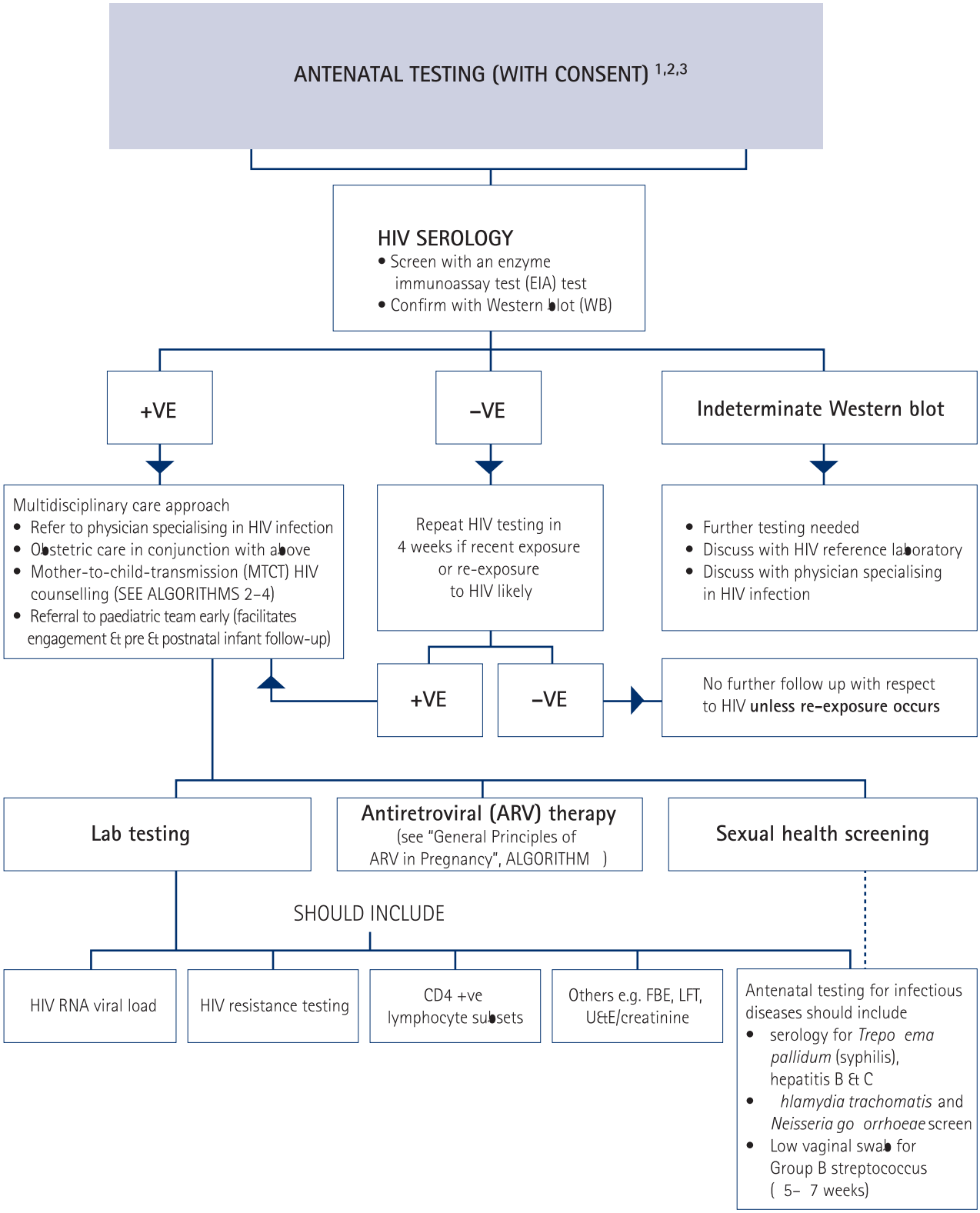
Human immunodeficiency virus

AUSTRALASIAN SOCIETY FOR INFECTIOUS DISEASES 2022

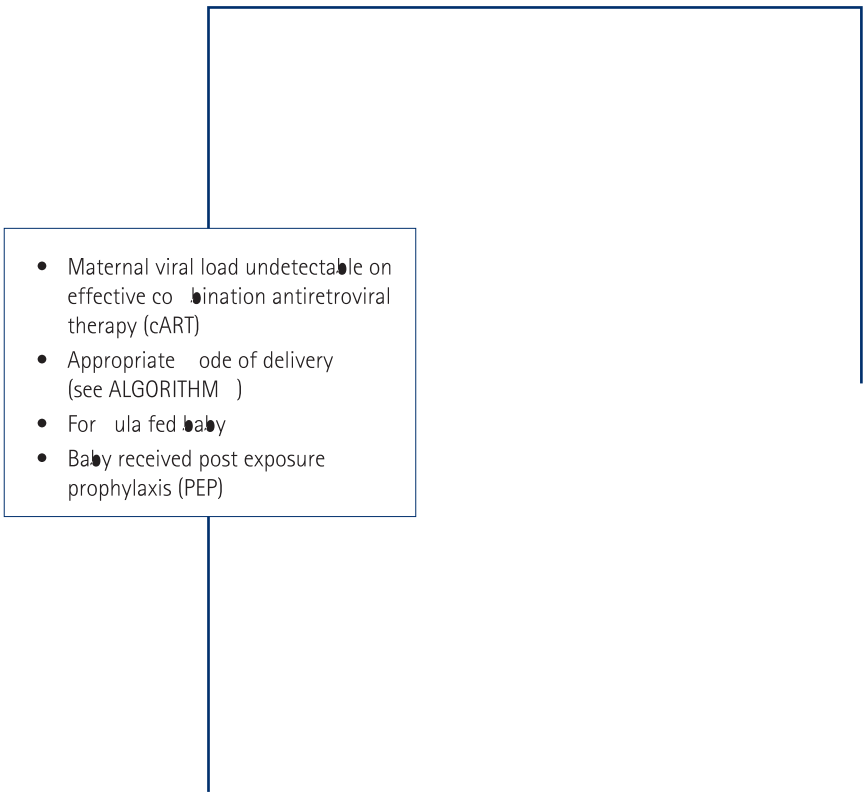
HUMAN IMMUNO EFICIENCY VIRUS (HIV) – ALGORITHM 1

DIAGN SIS F IV INFECTI N IN PREGNANCY



COMMENTS

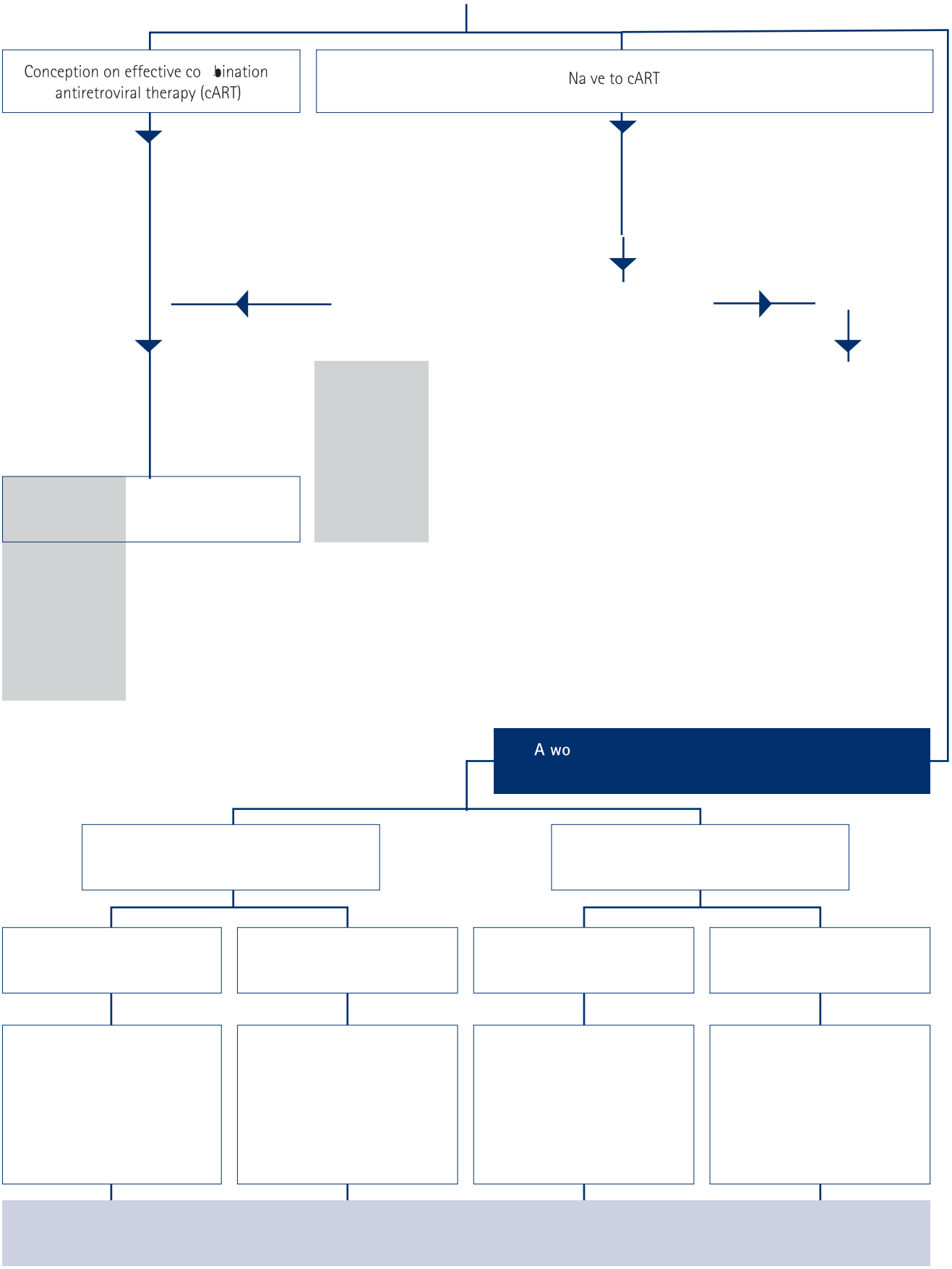
a. Antenatal testing for HIV is recommended to allow for the opportunity to implement MTCT prevention strategies



* The definition of "undetectable" ay vary according to which HIV RNA assay is used.

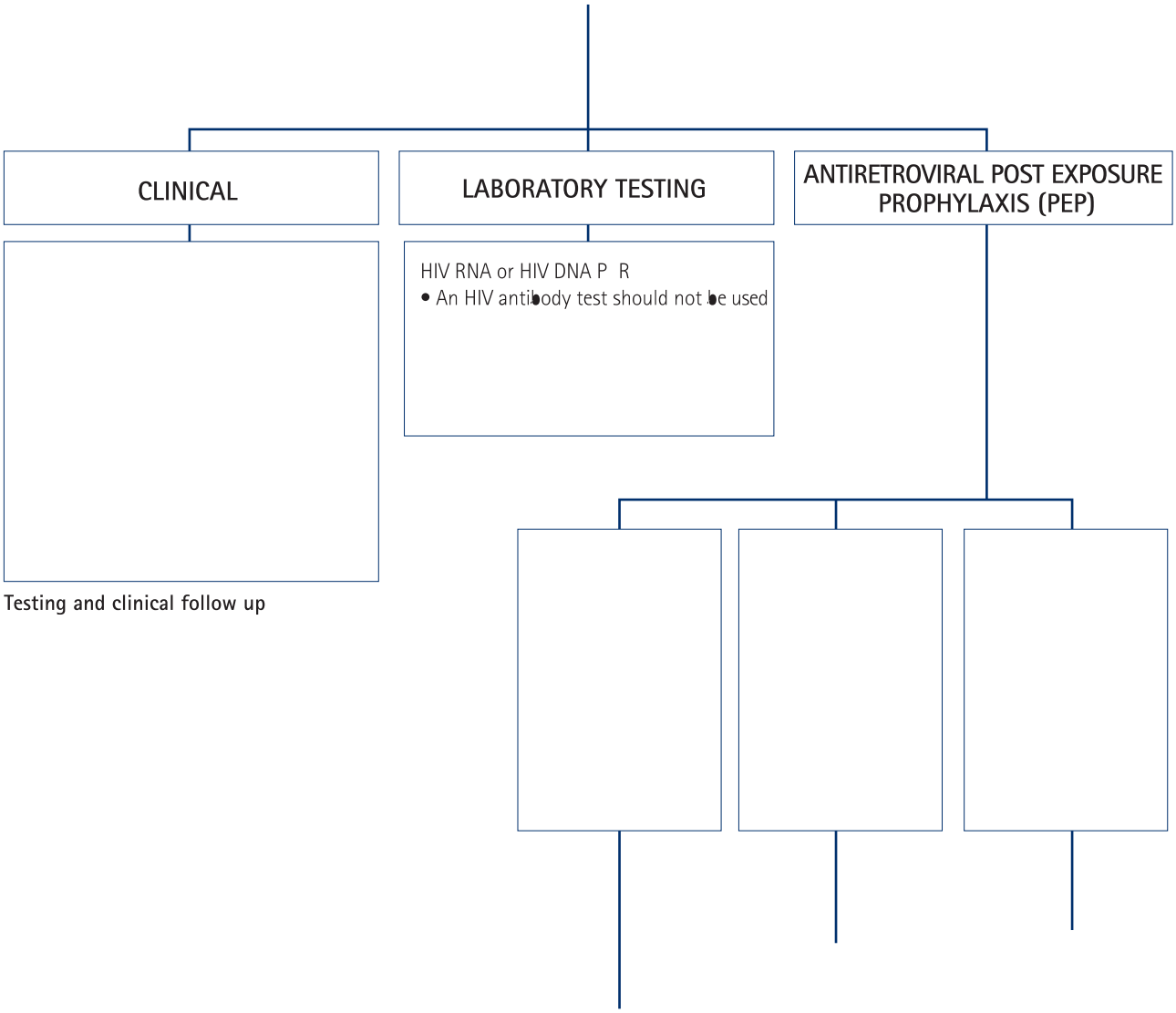
HUMAN IMMUNODEFICIENCY VIRUS – ALGORITHM 3

STRATEGIES T MINIMISE MTCT IV



HUMAN IMMUNODEFICIENCY VIRUS – ALGORITHM 4

MANAGEMENT F INFANT AT RISK F MTCT IV [11,12]



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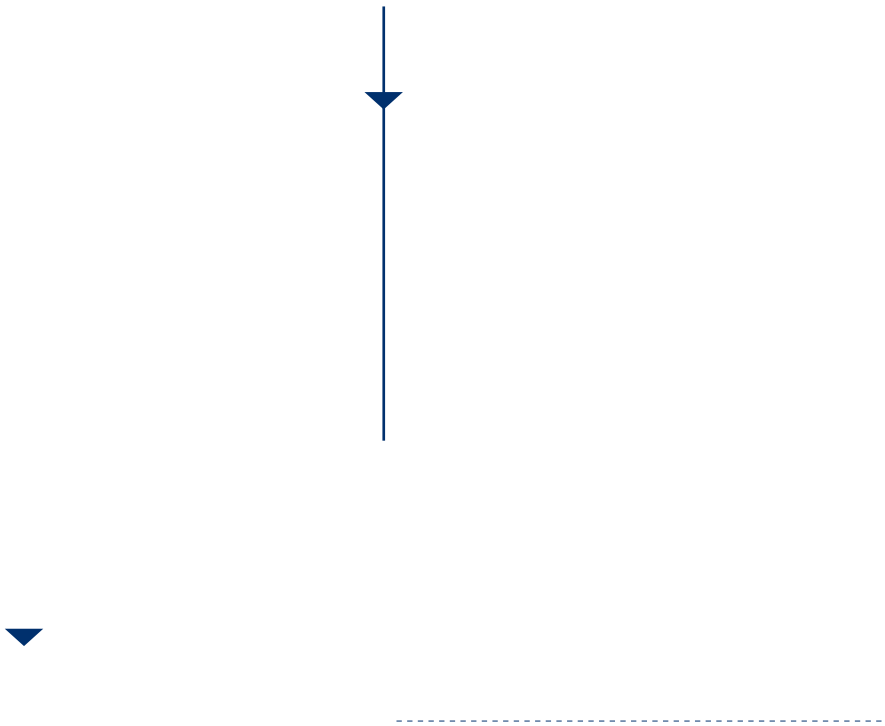
Listeria

AUSTRALASIAN SOCIETY FOR INFECTIOUS DISEASES 2022

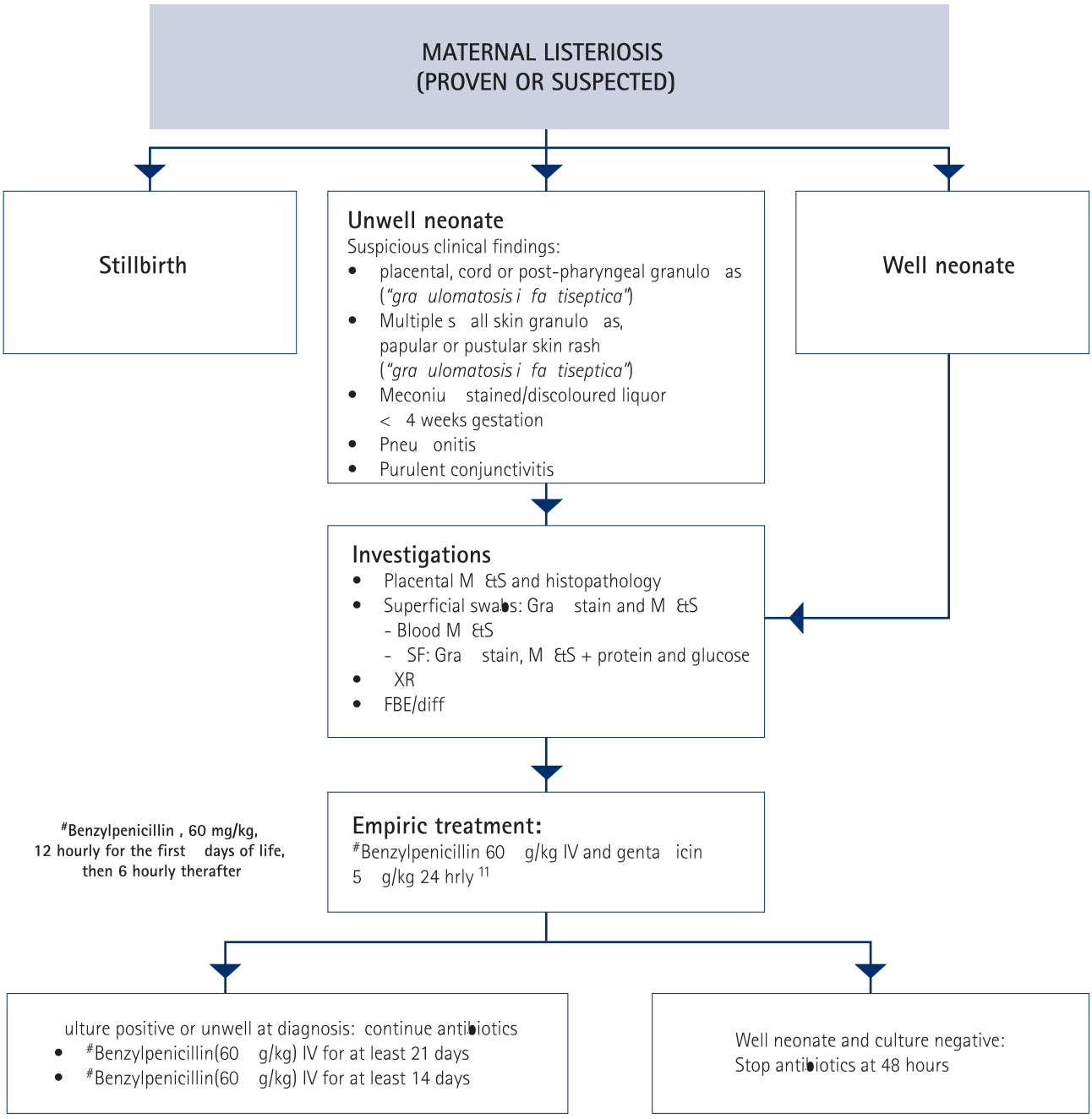
LISTERIA – ALGORITHM 1

DIAGN SIS F SUSPECTED MATERNA ISTERI SIS AND MANAGEMENT
F PR VEN MATERNA INFECTI N



LISTERIA – ALGORITHM 2

DIAGN SIS AND MANAGEMENT F INFANT AT RIS F PERINATA ISTERI SIS



COMMENTS

- Preter delivery is co on. Mortality rates range fro 20-60% in infected neonates born alive [2,6]
- Perinatal listeria infection can present as **early onset disease** (within 7 days of birth, ean 1.5 days) often associated with pre aturity and ful inant disease. Mortality is high (20–60%) [6]
- **Late onset disease** occurs typically in ter infants (4 - 6 weeks, ean onset ~14 days), often presenting with eningitis, but can be ore non-specific sepsis (fever, irritability, anorexia, diarrhoea, lethargy). Mortality is 10–20% [,6]
- Gra stain and M &S of swabs of the placenta, econiu , rectu and external ear canal have a high yield in identifying the organis [12]
- Opti al anti icrobial therapy for various anifestations of listeriosis has not been established in controlled clinical trials and re ains controversial. No controlled trials available to establish a drug of choice or duration of therapy [,4,10]
- Alternative antibiotics: Tri ethopri /sulfa ethoxazole reserved in the event of lack of response to standard therapy; Rifa picin effective in vitro but inadequate clinical infor ation available; Erythro ycin should not be used in eningitis as acrolides penetrate the blood brain barrier poorly
- Linezolid and quinolones are not reco ended in pregnancy or newborns
- There is no role for cephalosporins as listeria is resistant to this class of antibiotics

LISTERIA
APPENDIX AND RE ERENCES

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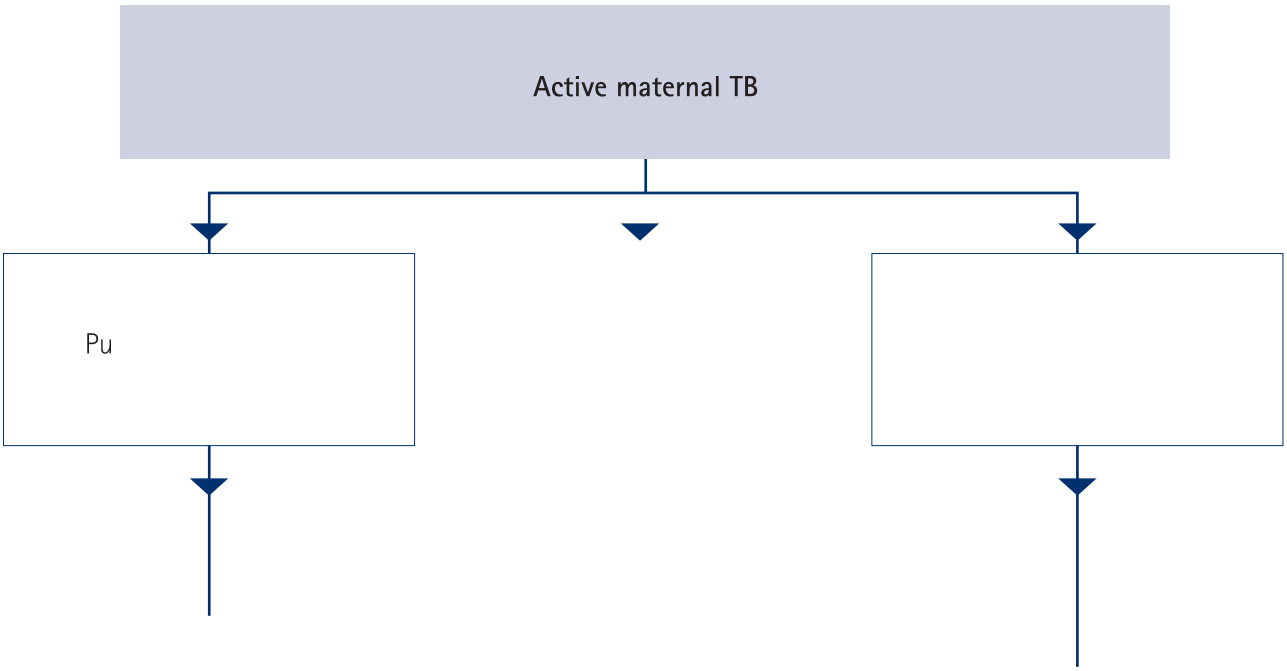
Mycobacterium tuberculosis

AUSTRALASIAN SOCIETY FOR INFECTIOUS DISEASES 2022

MYCOBACTERIUM

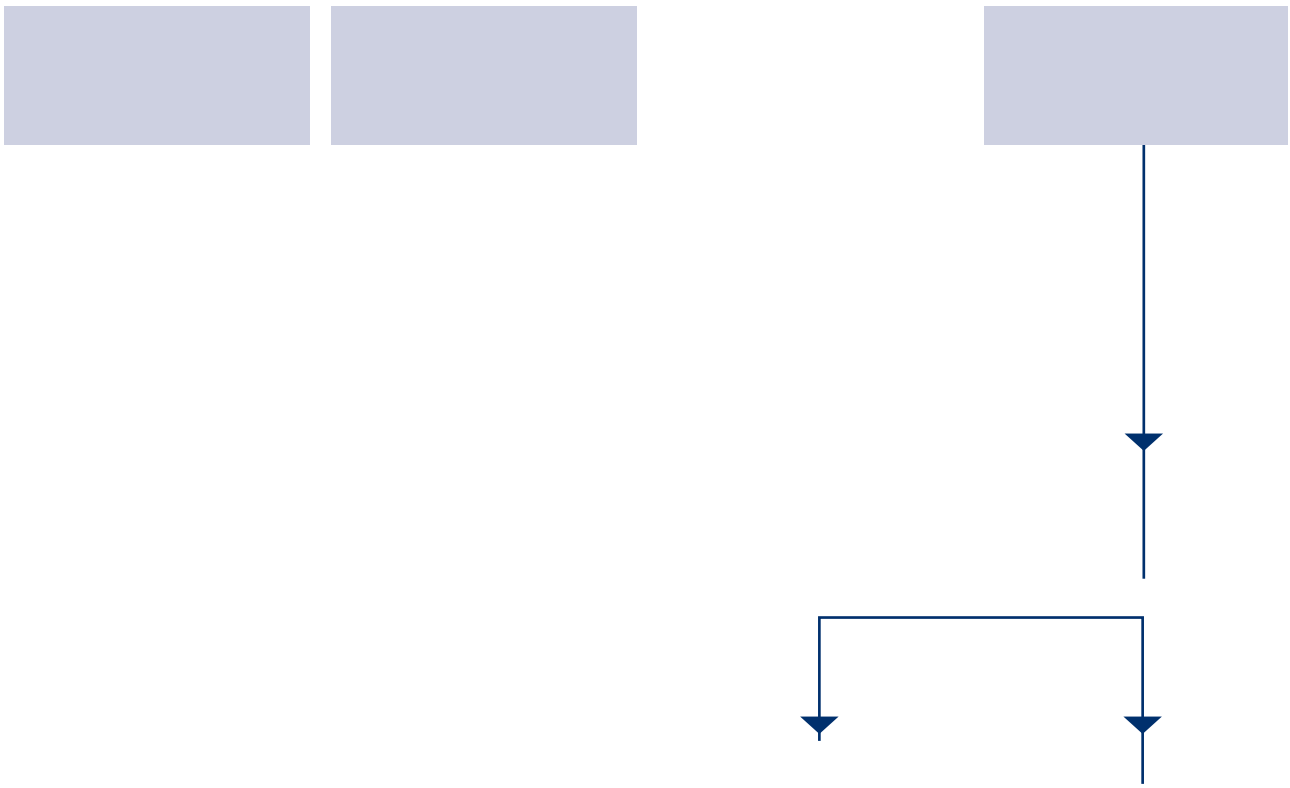
MYCOBACTERIUM TUBERCULOSIS – ALGORITHM 2

MANAGEMENT F PR VEN MATERNA TB



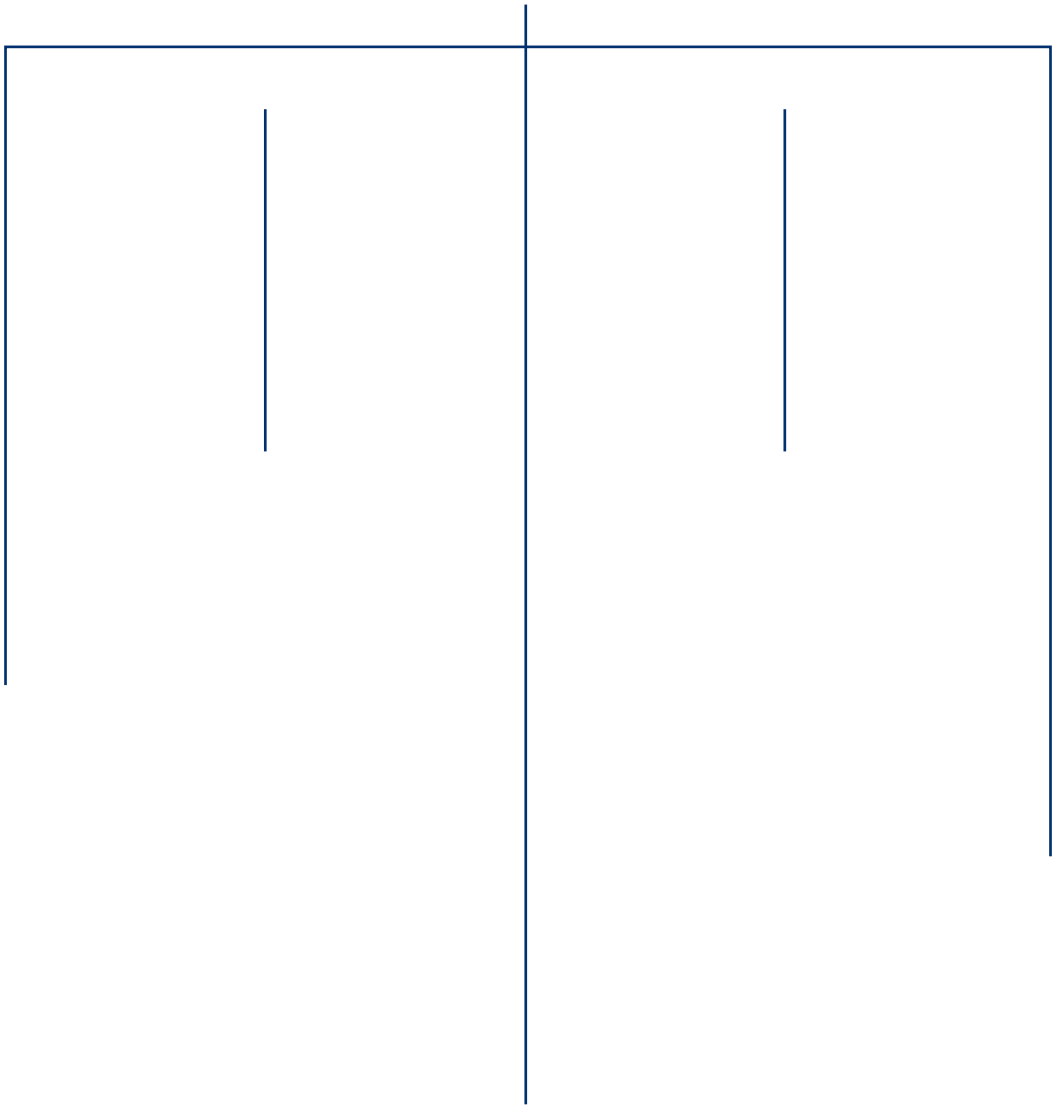
MYCOBACTERIUM TUBERCULOSIS – ALGORITHM 3

MANAGEMENT F T E NE NATE



NEISSERIA GONORRHOEAE – ALGORITHM 2

P STNATAL MA



NEISSERIA N RRH EAE RE ERENCES

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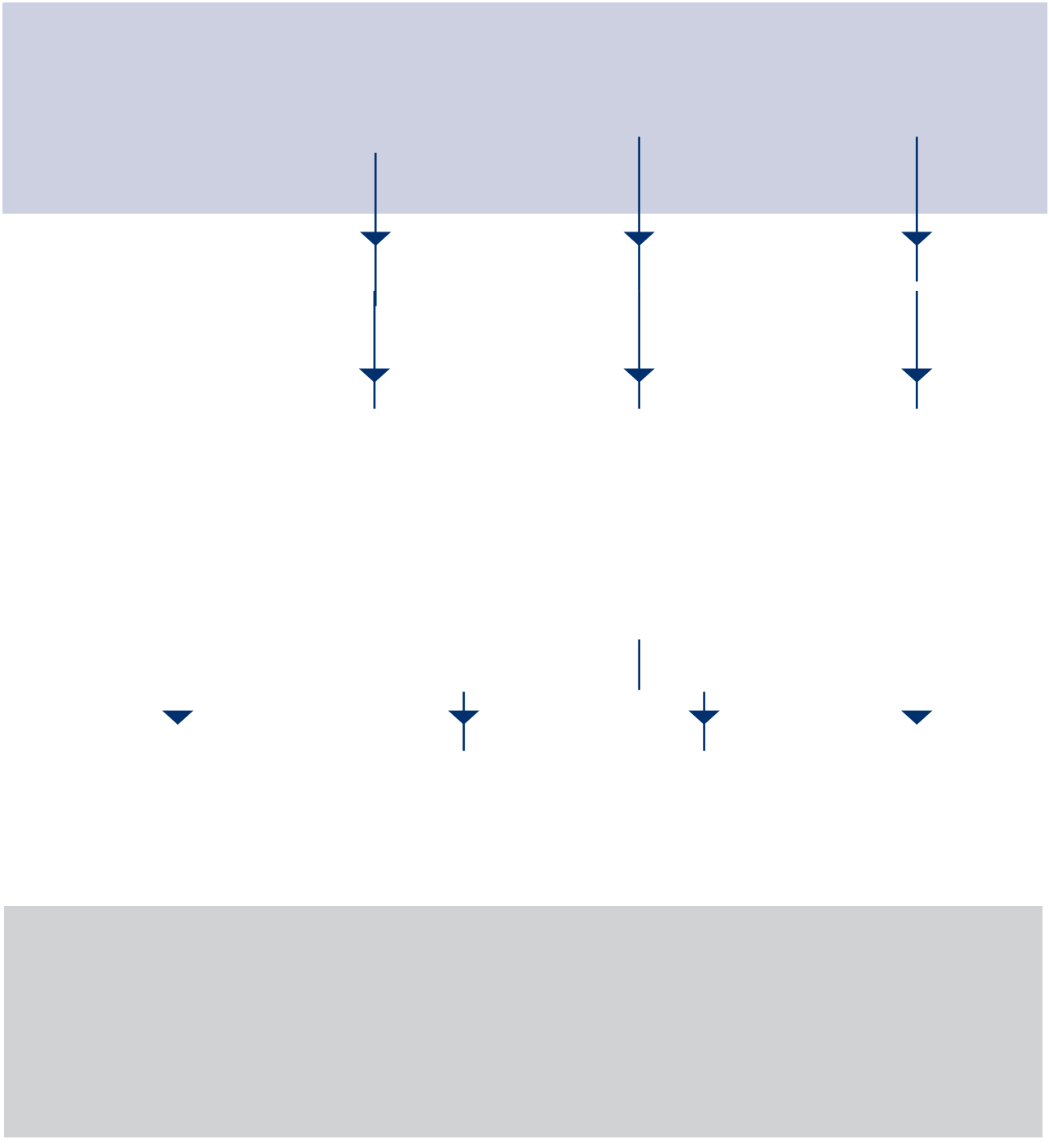
PARVOVIRUS – ALGORITHM 1

RIS ASSESSMENT

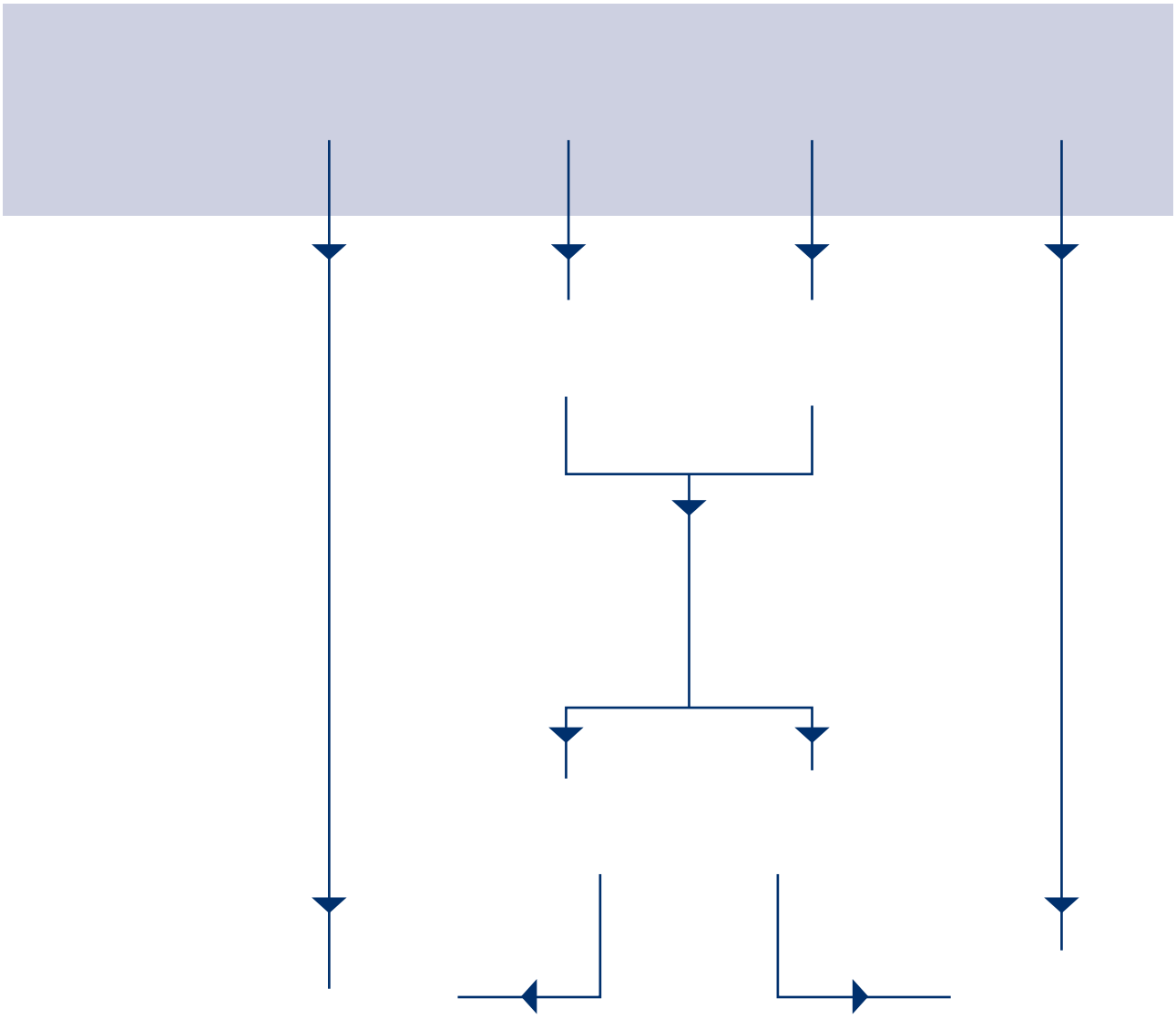


COMMENTS

a. It is not practicable to prevent exposure at ho e
b. Exclusion fro work of pregnant school teachers or child care workers **is no recommended** during parvovirus epide ics, which are often very prolonged (nor is exclusion of infected children)
c. Routine antenatal screening is **no** indicated
d. There is a 50% risk of trans ission fro an infected other to her fetus
e. Fetal loss = 15%, co pared with 5% overall (i.e. excess loss = 10%)
f. Onset of hydrops 2-17 weeks (average 5 weeks) after aternal infection
g. ongen

PARVOVIRUS – ALGORITHM 2

ANTENATA DIAGN SIS & MANAGEMENT

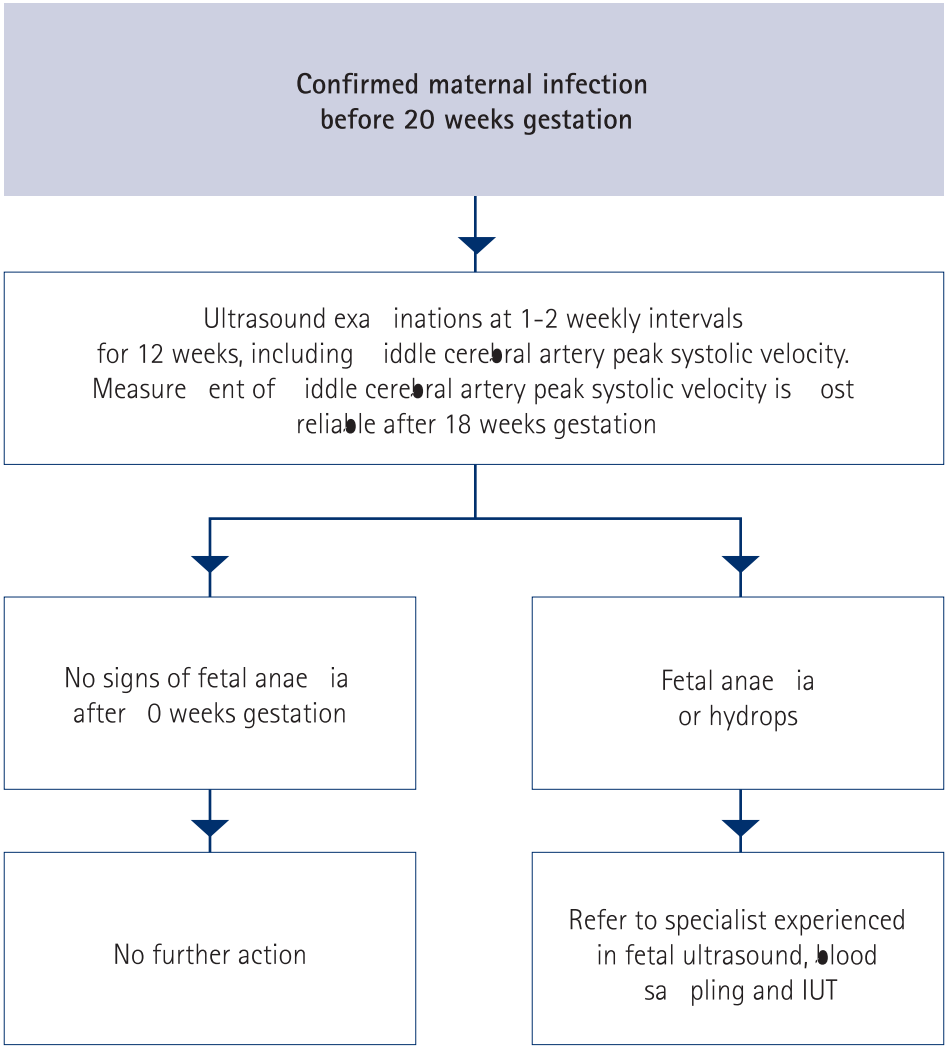


COMMENTS

- IgM is detectable within 1- weeks of exposure and usually re ains detectable for 2- onths
- o ercial IgM

PARVOVIRUS – ALGORITHM 3

MANAGEMENT F PR VEN MATERNA INFECTI N



COMMENTS

- No intervention is availale to prevent fetal infection or da age
- A niocentesis for diagnosis of asy pto atic intrauterine fetal infection is not reco ended
- α fetoprotein levels are not helpful – previous reports that increased levels predict poor outco e have not een confir ed
- Fetal infection ay e identified y using (non-quantitative) P R on a niotic fluid or fetal cord lood
- Pregnancy should e onitored y serial ultrasound exa ination to detect fetal anae ia
- A fetus with ild hydrops ay e profoundly anae ic
- Fetal lood sa pling ay e required to onitor for anae ia and thro ocytopenia
- Doppler assess ent of the fetal iddle cereral artery peak systolic velocity is an accurate tool for the deter ination of fetal ane ia fro 16- 4 weeks gestation, providing a noninvasive alternative to cord lood sa pling
- If anae ia and/or thro ocytopenia reach a critical level, IUT ay e required
- Infants in who hydrops has occurred and resolved should e onitored for evidence of anae ia
- No specific investigation is indicated in nor al infants

PARV VIRUS
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Rubella

AUST

RUBELLA – ALGORITHM 1

DIAGNOSIS OF SUSPECTED MATERNAL RUBELLA INFECTION

Routine antenatal screening (IgG only)[a] [1,2,3]
- If IgG –ve, prioritise rubella immunisation after delivery
- If IgG +ve at 10 - 15 IU/L: potential risk of reinfection
  Consider re-immunisation after delivery
- If > 15 IU/L: re-immunisation not needed

Rubella testing (IgG/IgM)[b] because of
(i) contact with rubella
(ii) rubella-like illness (fever, erythematous rash, arthralgia)
Serum should be obtained 7 - 10 days after onset of rash

IgG +ve
IgM +ve
Possible recent infection
(or reinfection,
depending on history)

REPEAT IN 2 - WEEKS TO CONFIRM

- Positive IgM confirmed
and/or
- Rise in IgG titre
- Rubella IgG avidity [d, 4,5]

Maternal rubella infection

Counsel and manage as per ALGORITHM 2

IgG –ve
IgM –ve
Susceptible

REPEAT IN 2 - WEEKS IF
< weeks since contact or
< 7 days since onset of illness

IgM or IgG
seroconversion[c]

IgG –ve
IgM +ve
Possible recent infection

REPEAT IN 2 - WEEKS

No seroconversion

Rubella susceptible
(possible false positive IgM)

Prioritise rubella immunisation after the birth of the child

IgG +ve
IgM – ve
Past infection or
prior immunisation

Pre-conceptional immunity to rubella

No increase in risk for
aterno-fetal infection
with pre-conceptional immunity.
Manage as a routine pregnancy

COMMENTS

a. Rubella serological tests are expressed as IU/l (WHO International reference)[6] and lack standardisation. Different laboratories use varying cut-offs for reporting low IgG levels (ranging from 5 - 10 IU/L). The WHO levels corresponding to protection from reinfection are imprecise, but only a small proportion of women are affected by reinfection [1,2]

b. IgM +ve results should be interpreted within the clinical context. IgM can be positive in re-infection, or persist after rubella vaccination or represent a false positive result [6]

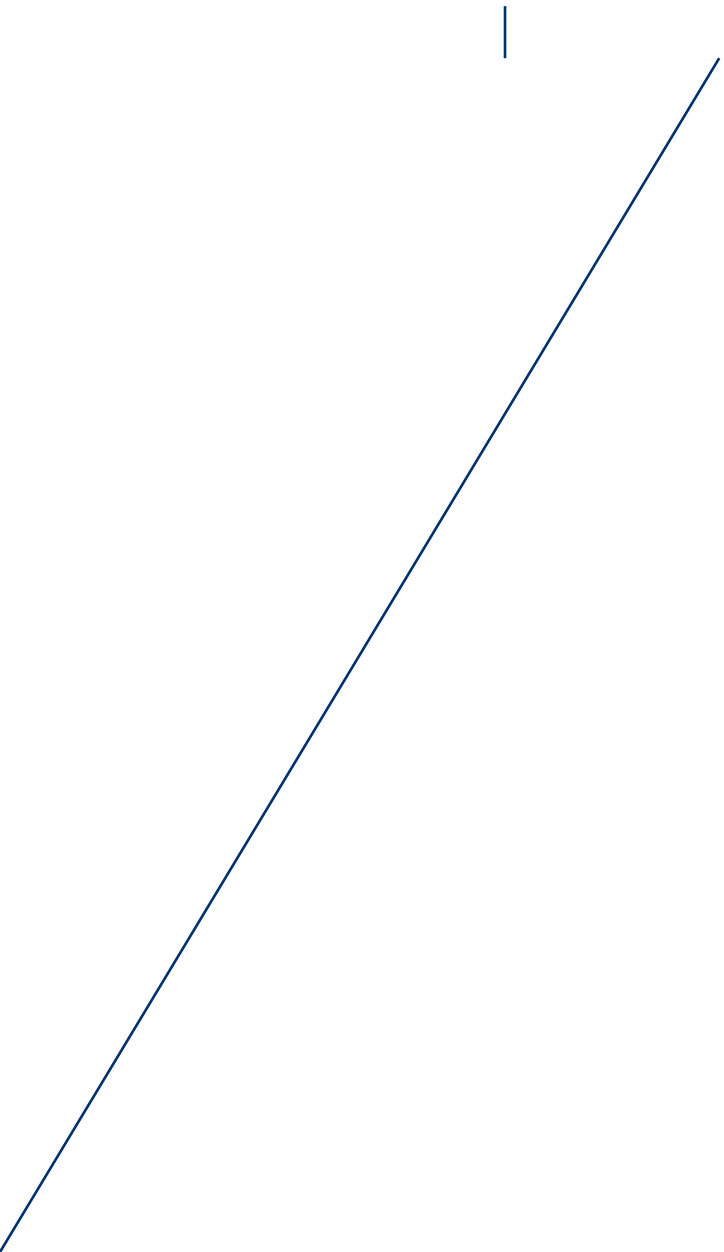
c. Seroconversion should be checked by testing the sera in parallel

d. Rubella IgG avidity may assist in determining primary infection, with low avidity indicating recent primary infection and high avidity against primary infection [4, 5]

e. Prevention: Women who are planning pregnancy who have not received rubella vaccination should be tested for immunity (rubella IgG). Non-immune women should receive rubella vaccination before they conceive, but should avoid pregnancy for 28 days after vaccination

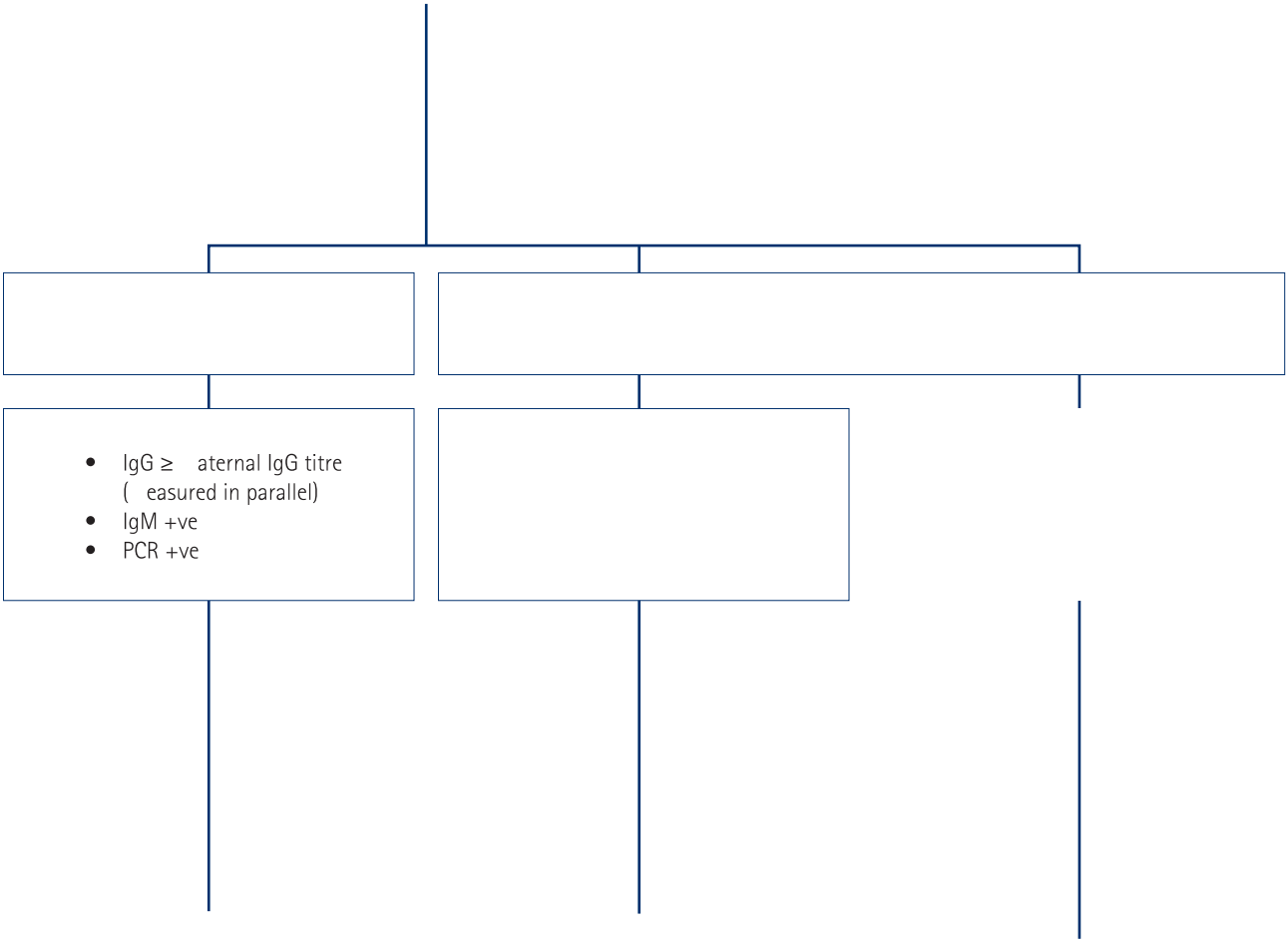
RUBE A – A GORITHM 2

MANAGƐMƐNT F PR VƐN MATƐRNAL RUBƐLLA INFƐCTI N



RUBELLA – ALGORITHM 3

MANAGEMENT AND F W UP F T E INFANT AT RIS F INFECTI N



RUBELLA
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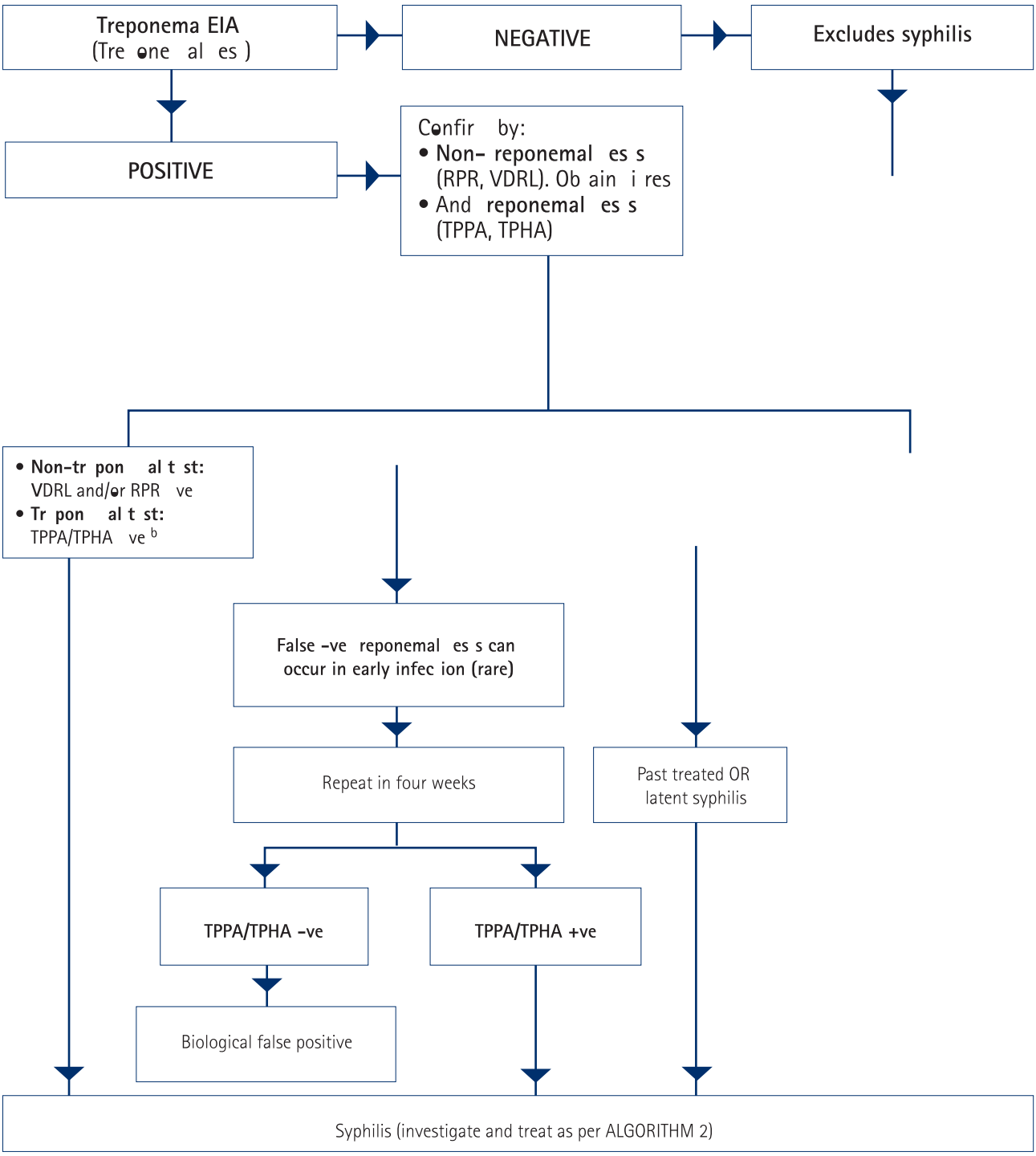
Syphilis (Treponema pallidu

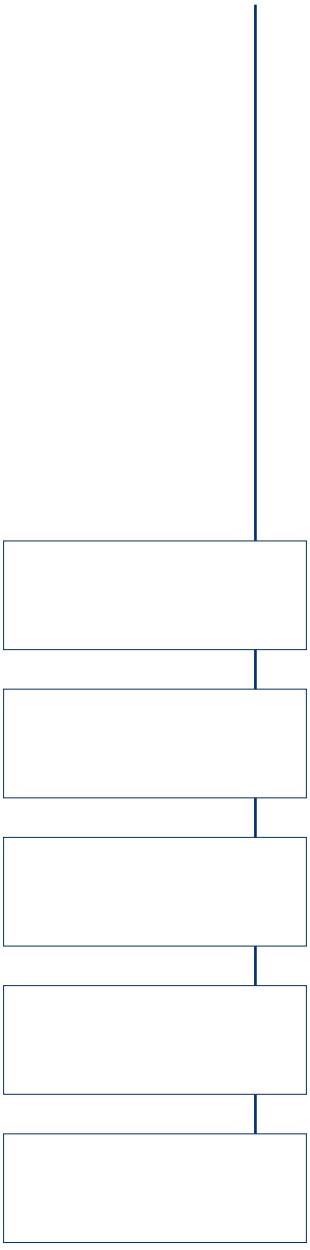
SYPHILIS (TREPONEMA PALLIDUM) – ALGORITHM 1

ANTENATA SCREENING F R SYP I IS



a Individuals at "high risk of *T. pallidum*" infection ay include

SYPHILIS (TREPONEMA PALLIDUM) – ALGORITHM 3

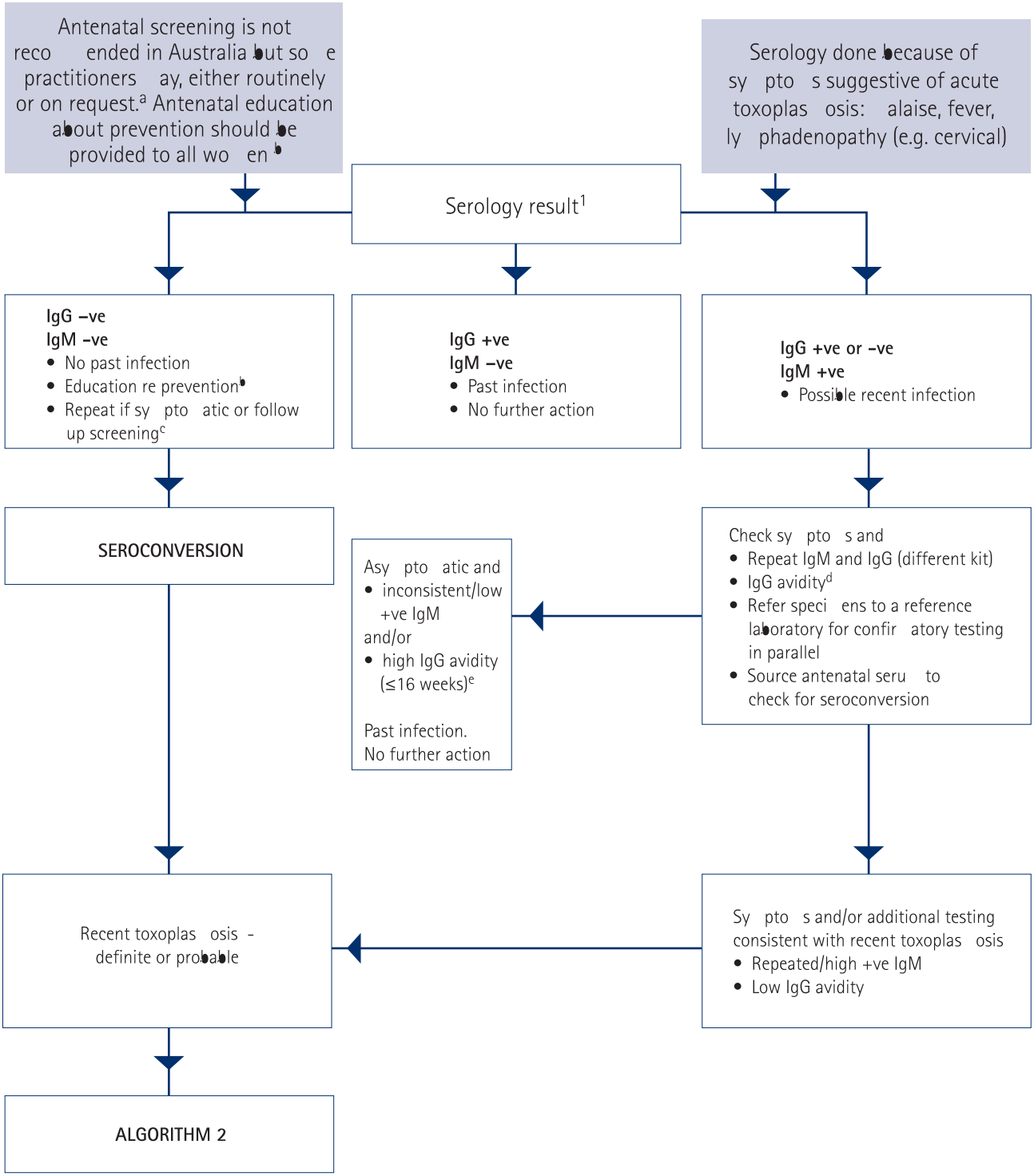


Toxoplasma gondii

AUSTRALASIAN SOCIETY FOR INFECTIOUS DISEASES 2022

TO OPLASMA GONDII – ALGORITHM 1

ANTENATA EVA UATI N



COMMENTS

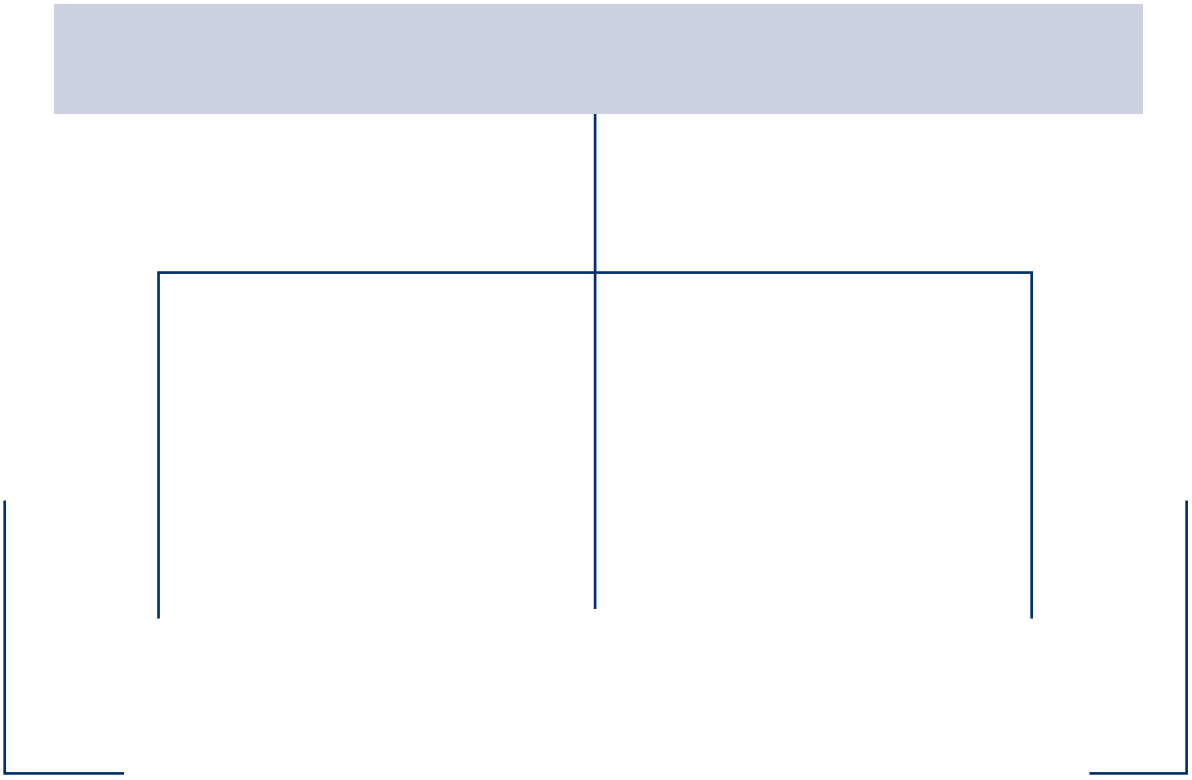
a. Pros and cons of antenatal screening are co plex; if done, there should e an appropriate anage ent plan. European centres screen seronegative wo en throughout pregnancy every 4-6 weeks and offer antenatal therapy if infection occurs

b. Avoid raw/undercooked eat; wash hands after gardening; wash raw vegeta les; ini ise contact with young kittens and their litter etc [1]

c.

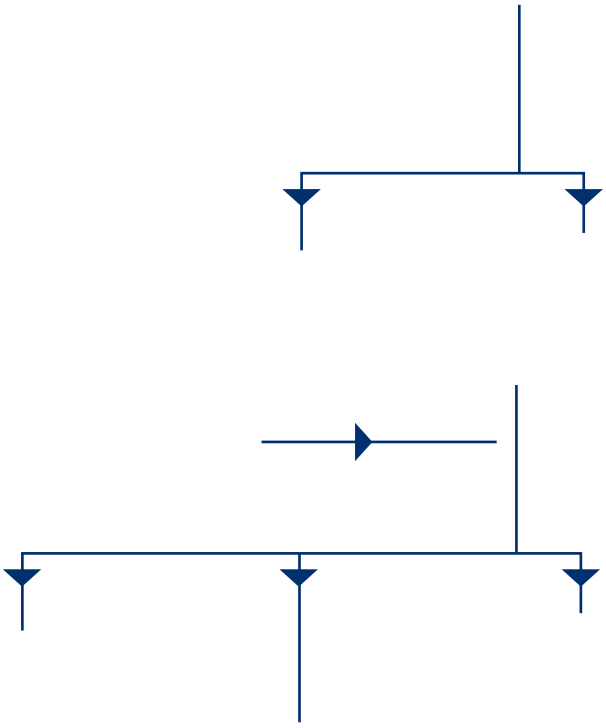
TO OPLASMA GONDII – ALGORITHM 2

INVESTIGATI N AND MANAGEMENT F MATERNA T X P ASM SIS



TO OPLASMA GONDII – ALGORITHM 3

INVESTIGATI N AND MANAGEME



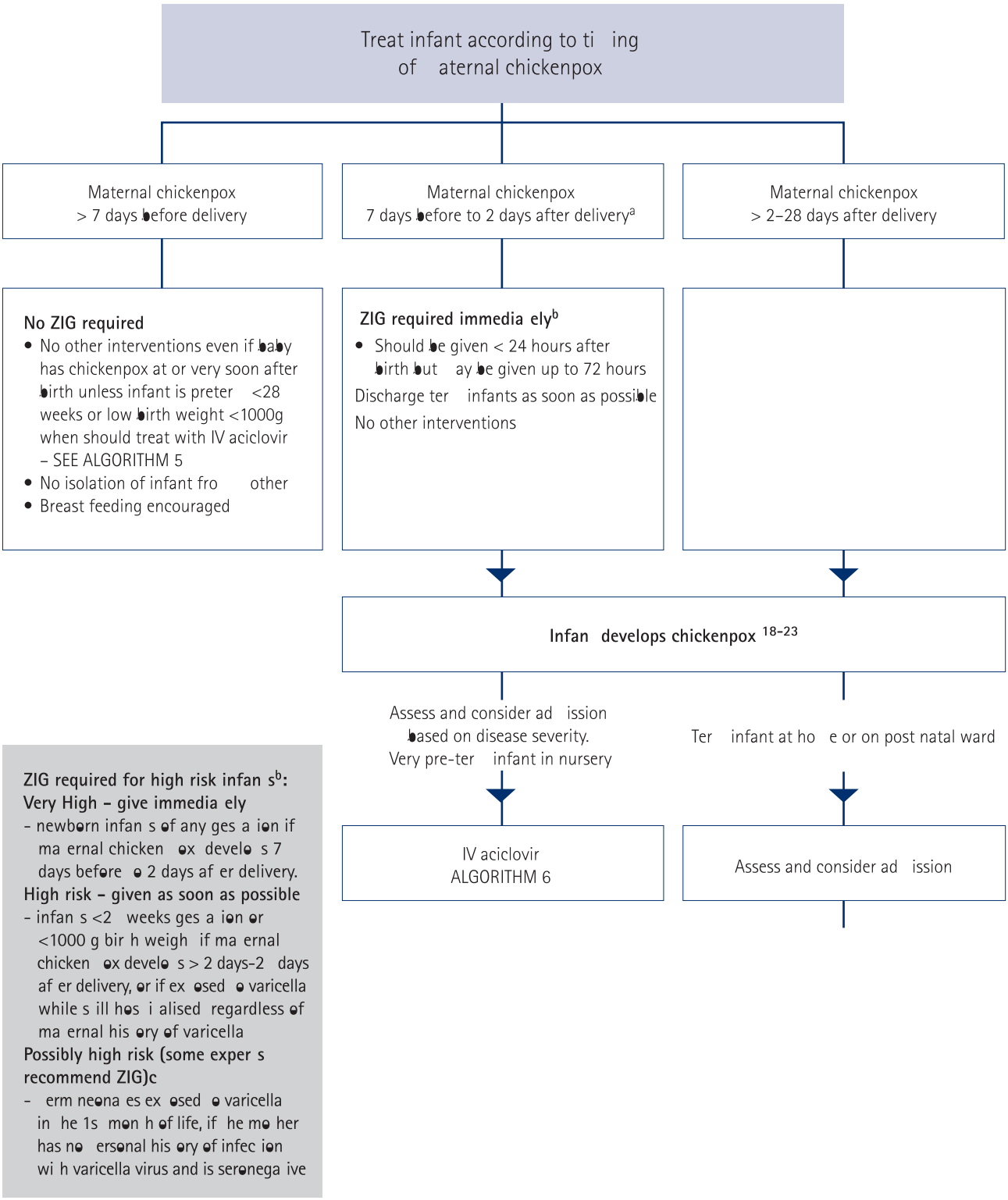
T X PLASMA
RE ERENCES

1. Jose G. Montoya and Jack S. Re ington Ma

Var

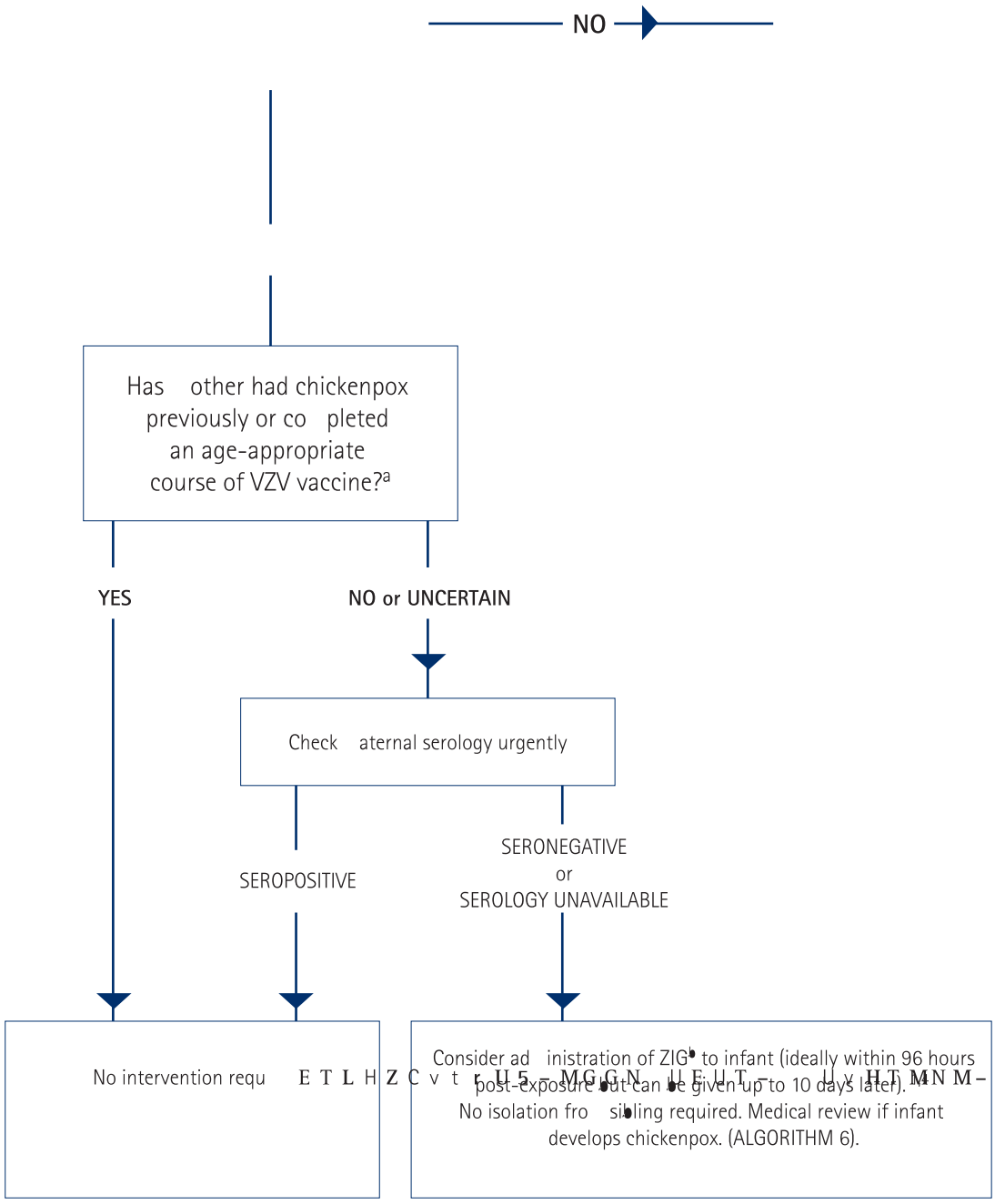
VARICELLA ZOSTER VIRUS – ALGORITHM 4

MANAGEMENT F INFANTS FR M M T ERS WIT PERINATA C IC ENP X

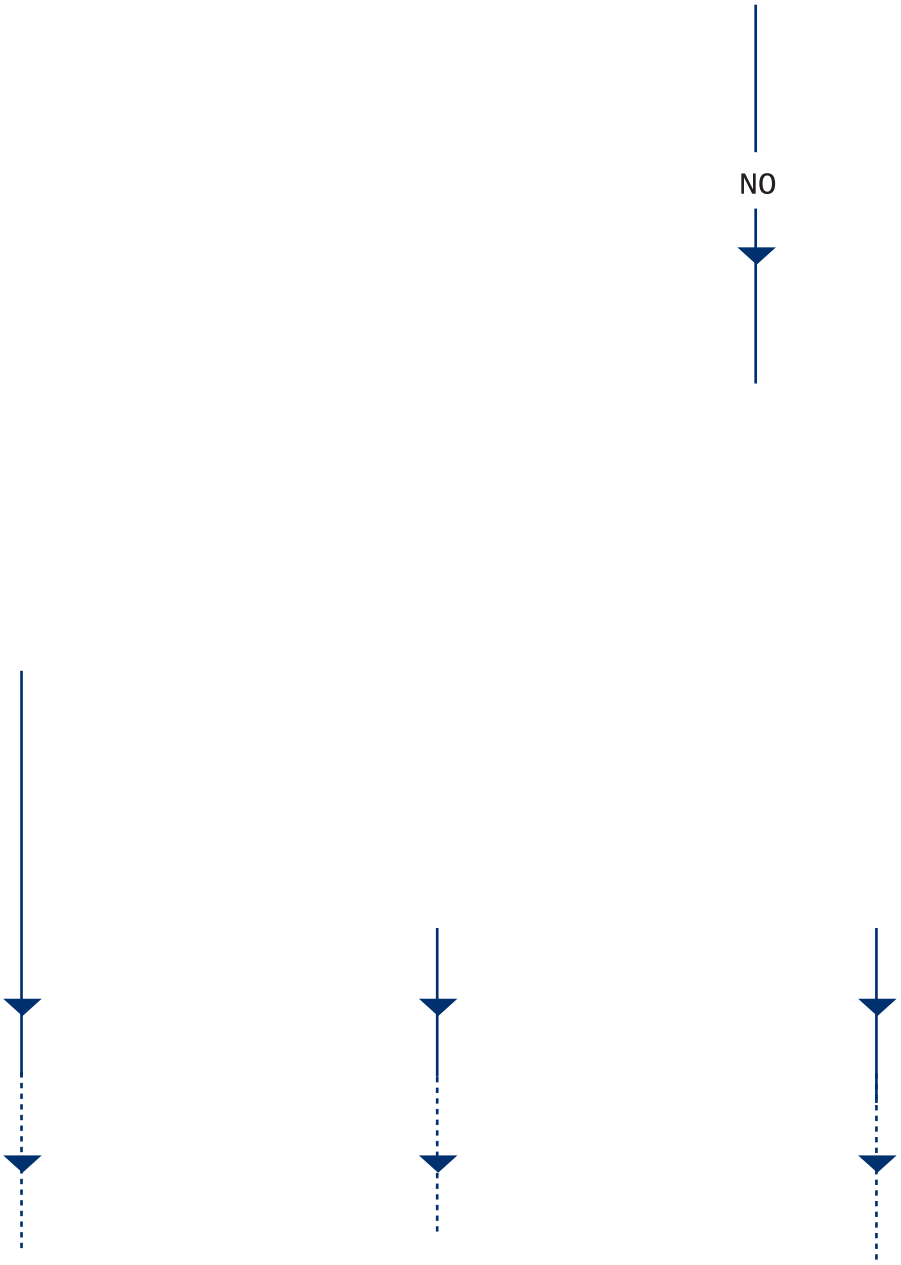


VARICELLA ZOSTER VIRUS – ALGORITHM 5

MANAGEMENT F TERM NE NATES EXP SED T V V IN T E P STNATA WARDS R AT ME



VARICELLA ZOSTER VIRUS – ALGORITHM 6



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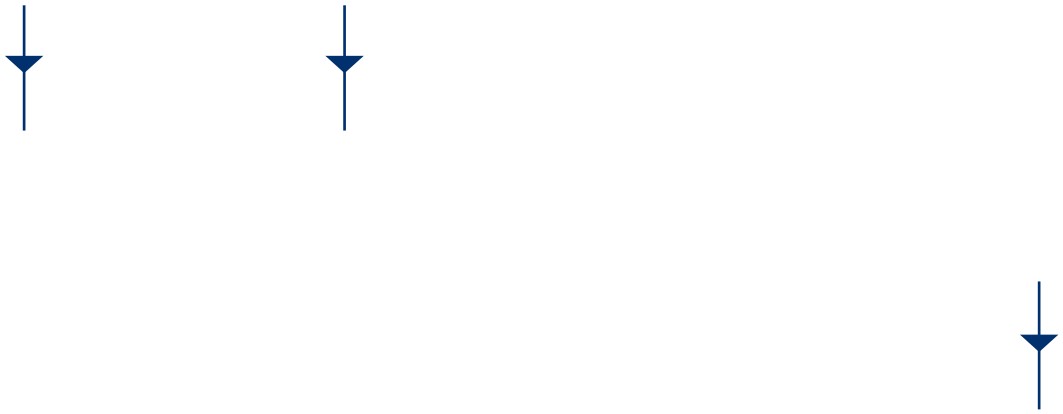
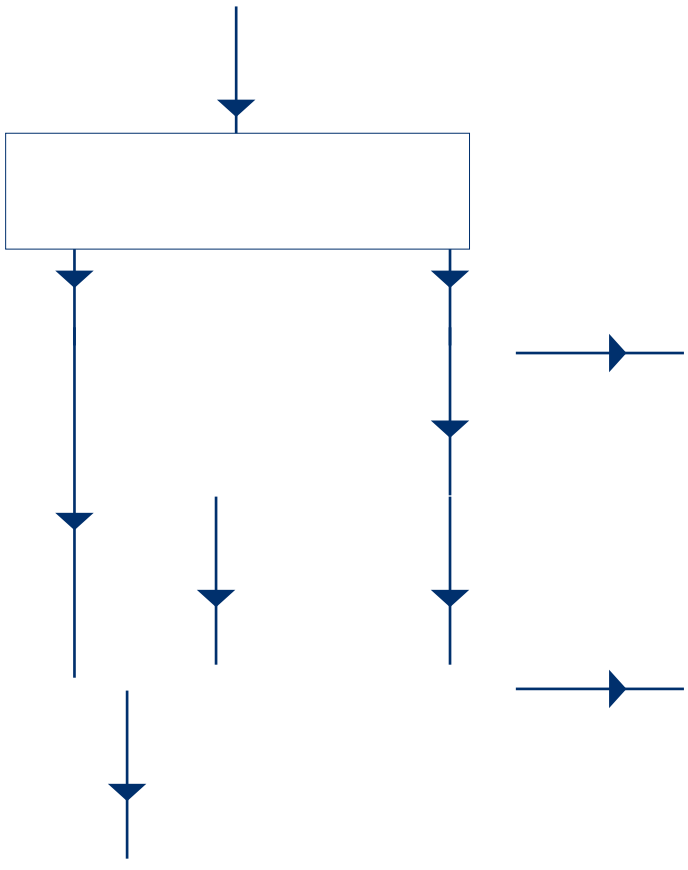
Zika virus

AUSTRALASIAN SOCIETY FOR INFECTIOUS DISEASES 2022





CZS is a classic pattern of birth defects and disabilities due to intrauterine trans ission of Zika[8]

- Severe icrocephaly
- Decreased brain tissue with subcortical calcifications
- Co on eye abnor alities: acular scarring and retinal focal pig entation
- Hypertonia
- Joint abnor alities: arthrogryposis, talipes
- Other findings include: dysphagia, seizures, other eye findings (icrophthal ia, optic nerve pallor, other brain alfor ations on neuroi aging (ultrasound or MRI/ autopsy) cerebral calcifications, disrupted brain develop ent (brain atrophy and asy etry, hydranencephaly, ventriculo egaly), abnor ally for ed or absent brain structures (e.g., corpus callosu , thala i, pons, cerebellar ver is, brainste)
- Long ter sequelae are not yet fully defined, including risks of adverse outco es in asy pto atic infected infants