

The clinicopathologic characters and activity survey of sudden death of infants in a depressed economy: south-eastern Nigeria experience

Ndubuka GIN¹, Ekezie J^{2,*}, Ngwogu KO³, Nkuma-Udah KI⁴, Okafor W⁵

^{1,4,5}Dept. of Biomedical Technology, Federal University of Technology, Owerri, Nigeria, ²Dept. of Anatomy, School of Basic Medical Sciences, Federal University of Technology, Owerri, Nigeria, ³Dept. of Chemical Pathology, Abia State University Teaching Hospital, Aba, Nigeria

***Corresponding Author:**

Email: ekeziejervas@gmail.com

Abstract

Sudden death of infant (SDI) is among the clinical conditions called sudden infant death syndrome (SIDS) referred to as death situation in which all clinical causative factors play apparent and hideous roles within an hour of unexpected death of infant within one year of age. To ascertain SDI at Abia State University Teaching Hospital (ABSUTH), a 6 year study of all infants' death cases in record books were searched and two types of questionnaires added. Medical officers and hospital staff involved in infant healthcare were 343, and 1400 mothers contacted were of age ranges 18-40 years. Causes of SDI were respiratory failure 107, RTA 4, circulatory failure 25, alimentary distress 103, trauma and domestic accident 10, and cardiac failure 70 cases. Highest Frequency of occurrence in the years was observed in 1999 and gave 104. Commonest clinical characters were anemic heart failure, child neglect and abuse, drug toxicity, hemorrhage, and vagal inhibition. The rapidity at which SDI occurred in 25% of 107 respiratory failures was within 10 seconds to 5 minutes, and to 232 cases was within 24 minutes of hospitalization. Common clinical symptoms were mild to high fever, intermittent coughing and vomiting, malnourished body, respiratory distress, and apnea while 77% full term birth cases had body weight of 2100 to 2500g. Child neglect and abandonment were evident in 49% mothers of lean economies. SDI peak was from 5th to 8th months, at which periods 112 female and 168 male infants were wean to death by 280 mothers. Yearly highest incidence of SDI is 1999.

Keywords: Sudden Death, Infant, Clinicopathologic Characters, Depressed Economy.

Access this article online

Website:

www.innovativepublication.com

DOI:

10.5958/2394-6776.2016.00045.X

Introduction

Sudden death has received several definitions including that which says, 'it is the termination of life occurring quickly and under a condition not expected to cause death'^[1]. This is not classically informative as there was neglect on the previous health condition before an unexpected death situation. Other closet attempts summed up that sudden death is unexpected and non-traumatic and is that which occurs instantaneously or within a few minutes of an abrupt change in the person's previous clinical state^[2]. However, the definition used in Framingham study^[3] attributed to WHO, not only gave clue to persons state prior to effect that brought death, also took into account all age groups and existing medical history. It states that sudden death is "when apparently well persons suddenly and unexpectedly collapsed and died within an hour or frequently in a matter of minutes, and without a cause suggested by their medical history". Undoubtedly this definition did not technically exclude traumatic sudden death. Also certain reports have inadvertently deduced in definition, no causative

findings of death after post mortem examination on age bracket,^[4] while others insisted that most findings are indirectly implicative of mechanisms associated with in-born errors of amino acid, carbohydrates, fatty acid, and genetic defects particularly in cases of sudden infant death syndrome (SIDS)^[5-9].

Consequently, the term infant sudden death syndrome a concept adopted in 1967 and introduced in 1970 was in a bid to analyze deaths in an environment with wide spectrum of clinico-pathologic presentations. This encompassed a large group of conditions^[10] including sudden unnatural death of infant syndrome (SUDIS), the earliest being that recorded in the holy bible (1 King 3:19, 22). It is defined as the sudden death of an infant younger than one year that remains unexpected after a thorough case investigation, including the performance of a complete autopsy, examination of the scene of death, and review of the clinical history^[11,12]. Cases which fail to fulfill the criteria are unclassified and unresolved cases though many may satisfy one of the conditions in the definition. The sudden infant death of children younger than one year has prevalence of 1 to 5 per 100 lives birth in the world and in USA record of 6,000 SIDS cases per annum, of these 90% occurred within first 6 month of live.

We therefore search for the prevailing causes of sudden death of infant (SDI) in our environment within the border period of infant health care delivery between the late twenty century and first four years of the

millennium and whether our finding merited further classification. The pattern of occurrence, medical approach, psychosocial effects, and quality of health personal involvement in a depressed economy were verified.

Materials and Methods

The survey which spanned through January 1999 to December 2004 involved the search of 515 clinical record folders of infant patients that were consulted or seen at the various Out-Patient Departments (OPDs), Accident and Emergency (A and E), Children Emergency (CE) Departments, of in-patients that were admitted to the Departments of Obstetrics and Gynecology (O and G), and pediatrics at Abia State University Teaching Hospital (ABSUTH), Aba. Also verification of all qualified records were done - particularly of those records from the wards, which though appeared authentic were further scrutinized and confirmed through performed laboratory test results save for the Department A and E. All other in-patients included in this work must have had one laboratory test performed or requested on which were either partly completed or could not be carried out before patient death. All patients included in the search must have medical records generated at ABSUTH whether brought in dead (BID) or alive on consultation, and must have met the following criteria

1. Must have been first seen and admitted by a consulting doctor at any of the emergency departments, and had adequate medical information recorded from the patients or guidance.
2. Cause of death confirmed or queried, hence death certified.
3. Time of death in relation to time of consultation was within 1 hour.
4. Brought in dead – in which case record insisted that the evil claws of death must have overpowered patients while on transits from abode, and that supposed illness must have occurred sudden and observed within 1 hour at death. Table 1

Hospital staff

We adopted the use of questionnaires for all 407 chosen medical officers and hospital staff who have been involved at one time or the other in infant patient's medical care within the period covered by this search. Valued were medical officers who must have participated in several child care services at any infant care post. Other criteria that must be fulfilled are:

1. Must have been a fully employed staff consulting or officer at ABSUTH for over 2 years before year 1999.
2. Must have had a direct or indirect contact with infant care activities in the day or night.
3. If administrative staff or alike, is either at the bedside of sudden death of infant (SDI) – in which case, must have observed more than one of such

cases, and is able to give tangible reason of presence at either children emergency, A and E, or infant wards at the time of death. Such officer's claims could be traced to accurate date and post of observation within the period said.

Non-medical mother questionnaire

Another was a non-medically oriented mother's questionnaire. The contact was with 1400 mothers who have experienced SDI at one time or the other in their families. The choice of mothers was not restricted to any particular trade or educational level and background, but on the understanding of the explained facts about SDI. These mothers may not be able to read or write but must be guided by a member of the investigating team. However, those that could not respond favorably have their eyes over-flow with tears. Such reports were discarded because their information was considered influenced by psychosocial errors rather than true medical information. Marriageable aged mothers that responded favorably to oral interview were 150 out of 1400 approached and their ages range from 18-40 years, and must have had at least two pregnancies with one live birth. She must have been present at the bedside of child sudden death. SDI from these mothers was recorded against the months when they occurred.

Hospital autopsy review

The morgue records of Department of Histopathology were consulted to ascertain the level of autopsy involvement with SDI within the period covered by the search. Five cases of brought-in-dead (BID) that autopsy were conducted were coroner cases; hence the full reports were not included save for external bodies findings and internal observations recorded of 10 none BID cases. All these findings helped to verify reports from Medical Officers.

Result

From the 515 cases in medical records books and folders consulted, were 319 cases that qualified for inclusion in the search, and these were linked to 343 Abia State University Hospital ABSUTH staff (Table 1) who were able to remember their involvement during the patients hospitalization/admission or receive as brought in dead (BID). Causes and frequency of occurrence of SDI within the 6 years (1999-2004 as in Fig. 1) varied and scrutiny shows that some cases were not yet fully diagnosed when SDI surprisingly took place. Suspected and confirmed causes of death in frequencies were as follows:

- Respiratory failure 107 infants
- Alimentary distress 103 infants
- Cardiac failure 70 infants
- Circulatory failure 25 infants
- Trauma and domestic accident 10 infants
- Road traffic accident 4 infants

Ten children died within 40 seconds before their doctors could attempt reasonable contacts with them. Hence no definite diagnosis established, but cause of death suspected (Cause of death unknown, and not included in the above) because mothers could not give substantive report of infants observed health changes prior to death. Of the 107 respiratory failures SDI cases were 10 BID cases which reports showcased sufficient

evidence in the events that led to death suspected to be respiratory failure. Findings showed that 232 children died within 24 minutes of hospitalization as appropriate diagnosis were not made and mothers were emphatic that illnesses were sudden within hour and death occurred. Sixty were dead 20 seconds after 5 minutes of admission, and 27 of 107 breathe last within 10 seconds to 5 minutes on arrival at children emergency.

Table 1: Hospital Officers of ABSUTH involved in the study and level of Infant Health care participation

Department/units of staff members	No of staff	M	F	Level of involvement in SDI
Children Emergency	29	10	19	All staff on various duty periods and on calls
Accident and Emergency	25	7	18	All staff on various duty periods and on calls
Children Theatre	15	5	10	All staff on various duty periods and on calls
Children surgical ward	14	5	9	All staff on various duty periods and on calls
Children crèche	35	6	29	All staff on various duty periods and on calls
General Nursing Department	134	2	132	All staff on various duty periods and supervision
Medical Doctors (unclassified)	35	27	8	Various duty and on call
Biochemical Engineer	1	1		On duty/on call
Pharmacist	15	8	7	On various duty and on shift.
Other medical staff (unclassified)	40	19	21	On various duty categories indirectly involved or related to patients hence present.

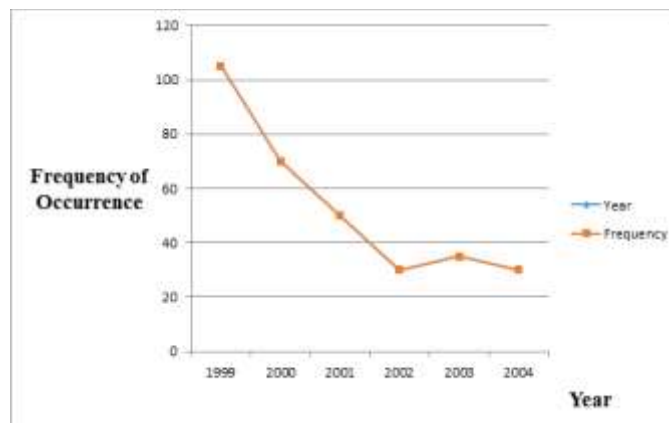


Fig. 1: Frequency and yearly involvement of SDI

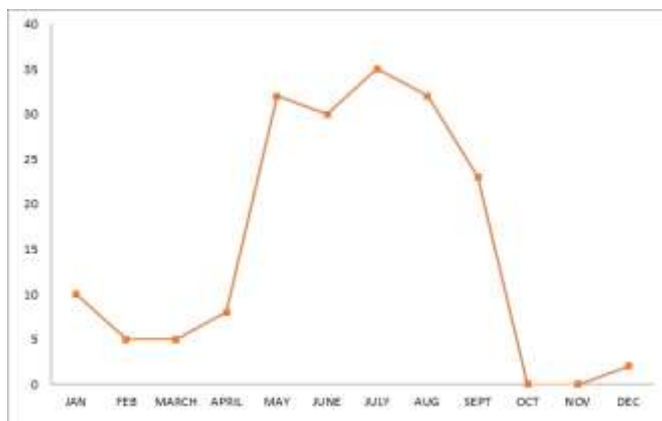


Fig. 2: Monthly frequencies of SDI in the years

Table 2: Yearly Clinicopathologic Evidence of SDI

Year	Frequency	Clinical evidence
1999	104	Anemic heart failure, child neglect, drug toxicity, hemorrhages.
2000	70	Anemic heart failure, child abuse and neglect, drug toxicity
2001	50	Child neglect, drug toxicity, anemic heart failure
2002	30	Anemic heart failure, hemorrhages, vagal inhibition.
2003	35	Aspirated food particles into the wind pipe, child neglect, vagus inhibition, dehydration, anemic heart failure
2004	30	Anemic heart failure, child neglect, drug toxicity.
Total	319	

Table 2 shows the clinical analysis of causes of death as provided in the patient folders, and the yearly frequency implication of SDI within the period under search.

From the medical questionnaire it was general opinion that SDI cases were at increase mid 1990s and that method of diagnosis and specialist staff inadequacy contributed to the increase as against the beginning of millennium when there were significant improvement in medical infrastructures at ABSUTH, Aba. Of 1400 questionnaires of non-medical mothers distributed, 450 were duly completed and received back. However a total of 400 out of all returned were considered satisfactory and authentic hence merited inclusion for scrutiny, and 311 had only A-section of the questionnaires that borders on previous SDI experienced completed. One hundred and fifty mothers interviewed by the team on field were included in 400 chosen for the study, and were all within the age range of 18-40 years. Three hundred and eighty parities were observed, and these could not be classified among spontaneous and criminal abortions, because most of the 400 refused to respond to such questions that would have aided characterization. However, from 150 mothers interviewed out of 400 in the study were observed 208 SDI involving 15 sets of twins, and 9 triplets.

Also from 311 mothers of 1400 were 594 SDI. Thus:

A. One mother had SDI four times involving 3 female and one male. All female died within 1 day few

hours and the male at 7th months from births. All babies were of normal full term birth without abnormality.

- B. Seventy mothers experienced SDI three times involving 131 males and 79 females, and death occurred of 100 was within 3 months, of 77 within 4 -6 months, of 31 within 7 months to one year, and in 2 within one year and 3 days of ages. Abnormal babies were 11 (5 males of which 2 had deformed left legs and 3 low birth weight without much weight gain till death, and 6 females all of low birth weight with gain before death).
- C. Fifty mothers had SDI twice involving 56 males and 44 females. Ten died within 1 day to 3 weeks, thirty died within 3-6 months, and 35 within 7 months to 1 year, while 25 within 1 year 6 days and 1 year 8 days from birth. Abnormal babies were 13 (8 males of which 3 had skull deformity and 5 low birth weight without gain till death, and 5 females all of low birth weight without appreciable gain till death).
- D. Two hundred and eighty mothers experienced SDI once. These involve 168 males and 112 females. Ten died within 1 day to 3 weeks from birth, One hundred and sixty three died within 1-3 months from birth, 80 within 4-6 months, 7 within 7 months to one year, and 20 within 1 year and 2 weeks from birth. Abnormal babies were 7 (5 males of which had skull and both legs deformed, 2 female of low birth weight and of full term).

Mothers informed that critical SDI period in the years were within the 5th to 8th months in years as also observed from medical folders. Fig. 2, and Table 3 shows SDI characteristic occurrences and frequencies on mothers and infants.

Table 4 shows analyzed events and characters of 208 SDI as obtained from 150 mothers interviewed.

Table 3: SDI occurrence and frequency as observed by mothers

SDI frequency in mothers	Male Infant	Female Infant	Total
Once	168	112	280
Twice	56	44	100
Thrice	131	79	210
Four times	1	3	4
Birth Abnormality frequency	18	13	31

Clinical finding from folder

In the entire 515 clinical folder consulted bearing sudden death of infant cases was variably comprehensive and altogether creditable to medical history given by infant parents. In 167 cases, parents tried to miss-address the typical observation and poise to present an excusable blameless posture though medical manifestations were ably traced to pregnancies or ignorance. These include;

1. Infants were typically pulse less and period of sleep were previously characterized by apnea.
2. Infants must have had recent meal few minutes/hour ago without apparent clinical sign of illness, and sleep was uneventful and peaceful. When next checked to breast feed, observed lifeless without pulse or respiration.
3. There were history of premature delivery of less than 36 weeks gestation and birth weight ranges from 2100g to 2500g.
4. Infants (246) were of full term born without significant pregnancy related complications.
5. Infant weights appreciated with feeding and age relatively commiserate to stature at or before sudden death.
6. There was no sign of threatening ill-health related concern shown by infants at any stage in life before sudden death.
7. Infants had history of two days minor gastrointestinal and/or respiratory tract illness with intermittent cough which ceases within a week, latter occasional vomiting though infant gained agility with full recovery. Following week, there was overt high fever or fever and respiratory distress or sign of dehydration consequent of which was death.
8. There was slight fever and cough three days back which relapsed on treatment, and babies were

doing well before sudden violent cough and death within minutes as babies were rushed to the hospital without pulse. BID cases.

Physical findings (Postmortem)

Study of infant environments was not embarked upon and 412 mothers were active petty traders and goods and services hawkers. In about 50 cases, mothers acknowledged having trusted infants in the care of young maids or infant's young siblings, hence possible neglects at various degrees existed. Only 24 mothers trusted infants in the care of experienced maids and the remaining 26 mothers nursed their infants till sudden death situation. Findings on the external bodies were as follows;

- i. Pale frothy watery fluid and sometimes mucoid discharges from the mouth and/or nose.
- ii. Signs of livor mortis or rigor-reddish-blue mottling of postmortem lividity.
- iii. Grossly, there were congenital abnormalities though not cause of death.
- iv. There were needle-like marks suspected to be bit-mark or from sharp object.
- v. Wounds in varying degrees of healing mostly on the legs.
- vi. Scalds or burns from gasoline flame on the fingers and palmers
- vii. Papillary changes
- viii. Retinal hemorrhage, bruises and old wounds.
- ix. Well-fed and cared bodies
- x. Body with serrated lower-lips loss.
- xi. Malnourished, neglected, cutaneous injuries, wounds and unkempt bodies.
- xii. Abnormal head shape and mosquito-like extremities perfectly fixed on the trunk of protruded abdomen.

Autopsy finding

Autopsy finding on the internal bodies of 5 coroner cases appear disturbing and misleading in causes of death opinion. Complete autopsy involving laboratory investigations were not included here for obvious reasons. Substantive findings were;

- i. Minor inflammatory changes within trachobronchial tree
- ii. Cyanosis (peripheral and central), congestion of the lungs and veins apparent.
- iii. Petechial hemorrhages- medullary, suboxia and cerebral edema.
- iv. Enlarged fatty- yellow liver and enlarged spleen.
- v. Foreign matter and/or vomits in the medium airway passages.
- vi. Normal thymus, adrenals, and hearts.
- vii. No significant gastro-intestinal tracts erosion

Table 4: SDI events as observed by mothers

Events	No. of mothers	No. of children
<i>Period of illness</i>		
Hour	40	70
Minutes	50	50
Seconds	60	88
<i>Hospitalization</i>		
Hospital admission	90	128
Home keep	60	80
<i>Place of death</i>		
Hospital	90	128
Home	60	80
<i>Hospital service</i>		
Poor	60	
Encouraging	90	
<i>Mode of death</i>		
Agonizing	40	60
Peaceful	70	100
Not observed	40	48
<i>Position of child in the family</i>		
Ist child	80	100
2 nd child	42	58
4 th child	18	35
5 th child	10	15
<i>Type of feeding</i>		
Breast milk only	98	100
Breast milk & baby formula	30	62
Breast milk, baby formula & adult food	22	46
<i>Age of child at death</i>		
1 year	30	
4-11 months	70	
1-3 months	85	
1 day to 3 weeks	23	
<i>Clinical presentations</i>		
Fever and vomiting	90	
High fever	48	
Fever, vomiting & stooling	60	
Nothing was observed	10	

Discussion

The study design is exceptional and captures the psychosocial influences of SDI on mothers and hence informs the various agony states of families who have experienced it (Table 3). Also in order to separate these feelings from clinical evidences and avoid distortion of valuable facts, medical staff questionnaire was included. This mitigates against the difficulties and harm possible in the scrutiny of responses and information of non-medical mothers. Such was that 150 of 400 mothers were re-visited.

Though that several studies in medical sciences adopt the use of questionnaire to obtain epidemiological data, ours differ in pathology because two questionnaire were employed to authenticate information, and this did transverse as it filters psycho-medical entities from clinical history of families with depressed economy.

Histo-physiological findings were able to support clinical findings as they help to ascertain correct diagnosis. Again, the information from Hospital staffers were further verified through medical record books and folders in the various departments involved at Abia State University Teaching Hospital in 6 years. This revealed the attitude and conduct of Hospital staff to duty post. The unwarranted appearances and participation of staff at wrong duty posts is it due to poor training or gross neglect of staffers to duty charges, hence the poor quality productivity? Or could it be that the Hospital Authority did fail to checkmate luxuriate and nonchalance at duty posts? The correct answer cannot be divorced from the reduced level of SDI recorded as the years progressed from 1999 to 2004 (Fig. 1). This is because appropriate equipment and specialized staff were engaged to the system^[13].

That is to say, healthcare technology was introduced to give sustainable efficiency unto increasing productivity.

From the results obtained it is obvious that causes of SDI in depressed economies drafted a while from that of SIDS under certain condition(s) resulting in road traffic accident (RTA), trauma, domestic accidents and alimentary distress as the variants. Also the frequency of occurrence can be bizarre and inconsistent with SIDS though much relationship exists with SDI^[14]. Again, when considered that alimentary disease is second highest, the consequent hideous/remote factors to suspect may reveal gastro intestinal system derailment resulting from genetic disorder^[1], such assertion then favors our findings for SIDS than SDI. The same cannot be said of respiratory failure which appears rapid for SIDS as well as SDI, presenting that infant death situation caused by any respiratory failure may be rapid in the absence of sustained complication or active genetic factor^[16-20], hence sudden and is expected within hour.

Our finding informed SDI occurred most within 5th to 8th month of the years on search; an information that may be considered unique for the geographical location because of the climatic condition (Rainy season) and increased traditional activities. Also the age range at which SDI show highest frequent in our finding appear inconsistently irregular unlike SIDS which show strength at 2nd to 4th month^[21,22]. Though reasons appear unclear for this finding, however this may be one of the epidemiological patterns of SDI.

The time lapse at which SDI takes place suggest that infant health condition should be tagged emergency. This is because we were unable to place traceable line of difference between SDI and SIDS timing. When clinicopathologic evidences are considered and their frequencies as is in our finding (Table 2), SDI has shown border in SIDS. Also our finding showcases the effect of abnormality at premature birth and full term birth. It is obvious therefore that for SDI the consequences are fairly the same for SIDS^[21,23]. Again for SDI, the infant failed to gain appreciable weight before death can rightly be related to poor nutrition from the 400 mothers to their infants as in our study. Also from Table 4, it is certain that infants feeding were primitive and hence must have been denied good quality and expected sanitary condition. Are these not sufficient to prompt as reasons for the loss of 594 infants to SDI by 311 mothers? If the answer is in the affirmative, SDI could have been caused by poor feeding and hygiene, lack of quality medical attention, poverty, and ignorance of weaning mothers as shown in our report rather than remote factors. There are facts in other reports that SIDS may be associates with low birth weight and premature births, but none to our knowledge have been able to express sex character as in a report^[22], which reveals more males than females affected by SIDS as in SDI. The revelation also informed that more males were born

in South-Eastern Nigeria (Table 3) within the period covered by the search, because Aba town and environment is the economic net centre of South-Eastern Nigeria predominately occupied by the Igbo-ethnic Nationality with amazing population.

Clinical and pathological evidences of SDI as shown in our report support the assertion that causes of SDI can be traced to occur along and within the corridor of economic depression, though that few remote causes may be involved. Again the unavailability of appropriate biomedical equipment (Clinical Engineering) and staff to man such contributed to increased occurrence of SDI such that prompt diagnostic and emergency attention could not be given. The Team from Federal University of Technology (FUTO) involved discovered that the deplorable conditions of medical equipment's and scarce staff injection in the system were the major cause of SDI in the Hospital rather than other causes, because there were no evidence of integrated workflow for efficiency and effective communication system for rapid respond when need be^[24,25]. From Table 1, it is obvious that there were no clinical Engineer but one whose diagnostic kit lack relevance to type of equipment available.

It is obvious from this search that SDI differs in character of occurrence in the presence of clinic-pathologic factors and poor economy of families, and do present as SIDS when hideous causes are considered though may have epidemiological pattern geographically. The importance of optimized and integrated health care technology for infants is increasing task to achieve.

References

1. Van Camp SP: Sudden death. Clin Sports Med 1992;11,273-289.
2. Van Camp SP, Bloor CM, Mueller FO, Olson HG: Non-traumatic sport death in high school and college athletes. Med Sci Sport Exerc 1995;27,6471-6477.
3. Gordon T, Kannel WB: Premature mortality from coronary heart disease: The Framingham study: J Am Col Cardio 1971;216,1617-1625.
4. Backwith J. B, Bergman A. B, Beckwith J. B: Observation on the pathological anatomy of the sudden infant death syndrome. Sudden infant syndrome 1970. University of Washington Press Seattle. 83-102.
5. Sinclair-Smith C, Dinsdale F, Emery J: Evidence of duration and type of illness in children found unexpectedly dead. Arch Dis Child 1976;51,424-428.
6. Howat A. J, Beneth M. J, Shaw L, Variend S: Medium-chain acylcoenzyme A dehydrogenase deficiency presenting as sudden infant death. Brit Med J 1984;288,976 [ISI].
7. Hwat A. J, Bennet M. J, Variend S, Shaw L, Engel P. C: Defects in the metabolism of fatty acids in the sudden infant death syndrome. Brit Med J 1985;290,1771-1773.
8. Rinaldo P, Yoon H. R, Yu C. Raymond K, Tiozzo C, Giordano G: Sudden and unexpected neonatal death protocol for the postmortem diagnosis of fatty acid oxidation disorders. Semin Perinatal 1999;23,204-210.

9. Miller M, Brooks J, Forbes N, Insel R: Frequency of G-985 mutation in medium-chain acyl-coA dehydrogenable (MLAD) deficiency in sudden infant death syndrome. *Prog Uni. Bio Res* 1992;375,495-498.
10. Michael J. Benneth, Piero Rinaldo: The metabolic autopsy comes of age. *Clin Chemistry* 2001;47,1145-1146.
11. Patrick L. Carolan: Sudden infant death syndrome. 2002. 40, Update Medicine, 1-20 (Online).
12. Maron B. J, Shem W. K, Link M. S et al: Efficacy of the implantable cardioverter-defibrillator for the prevention of sudden death in hypertrophic cardiomyopathy. *N Engl J Med* 2000.432,265-273.
13. Roberts G: Supporting of children with serious health care needs: Analysing the costs and benefits. *Eval Health Prof* 2001;24 (1),72-83.
14. Rinaldo P, Mattern D: Disorders of fatty acid transport and transport mitochondria oxidation: Challenges and dilemma of metabolic evaluation. *Geneth Med* 2000.2,338-344.
15. Martin Ward Platt, Peters Blair, Peter J. Fleming, Lain J. Smith, Tim J. Cole, Charlote E. A, Leach, P. J. Berry, Jean Golding, and the CESDI SUDI research group. A clinical comparison of SIDS and unexplained sudden infant deaths: How healthy and how normal. *Arch Dis Child* 2000.82,98-106.
16. Schwartz P. J, Stramba-Badiale M, Segantini A et al: Prolongation of the QT interval and infant death syndrome: *N Engl J Med* 1998.338(24),1709-1714.
17. Schaffer M. S, Trippel D. L, Buckles D. S, et al: The longitudinal time course of QTc in early preliminary results of a prospective sudden infant death syndrome. 1991 Surveillance Program *Mai*.11(1),57-62.
18. Towbin J. A, Friedman R. N: Prolongation of the QT interval and the sudden infant death. *N Engl J Med* 1998.338(24),1760-1761
19. Wang Q, Bowle N. E, Towbin J. A: The molecular basis of long QT syndrome and prospect. *Mol Today* 1998;4(a),382-388.
20. Wang Q, Chen Q, Li H, Towbin J. A: Molecular genetics of long QT syndrome from gene. *Curr Opin Cardio* 1997;12 (3),310-320.
21. Lynn Barkley Burnett, Jonathan Adler: Pediatrics sudden infant death syndrome; Update. *E-Medicine* 2001;13, July, Online.
22. Neil K. Kaneshiro and David Zieve. Sudden Infant death syndrome; causes, incidence and risk factors. PubMed Health. National Labrary of Medicine, National Institutes of Health. Reviewed 2011. A.D.A.M Medical Encyclopedia (Internet). Atlanta (GA),2013.
23. Krous H.F: The microscopic distribution of intrathoracic petechiae in sudden infant death: *Arch Pathol Lab Med* 1984;108(1),77-79.
24. Mira A, Lehmann C: Pre-analytical workflow analysis reveals simple changes and can result in improved Hospital efficiency. *Clin Leadersh Manag Rev* 2001;15(1),23-29.
25. Bryan S, Buxton M, Brenna E: Estimating the impact of a diffused technology on the running cost of a hospital: A case study of a picture archiving and communication system. *Int J Technol Assess Health Care* 2000;16(3):787-789.