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Aleyd von Gartzen[1]

Caroline.J Hollins Martin Martin[2]

[1] Midwife, International Board Certified Lactation Consultant (IBCLC), Hannover, Germany. Email – aleyd.v.g@gmx.de

[2] Professor in Midwifery, School of Nursing, Midwifery & Social Work, University of Salford, UK

Contact Details

Prof Caroline J Hollins Martin PhD MPhil BSc PGCE RMT ADM RGN RM MBPsS

Telephone number – 0161 2952522

Email – C.J.Hollins-Martin@salford.ac.uk

Address – MS 2.78, Mary Seacole Building, University of Salford, Frederick Road, Salford, Greater Manchester

M6 6PU

An email survey of midwives knowledge about CytoMegaloVirus (CMV) in Hannover and a skeletal framework for a proposed teaching program

Abstract

At present there is lack of information about CMV transmission given to midwives, general practitioners, neonatal pediatricians and nurses, with intrauterine transmission having profound consequences in terms of outcomes for the infected neonate. To identify one particular group of midwives knowledge about CMV, the research question surveyed midwives' knowledge of CMV. A quantitative electronic survey was the research method utilised in this study. To assess midwives knowledge about CMV, the first author emailed colleagues in Hannover and was in receipt of 40 completed questionnaires. Results showed that midwives have gaps in their knowledge about CMV and that an educational program is necessary to enlarge their understandings. Given the catastrophic consequences to the neonate of contracting congenital CMV, it is imperative that both health care professionals and women receive the educational message about prevention. In response an education program for lecturers has been proposed, which consists of eleven learning objectives.

An email survey of midwives knowledge about CytoMegaloVirus (CMV) in Hannover and a skeletal framework for a proposed teaching program

Introduction

The human CytoMegaloVirus (CMV) is a beta-herpesvirus and belongs to the family of Herpesviridae. It was first described by Ribbert in 1881, who mistakenly defined the large inclusion bearing cells as a kind of protozoa. In 1920, Goodpasture unearthed the viral etiology of these cells and used the term “cytomegalo”, comprised from “zytos” and “megalo”, the Greek words for “cell” and ”large” which refer to enlargement of the infected cells (Schleiss, 2010). In 1956, Weller, Smith and Rowe were able to isolate and grow the virus (Ho, 2008).

Humans are a desirable host for CMV. Transmission occurs via bodily fluids, e.g., urine, saliva, vaginal secretions, semen, breastmilk, blood transfusions and via organ transplants. In immunocompetent individuals, most CMV infections are mild and more often asymptomatic. In contrast, in immunocompromised individuals, e.g., those with HIV, organ transplants, premature infants and fetuses, the infection can cause encephalitis, retinitis, hepatitis, nephritis, splenomegaly and colitis. The latent period of CMV is 4-8 weeks and is a time during which the virus becomes virulent. Infected individuals can continue to secret the virus for months and sometimes years post initial infection (Nyholm & Schleiss, 2010), with adults moreoften transmitting the virus sexually (Ludwig et al., 2009). Like other members of the Herpes family, the virus establishes a life-long latency post primary infection and periodically reactivates.

Awareness about CMV

At present, there is lack of information about CMV transmission given to general practitioners, midwives, neonatal pediatricians and nurses. However, there have been some efforts to sensitize the public through self-help groups established by effected parents. For example, the “Stop CMV: the CMV Action Network” attempts to raise public awareness through campaigns and issue of brochures about CMV spread. Official health authorities, for example, the Centre for Disease Prevention (CDC) in USA have made efforts to inform the public and pregnant women about CMV.

In recent years, several studies have been published about CMV (Bate et al., 2010; Cannon, 2009; Colugnati et al., 2007; Cordier et al., 2010; Dollard et al., 2007; Jacobsen & Sifontis, 2010), which emphasizes interest in providing health promotion in relation to prevention. Despite efforts, a great deal of ignorance prevails. Korver et al. (2009) discovered several gaps in knowledge of Dutch doctors about infection modes and treatment possibilities. Cannon (2009) concluded that many obstetricians do not counsel

pregnant women about CMV prevention and as a consequence many pregnant women do not know about CMV and its implications for their child's future. In a survey conducted by the CDC in the USA, CMV was the condition the general public knew least about (see *Table 1*).

TABLE 1 HERE

In many countries great efforts have been made to inform pregnant women about the dangers of toxoplasmosis or listeriosis, with the number of CMV infections much higher. The Junger and Wilson (1968) criteria was revised in 2008 and has been adapted, updated and applied for screening pregnant women for a variety of infections (Andermann et al., 2008, app.5) (see *Table 2*).

TABLE 2 HERE

It is proposed that general newborn screening for CMV be considered for detecting asymptomatic infected children, so they can be pursued periodically for hearing and eyesight tests. Since hygienic precautions for seronegative women minimizes infection spread, doctors, midwives and medical staff should counsel pregnant women about CMV prevention, recognition and management. Most mothers are willing to practice preventive behaviour (Nigro & Adler, 2011, Cannon, 2009), with many who acquire CMV infection during pregnancy retrospectively wishing they had known about measures to minimize risk (Adler, 2011).

The rationale underpinning this project is a recognized dearth of information and knowledge sharing amongst health care professionals who deal with childbearing women. This dearth of knowledge has profound consequences in terms of sequelae for an infected neonate (Korver et al., 2009; Cannon, 2009), with many pregnant women uninformed about CMV and its implications for their child's health. To identify one particular group of midwives knowledge about CMV, the research question surveyed midwives' knowledge of CMV.

Method

A quantitative electronic survey was the research method utilised in this study. To date, no surveys in Germany have assessed midwives' knowledge base in relation to CMV. Email seemed a quick, inexpensive and reasonable way to explore their comprehension. Consequently, a quantitative electronic survey was selected because it is an effective method by which to engage with a sizable population. Also, survey information provides a "snapshot" of the target population to establish a baseline from which the researcher can assess knowledge base.

Participants

The study assessed a purposive and representative sample of midwives working in Hannover at the time of enquiry. The inclusion criteria included being registered and currently practicing as a midwife in Hannover at the time of data collection. To assess midwives knowledge about CMV, the first author emailed the 151 colleagues in her group email address book.

Ethics

Ethical approval was not required because the first author in capacity as a supervisor was addressing educational needs of midwives within her remit. Education in relation to CMV was of focal interest at the time of enquiry. Consent was implied in that participants elected to answer the questions placed. Confidentiality and anonymity was assured.

Content validity assessment

To assess content validity, two individuals with high credibility in terms of knowledge about midwifery were recruited. Their advice and guidance helped shape development of the questions to provide a meaningful evaluation of respondents' knowledge about CMV. Alterations and additions were made in line with the feedback offered.

Data collection

Data was collected using a structured survey instrument consisting of four questions:

(1) Since you have been working as a midwife, have you cared for women with CMV infections? YES / NO
(2) Do you feel well informed about CMV infection? YES / NO
(3) Do you know the most common sequelae of congenital CMV infection? YES/NO
    If so, please state.
(4) Do you know measures that prevent spread of CMV infection in pregnant women? YES / NO
    If so, please state.

In response to two rounds of emails to the 151 midwives, 40 (26.5%) completed and returned the questionnaire between the months of May and July in 2011.

Data analysis

The completed questionnaires were read in their entirety. Descriptive statistics were calculated in relation to respondents' responses. To assimilate and provide comprehensive dissemination in relation to the four questions, data was inserted into a table. Relevant comments about proposed sequelae were transcribed into the table against anonymous and tagged participant numbers.

Validity

To establish content validity, two expert researchers assessed the questions for whether or not they were in fact asking appropriate questions to identify midwives general knowledge about CMV. The questions were them piloted on two midwives for their interpretation of what was being asked. Minor alterations were made in line with the feedback offered. All data collected remained confidential and anonymity measures were imposed.

Results

Twelve out of forty (30%) of the participating midwives had previously provided care for women infected with CMV. Eight out of forty (20%) felt well informed about CMV infection. Eighteen out of forty (45%) stated to know about the most common sequelae from CMV, with only eleven out of eighteen (61%) mentioning “hearing impairment”. Thirteen out of forty (32.5%) affirmed to know measures that minimize risk of infection spread. Prevention measures cited by respondents included hygiene measures, staying away from small children, using condoms and being banned from work whilst actively infected with CMV. To view a summary of the results (see *Table 3*).

TABLE 3 HERE

Discussion

Results of the questionnaire show that midwives have gaps in their knowledge about CMV and that an educational program is necessary to enlarge their understandings. Accordingly, it is proposed that an education program be instigated. To view a proposal of potential learning objectives that could be used to underpin a CMV educational program for midwives (see *Table 4*).

TABLE 4 HERE

What follows is examples of information that could be used to underpin such a program.

TABLE 5 HERE

(Learning Objective 1) General prevalence of CMV

The CMV virus presents itself in every human population (Nassetta et al., 2009). The seroprevalence of the CMV virus varies with age, ethnicity and social status of groups within individual populations. Seroprevalence is the number of persons in a population who test positive for a specific disease based upon a blood serum specimen. Other rates differ, with prevalence higher in developing countries and within lower socioeconomic groups of developed countries (Staras et al., 2006). There are two infection peaks. The

first is in the initial 2-3 years of life, and the second is in young adults who have recently become sexually active (Schottstedt et al., 2010).

(Learning Objective 2) Prevalence of CMV in pregnancy

The seroprevalence of CMV in pregnancy in Europe differs between 40-90% in women of childbearing age (Ludwig & Hengel, 2009). Kenneson and Cannon (2007) claim a seropositivity rate of 98%, whilst Foulon (2005) demonstrated a seroprevalence of 57% based upon (n = 7140) pregnant women. Predisposing factors to CMV spread include crowded living conditions and low household income (Bate et al., 2010). Primary infection in pregnancy occurs in approximately 0.15-2.0% of all pregnancies (Nigro & Adler, 2011). Women of higher socioeconomic groups have a prevalence of 2%, whilst women of lower socioeconomic groups have an incidence of 6% (Nassetta et al., 2009).

(Learning Objective 3) Prevalence of congenital CMV infection

CMV is the most common cause of maternal-fetal infection during pregnancy. Even though there is less risk of transmission in the first trimester, primary infection during this time is associated with the most severe fetal sequelae (Nigro & Adler, 2011). The risk of congenital infection is much higher for unborn infants whose mothers experience primary infection (32.3%), compared with those sero-positive prior to conception who have reactivation of the virus (1.4%) (Luck & Sharland, 2009). Dollard et al. (2007) reviewed data from 15 studies, accumulating a total number of (n = 117, 986) screened infants. The overall prevalence of CMV at birth was 0.7%, with 12.7% of these infants becoming symptomatic immediately post delivery, of which 40-58% developed permanent sequelae. 13.5% of infected infants were asymptomatic at birth, but proceeded to develop permanent sequelae at later check-ups.

de Fries (2011) identified that a total of 6800 congenitally infected infants develop permanent sequelae in Europe annually. According to the CDC in the USA, the estimated numbers are totalled at 5500. The number of children infected with CMV in the USA who progress to develop medical conditions is higher than the number of children born with Downs Syndrome or Fetal Alcohol Syndrome in 2012 (CDC, 2012) (see *Table 6*).

TABLE 6 HERE

(Learning Objective 4) Sequelae of congenital CMV infection

There are several clinical presentations of CMV in newborn infants. Cytomegalic Inclusion Disease (CID) is the most severe form of congenital infection. Almost all cases occur when the mother is primary infected. Bristow et al. (2011) identified 777 congenital CMV associated deaths in the USA over a period of 17 years. They calculated that out of 1000 infected children, 5 will die (Dollard et al., 2007). CID is characterized by Intra Uterine

Growth Retardation (IUGR), hyperbilirubinemia, hepatosplenomegaly, seizures and thrombozytopenia leading to purpura. Some manifestations of CMV can affect the Central Nervous System (CNS) to cause microcephaly and mental retardation, which can cause learning disabilities, cerebral palsy, epilepsy, optic atrophy and hearing impairment (Schleiss, 2010). 10% of infants with symptomatic congenital CMV develop handicaps (Nassetta et al., 2009), which is a higher number than is quoted by Dollard et al. (2007) (see *Table 7*).

TABLE 7 HERE

SNHL is the most common outcome from congenital CMV infection and is responsible for around 21% of all hearing loss at birth and 25% of deafness in children up to 4 years of age. Sensori Neural Hearing Loss (SNHL) occurs in 10-15% of infected infants, with 30-65% symptomatic at birth. Only half of these infants present with hearing loss at birth (Nigro & Adler, 2011), with late-onset SNHL manifesting by early school age. It is difficult to make a reliable predication of the percentage of (late-onset) sequelae following congenital CMV infection, as many infants are infected during the postnatal period. For example, through breastfeeding (Fowler, 2008).

(Learning Objective 5) Prevention of CMV infection

Development of a vaccine is a major public health priority (Revello et al., 2010, Nyholm & Schleiss, 2010, Ghandi et al., 2010), since no passive or active vaccine against CMV is currently available. Trials of a passive immunization that attempts to prevent cross placental fetal infection are in the very early stage of development (Nigro & Adler, 2011), with another 10 years anticipated before a tried and tested vaccine becomes available. Exposure to saliva and urine of small children is the main cause of primary CMV spread to pregnant women (Cannon & Davis, 2005). Infection rates are high for small children who attend daycare centers. Since pregnant women are key attendees at nurseries, it is important to provide them with information about CMV prevention and transmission. The European Congenital CMV Initiative (ECCI) and the CDC have developed recommendations about how to avoid infection spread (Hyde et al., 2010). Since only 1 in 4 mothers actually become infected, this emphasizes that CMV is not that easily transmitted and that parental infection is in fact avoidable. Preventing transmission through behavioural change is the most effective and inexpensive way to decrease risk of CMV infection during pregnancy (Cordier et al., 2010).

(Learning Objective 6) Maternal CMV screening

Routine screening of pregnant women is a controversial topic. The gold standard of serologic diagnosis is maternal seroconversion and the detection of CMV-specific IgG with low and slowly increasing levels of CMV-specific IgM antibodies (Nigro & Adler, 2011).

Unfortunately, detection of antibodies does not predict primary infection reliably, since IgM antibodies not only occur in primary infections, but can also be present in reactivations or reinfections. A primary infection can only be diagnosed when maternal or fetal symptoms are present, as well as anti-CMV IgM antibodies and low-avidity anti-CMV IgG antibodies (Nigro & Adler, 2011). Another concern is that maternal immunity does not rule out a recurrent infection or an infection with a new CMV strain (Nyholm et al., 2010). Diagnosis of infection in utero cannot predict symptomatic disease, even if it is asumed that the fetus has active CMV virus. Also, there is no evidence-based treatment available. However, controversial voices claim that a general screening program for all pregnant women would reduce sequelae caused by the CMV virus (Colugnati et al., 2007; Harvey & Dennis, 2008; Nigro & Adler, 2011). Teaching pregnant seronegative women prevention measures could seriously reduce infection spread. Cahill et al. (2009) propose that general screening of all pregnant women should be routine, instead of just high-risk women and those with abnormal ultrasound findings. Treating childbearing women with IgG and IgM antibodies in CMV intravenous immuneglobulin would achieve approximately 47% reduction in CMV and its associated sequelae (Cahill et al., 2009).

(Learning Objective 7) Infant CMV screening

There are several options about how to screen for CMV in newborns. These include, collecting saliva, urine and/or Polymerase Chain Reaction (PCR). PCR is a technique by which minute amounts of DNA can be replicated very rapidly and thereby amplified to such an extent that the DNA becomes easy to detect. Testing saliva or urine is more sensitive than a blood test, since the viral load is lower in blood. Real-time PCR assays of both liquid and dried saliva specimens show high sensitivity and specificity for detecting CMV infection, and therefore should be considered potential screening tools for CMV in newborns (Boppana et al., 2011). de Vries (2011) strongly recommends that post implementation, that a large scale study be conducted to test effectiveness of screening on outcome measures. The rationale is that early identification of congenital CMV would allow timely recognition of deafness, although screening infant hearing only discovers 50% (up to 75% according to Nyholm & Schleiss, 2010) of all SNHL cases caused by CMV infection.

(Learning Objective 8)Treatment of an infected mother

There are two treatment options for a CMV infected mother. The first involves administration of CMV immunoglobulins or antiviral drugs (Valaciclovir) to reduce the rate of transmission and improve neonatal outcomes (Lazzarotta et al., 2011). There is however no evidence-base to confirm their efficiency (Mc Carthy et al., 2011). Treatment with Valaciclovir, which is Human CMV Human Globuline (HIG) has been recommended

by Nigro and Adler (2011). Benefits include: (1) there is no known toxicity, (2) it is easily available, and (3) cost is modest compared to what is spent on a child with CMV infection sequelae. Another study is presently examining the effectiveness of Valaciclovir and is projected to be complete in 2013 (Lazzarotto et al., 2011).

(Learning Objective 9) Treatment of the CMV infected infant

Currently there are four antiviral agents effective at eradicating CMV. These include: (1) Ganciclovir, (2) Valganciclovir, (3) Foscarnet, and (4) Cidofovir. At present none of these are approved for paediatric use and therefore experience of their outcome is limited. Foscarnet and Cidofovir are associated with severe side-effects, and so Ganciclovir and Valganciclovir have become the favoured drugs for treating children (Marshall & Koch, 2009). Prevention of hearing deterioration is the main desired impact. One study of asymptomatic infected infants who received Ganciclovir has shown that none developed hearing loss, compared to 11.1% in the untreated group. In spite of this success treatment is not recommended (Ghandi et al., 2010), because toxicity of the drugs can cause neutropenia (most commonly), reproductive toxicity, teratogenicity and mutagenicity. As a consequence of high toxicity and the narrow therapeutic range of CMV antiviral medications, patients in receipt must be carefully monitored for potential adverse side effects (Jacobsen & Sifontis, 2010).

Congenital CMV infection is still the most common cause of maternal-fetal infection. Efforts have been instigated to develop appropriate treatment for women with CMV and their infected children. These programs are still in the initial stages of development. Treating infected newborns is linked with potential risk of severe side-effects. Consequently, it seems reasonable to propose that a general screening program for all women in the early antenatal period and ideally preconception is the best approach. Post booking screening, it is proposed that a second serological testing at 15-16 weeks of pregnancy takes place in seronegative women to detect seroconversion and possibly initiate treatment.

Conclusion

Given the catastrophic consequences to the neonate of contracting congenital CMV, it is imperative that both health care professionals and women receive the educational message about prevention (Osterholm et al.,1992). Education delivered from midwives about CMV should emphasize hygienic practices as a precaution for all women who are pregnant or planning to become pregnant. Education would be strengthened by using general public health messages about preventing infection spread; for example, teaching rigorous methods of hand hygiene, how to reduce sexual transmission and avoid spread

between children in day care facilities. Education as regard hygienic practices to reduce spread of CMV is relatively inexpensive and is capable of preventing disability.

It is argued that an education program to extend midwives knowledge about CMV is required in Hannover. It is proposed that single study days are organised within the midwifery education institutions and a program rolled out that all midwives are required to attend. Post delivery an evaluation of effectiveness of the education program should be conducted. It is also recommended that the level and amount of CMV education in undergraduate midwifery curriculums is increased. Evidence supports that high quality training in prevention and management of CMV could profoundly improve mortality and morbidity statistics.

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Table 1: Women's awareness of conditions that affect children (CDC, 2012)

Disease	% of women aware
Cytomegalvirus (CMV)	22%
Parvovrus B19	32%
Congenital Toxoplasmosis	37%
Congenital Rubella Syndrome (CRS)	53%
Group B streptococcus (GBS)	59%
Spina Bifida	76%
Fetal Alcohol Syndrome (FAS)	83%
Sudden Infant Death Syndrome (SIDS)	94%
Down Syndrome	97%
HIV/AIDS	98%

Table 2: Synthesis of emerging screening criteria proposed over the past 40 years (Andermann et al., 2008)

(1) The screening program should respond to a recognized need.
(2) The objectives of screening should be defined at the outset.
(3) There should be a defined target population.
(4) There should be scientific evidence of screening program effectiveness.
(5) The program should integrate education, testing, clinical services and program management.
(6) There should be quality assurance, with mechanisms to minimize potential risks of screening.
(7) The program should ensure informed choice, confidentiality and respect for autonomy.
(8) The program should promote equity and access to screening for the entire target population.
(9) Program evaluation should be planned from the outset.
(10) The overall benefits of screening should outweigh the harm.

Table 3: Summary of results of the Hannover participating midwives knowledge about CMV?

Question	1		2		3			4		
n	yes	no	yes	no	yes	no	proposed sequelae	yes	no	prevention measures
1		1		1	1		SGA, immature infant, pneumonia		1	
2	1			1		1			1	
3		1	1		1		microcephaly, retardation		1	
4	1			1		1			1	
5		1		1	1		mental retardation	1		not stated
6		1		1		1			1	
7		1		1		1			1	
8		1		1		1	mental impairment		1	
9		1		1		1			1	
10		1		1		1			1	
11		1	1		1		eye, ear and mental impairment	1		
12		1		1	1		eyes, cerebrum, ears	1		keep away from small children
13		1		1	1		microcephaly	1		not stated
14		1		1		1		1		hand washing after changing nappies and feeding
15	1			1		1	mental impairment		1	handwashing
16	1		1		1		microcephaly, retardation, hearing loss, eye impairment	1		avoidance of contact, hygiene measures, ban from work
17	1		1		1		deafness, meningitis	1		not stated
18	1		1		1		mental and hearing impairment		1	
19	1			1		1			1	
20		1		1	1		mental impairment		1	
21	1			1		1	deafness		1	
22	1			1		1			1	
23		1	1		1		mental impairment,hardness of hearing	1		good hygiene
24		1		1		1		1		not stated
25		1		1	1		hearing disorder, mental and physical retardation	1		not stated
26		1	1		1				1	
27	1			1		1	mental and hearing impairment, blindness		1	
28	1			1		1	prematurity, hepatosplenomegaly, seizures, SGA	1		dirt, smearinfection,kisses
29		1		1		1			1	
30		1		1	1		impairment of the cardio-vascular system and gastro-intestinal tract, microzephaly	1		not stated
31		1		1		1			1	
32		1		1	1		mental impairment		1	
33		1		1	1				1	
34		1		1		1	neurological defects		1	
35		1		1		1			1	
36		1	1		1		mental and hearing impairment, severe multiple handicaps	1		avoid smear infections, hand washing, ban of work
37		1		1	1		SGA, prematurity, pneumonia		1	
38		1		1		1	prolonged icterus		1	
39		1		1		1			1	
40	1			1		1	fever,sucking weakness, flaccidity, Seizures, impairment of the CNS		1	facemask, condoms
total	12	28	8	32	18	22		13	27	
percent	30,0	70,0	20,0	80,0	45,0	55,0		32,5	67,5	

Table 4: Summary of proposed learning objectives for a CMV educational program for health care professionals that work with childbearing women

(1) Present a case study (see *Table 5*).
(2) Provide a definition of (CMV) (see Introduction).
(3) Discuss general prevalence of CMV (see Subsection 1).
(4) Discuss prevalence of CMV in pregnancy (see Subsection 2).
(5) Discuss prevalence of congenital CMV infection (see Subsection 3).
(6) Discuss sequelae of congenital CMV infection (see Subsection 4).
(7) Critically discuss how to prevent CMV infection (see Subsection 5).
(8) Debate issues surrounding maternal CMV screening (see Subsection 6)
(9) Debate issues surrounding infant CMV screening (see Subsection 7)
(10) Discuss treatment of an infected mother (see Subsection 8).
(11) Discuss treatment of an infected infant (see Subsection 9).

Table 5*:* Learning outcome one: a CMV case study

Paul was born in October 2010 by caesarean section. He is the second child in his family. His older brother Sebastian is 24 months older. Shortly after delivery Paul was referred to the intensive care unit with suspected group B streptococcal infection and treated with antibiotics. During the first three days of life Paul underwent numerous investigations. These included: blood taken from the umbilical cord and veins, urine specimens, ultrasound of the head and abdomen, tests for hearing and eyesight and a lumbar puncture. Symptoms of the infection rapidly reduced. Within days, Paul presented as a healthy newborn, with no obvious sign of pathology. Despite his healthy appearance, treatment was initiated. A central venous catheter was placed in Paul's subclavian vein and he received intravenous treatment twice a day for the subsequent six weeks. During this time Paul was continuously monitored for side effects of the medication and for signs of disease using blood, ear and eye tests and ultra sound. His mother stayed with him in hospital for the duration of his treatment. His father took parental leave to care for the older son. This situation was highly stressful for the whole family. Paul's mother Christiane had undergone a CMV screening early in her pregnancy. Findings from this investigation were seronegative. In efforts to reduce the risk for infection, Christiane was advised not to kiss her sons mouth. In the 31st week of Paul's pregnancy, the second CMV screen was positive. Christiane was unable to recall any significant period of ill-health between the two tests. She did, however, note a mild cold during the end of her second trimester. It was assumed that CMV was most likely to have been contracted from the older son Sebastian. Christiane has been feeling considerable guilt about this, and regretted not taking the advice of her obstetrician seriously. Following the positive CMV result, various doctors were consulted. Christiane was provided with information regarding CMV hyperimmunglobuline treatment. As the unborn baby did not show signs of the disease, treatment was not recommended. Based upon this advice she opted against treatment. It can also be noted that this treatment would have been an off-label use (a drug prescribed to treat a condition for which it has not been approved by the responsible authority). The last few weeks of pregnancy were afflicted with great concern and worry about what could happen to her baby. Following Paul's delivery and admission to intensive care, it became clear that Paul had been infected during the pregnancy. This was evidenced by a high virus load identified in blood and urine tests. No clinical signs of CMV were ever documented.

Table 6: Children born with or developing long term medical conditions in the USA (CDC, 2012)

Cytomegalovirus (CMV)	5,500
Fetal Alcohol Syndrome	5,000
Down Syndrome	4,000
Spina Bifida / Anencephaly	3,000
Paediatric HIV / AIDS	200
Invasive Homophillis / Influenza b (Hib)	60
Congenital Rubella Syndrome (CRS)	10

Table 7: Estimates of sequelae among children with congenital CMV infection (out of 1,000) (Dollard et al., 2007)

CMV infection	Symptomatic	Asymptomatic
Infected infant	127 (12.7%)	873 (87.3%)
Deaths	5	0
Survivors	122	873
With permanent sequelae	50-70 (40%-58%)	118 (13.5%)
Conclusion	17–20% of the 1000 infected infants will have permanent sequelae; 1/3 from the symptomatic group and 2/3 from the asymptomatic group.	