INTRODUCTION

Biomedical informatics is the interdisciplinary scientific field that studies and pursues the effective use of data, information, and knowledge for scientific inquiry, problem solving, decision making, and communication ***(Stead, 2011).***

Medical computing offers tools and instruments that support the data, generate diagnoses, provide therapeutical advice and access to information in order to improve medical knowledge and to make it available whenever and wherever adequate decision-making is required ***(Wechsler, 2003).***

The Electronic Medical Record is an enabling technology that allows physician practices to pursue more powerful quality improvement programs than is possible with paper- based records ***(Loomis et al., 2002).***

Electronic health records refer to the recording of the medical and relevant social history of the patient, obtained directly or indirectly. It is an instrument of frequent use that must guarantee the quality of assistance provided, reflecting all information pertinent to forming the patient medical history. It must be designed so that data is easily and effectively retrieved for everyday use ***(Romeu, 1995).***

Moving from paper-based to Electronic Medical Records (EMR) system is complex but inevitable. A gap exists between Electronic Medical Records users and nonusers regarding issues that affect Electronic Medical Records implementation,

including necessity, usefulness, data entry, cost, security and confidentiality ***(Miller and Sim, 2004).***

Neonatal care is an extremely data-intensive activity. Physiological monitoring equipment is used extensively along with web-based information tools and knowledge sources. Merging data from multiple sources adds value to this data collection. An informatics approach has much to offer in terms of both efficiency and clinical safety. Firstly, it may serve as a web-based resource or repository for information. Secondly, it can provide web-based tools, such as drug calculators or nomograms, which aid the clinician with procedures such as estimation of length of insertion of catheters or endotracheal tubes.

Finally once data has been collected it can then be used to generate an automated discharge summary that includes physiological parameters, radiology and laboratory results, as well as clinical information ***(Battin et al., 2009).***

On a daily basis, bedside visit and other care-related notes that outline the patient's condition, medications, treatments, nutrition, new problems, care being provided, plans, and family updates must be generated by physicians. Tracking changes over time is a key for clinical decision-making in intensive care units (ICUs) ***(Drummond, 2010).***

Electronic Health Record systems (EHRs) are clinical support tools with the potential to reduce strains on clinician memory and cognition while improving efficiency in workflow and effectiveness in care quality and coordination. The safe,

efficient, effective, patient-centered, equitable, and timely delivery of health care services requires tools that organize and display information which places patient data in context, synthesizes that information with available medical evidence, and supports the clinician's decision making process ***(Stead and Lin, 2009).***

The increased availability of patient information and decision support at the point of care has tremendous potential for reducing errors and improving the delivery of evidence-based care. The evolving role of the electronic medical records in supporting clinical practice can be organized around four primary functions necessary to achieving this potential and related efficiency gains. These roles include:

- Memory aid: Reduces the need to rely on memory alone for information required to complete a task.
- Computational aid: Reduces the need to mentally group, compare, or analyze information.
- Decision Support aid: Enhances the ability to integrate information from multiple sources to make evidence-based decisions.
- Collaboration aid: Enhances the ability to communicate information and findings to other providers and patients ***(Armijo et al., 2009).***

AIM OF THE STUDY

The aim of this study was:

1. Designing competent model of electronic medical records in neonatal intensive care unit to replace the manual maneuvers of writing medical records.
2. Implementation of the electronic medical record on all cases in Om-el-attebaa pediatric hospital neonatal intensive care unit for 12 months duration.
3. Analyze the collected data through the computerized patient-based records and present them in a scientific way to facilitate effective and efficient data collection for policy making, evaluation, disease management and quality care delivery.

Chapter 1

NEONATOLOGY REVIEW

The high risk newborn

High-risk newborns are often associated with certain maternal, placental, or fetal conditions; when one or more are present, nursery staff should be aware and prepared for possible difficulties. ***Smith (2014)*** summarized the factors associated with high-risk newborns:

A. Maternal characteristics and associated risk for fetus or neonate

Maternal factors	Associated risk for fetus or neonate
1. Age at delivery:	
a. Over 40 years.	Chromosomal abnormalities, macrosomia, intrauterine growth retardation (IUGR), blood loss (abruption or previa).
b. Under 16 years.	IUGR, prematurity, child abuse/neglect (mother herself may be abused).
2. Personal factors	
a. Poverty.	Prematurity, IUGR, infection
b. Smoking.	Increased perinatal mortality, IUGR
c. Drug/alcohol use.	IUGR, fetal alcohol syndrome, withdrawal syndrome, sudden infant death syndrome, child abuse/neglect.
d. Poor diet.	Mild IUGR to fetal demise in severe malnutrition.
e. Trauma (acute, chronic)	Abruptio placentae, fetal demise, prematurity.

3. Medical conditions	
a. Diabetes mellitus	Stillbirth, macrosomia/birth injury, respiratory distress syndrome (RDS), hypoglycemia, congenital anomalies.
b. Thyroid disease.	Goiter, hypothyroidism, hyperthyroidism.
c. Renal disease.	Stillbirth, IU GR, prematurity.
d. Urinary tract infection.	Prematurity, sepsis.
e. Heart and/or lung disease.	Stillbirth, IUGR, prematurity.
f. Hypertension (chronic or pregnancy-related).	Stillbirth, IUGR, prematurity, asphyxia.
g. Anemia.	Stillbirth, IUGR, hydrops, prematurity, asphyxia.
h. Isoimmunization (red cell antigens).	Stillbirth, hydrops, anemia, jaundice.
i. Alloimmunization (platelet antigens).	Stillbirth, bleeding.
j. Thrombocytopenia.	Stillbirth, bleeding.
4. Obstetric history	
a. Past history of infant with prematurity, jaundice, RDS, or anomalies.	Same with current pregnancy.
b. Maternal medications.	eg. Phenytoin is considered a teratogen causing recognizable pattern of malformations known as fetal hydantoin syndrome,
c. Bleeding in early pregnancy.	Stillbirth, prematurity.
d. Hyperthermia.	Fetal demise, fetal anomalies.
e. Bleeding in third trimester.	Stillbirth, anemia.
f. Premature rupture of membranes.	Infection/sepsis.
g. TORCH infections.	eg. Congenital varicella syndrome.
h. Trauma.	Fetal demise, prematurity.

B. Fetal characteristics and associated risk for fetus or neonate

Fetal characteristics	Associated risk for fetus or neonate
1. Multiple gestation.	IUGR, twin-twin transfusion syndrome, prematurity, birth trauma, asphyxia.
2. IUGR.	Fetal demise, congenital anomalies, asphyxia, hypoglycemia, polycythemia.
3. Macrosomia.	Congenital anomalies, birth trauma, hypoglycemia.
4. Abnormal fetal position/presentation.	Congenital anomalies, birth trauma, hemorrhage.
5. Abnormality of fetal heart rate or rhythm.	Congestive heart failure, heart block, hydrops, asphyxia.
6. Decreased activity.	Fetal demise, asphyxia.
7. Polyhydramnios.	Anencephaly, other central nervous system (CNS) disorders, neuromuscular disorders, problems with swallowing (e.g., agnathia, any mass in the mouth, esophageal atresia), chylothorax, diaphragmatic hernia, omphalocele, gastroschisis, trisomy, tumors, hydrops, isoimmunization, anemia, cardiac failure, intrauterine infection, inability to concentrate urine, large for gestational age, maternal diabetes.
8. Oligohydramnios.	Fetal demise, placental insufficiency, IUGR, renal agenesis, pulmonary hypoplasia, deformations, intrapartum distress, postterm delivery.

C. Conditions of labor and delivery and associated risk for fetus or neonate

Conditions of labor and delivery	associated risk for fetus or neonate
1. Preterm delivery.	RDS, other issues of preterm birth.
2. Postterm delivery (occurring more than 2 weeks after term)	Stillbirth, asphyxia, meconium aspiration.
3. Maternal fever.	Infection/ sepsis.
4. Maternal hypotension.	Stillbirth, asphyxia.
5. Rapid labor.	Birth trauma, intracranial hemorrhage (ICH), retained fetal lung fluid/transient tachypnea.
6. Prolonged labor.	Stillbirth, asphyxia, birth trauma.
7. Abnormal presentation.	Birth trauma, asphyxia.
8. Uterine tetany.	Asphyxia.
9. Meconium-stained amniotic fluid.	Stillbirth, asphyxia, meconium aspiration syndrome, persistent pulmonary hypertension.
10. Prolapsed cord.	Stillbirth, asphyxia.
11. Cesarean section.	RDS, retained fetal lung fluid/transient tachypnea, blood loss.
12. Obstetric analgesia and anesthesia.	Respiratory depression, hypotension, hypothermia.
13. Placental anomalies	
a. Small placenta.	IUGR
b. Large placenta.	Hydrops, maternal diabetes, large infant.
c. Torn placenta and/or umbilical vessels.	Blood loss.
d. Abnormal attachment of vessels to placenta.	Blood loss.

Assessment of the Newborn

General Assessment

Detailed newborn examination should begin with general observation for normal and dysmorphic features. A term newborn should have pink skin, rest symmetrically with the arms and legs in flexion, cry vigorously when stimulated, and move all extremities equally. The new Ballard score was designed to assess a newborn's gestational age through a scoring system that combines physical characteristics with neuromuscular development ***(Lewis and Eisenhower, 2014).***

Infant classification by gestational (postmenstrual) age

a. Preterm. Less than 37 completed weeks (259 days).
b. Late preterm. A subgroup of infants born at 34 through 36 weeks GA (238-258 days).
c. Term. Thirty-seven to 41 6/7 weeks (260-294 days).
d. Post-term. Forty-two weeks (295 days) or more.

Neuromuscular Maturity

Score	-1	0	1	2	3	4	5
Posture							
Square window (wrist)	 >90°	 90°	 60°	 45°	 30°	 0°	
Arm recoil		 180°	 140°–180°	 110°–140°	 90°–110°	 <90°	
Popliteal angle	 180°	 160°	 140°	 120°	 100°	 90°	 <90°
Scarf sign							
Heel to ear							

Physical Maturity

Skin	Sticky, friable, transparent	Gelatinous, red, translucent	Smooth, pink; visible veins	Superficial peeling and/or rash; few veins	Cracking, pale areas; rare veins	Parchment, deep cracking; no vessels	Leathery, cracked wrinkled
Lanugo	None	Sparse	Abundant	Thinning	Bald areas	Mostly bald	
Plantar surface	Heel-toe 40-50 mm: –1 <40 mm: –2	>50 mm, no crease	Faint red marks	Anterior transverse crease only	Creases anterior ⅔	Creases over entire sole	
Breast	Imperceptible	Barely perceptible	Flat areola, no bud	Stippled areola, 1–2 mm bud	Raised areola, 3–4 mm bud	Full areola, 5–10 mm bud	
Eye/Ear	Lids fused loosely: –1 tightly: –2	Lids open; pinna flat; stays folded	Slightly curved pinna; soft; slow recoil	Well curved pinna; soft but ready recoil	Formed and firm, instant recoil	Thick cartilage, ear stiff	
Genitals (male)	Scrotum flat, smooth	Scrotum empty, faint rugae	Testes in upper canal, rare rugae	Testes descending, few rugae	Testes down, good rugae	Testes pendulous, deep rugae	
Genitals (female)	Clitoris prominent, labia flat	Clitoris prominent, small labia minora	Clitoris prominent, enlarging minora	Majora and minora equally prominent	Majora large, minora small	Majora cover clitoris and minora	

Maturity Rating

Score	Weeks
-10	20
-5	22
0	24
5	26
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44

Figure (1): Neuromuscular and Physical maturity ***(Ballard et al., 1991)***

Birth weight classification

Although there is no universal agreement, the commonly accepted definitions are as follows:

1. Normal birth weight (NBW): From 2,500 to 4,000 g.

2. Low birth weight (LBW): Less than 2,500 g. Note that, while most LBW infants are preterm, some are term but SGA. LBW infants can be further subclassified as follows:

   a. Very low birth weight (VLBW): Less than 1,500 g.

   b. Extremely low birth weight (ELBW): Less than 1,000 g.

(Cloherty et al., 2014)

Infants who fall outside the normal weight range (or 2 SDs above or below the mean) for gestational age are considered large for gestational age (LGA) (>90th percentile) or small for gestational age (SGA) (<10th percentile). Intrauterine growth restriction occurs when the fetus is unable to reach its growth potential due to maternal, uteroplacental, or fetal factors that prevent adequate gas exchange or nutrient delivery. These infants are at greater risk of morbidity and mortality than constitutionally SGA infants ***(Longo et al., 2013)***.

The term small for gestational age simply identifies a fetus below a specific weight cutoff without identifying any underlying cause "SGA" The terms intrauterine growth restriction IUGR and fetal growth restriction imply that some pathologic process has prohibited attainment of genetic growth potential.

Causes of IUGR are:

- **Maternal factors**
  - High blood pressure (chronic or pregnancy induced)
  - Chronic kidney disease
  - Advanced diabetes
  - Cardiac or respiratory disease
  - Malnutrition
  - Infection (toxoplasmosis, other viruses, rubella, cytomegalovirus, herpes viruses)
  - Substance abuse (alcohol, illegal drugs, tobacco)
  - Clotting disorders
  - Autoimmune disease
  - Chronic exposure to high altitudes
  - Uterine or placental factors
  - Abnormal placentation
  - Chronic placental abruption
  - Abnormal cord insertion or cord anomalies
- **Fetal factors**
  - Multiple gestations
  - Infection (cytomegalovirus, rubella)
  - Birth defects

- Chromosomal anomalies

- **Placental**
  - Primary placental disease
  - Placental abruption and infarction
  - Placenta previa
  - Placental mosaicism

(Baschat and Galan, 2017)

Because of an increased risk of hypoglycemia, the American Academy of Pediatrics recommends scheduled glucose screening for newborns who are large or small for gestational age, newborns of mothers with diabetes, and late preterm newborns (34 to 36 6/7 weeks gestational age), and provides protocols for their management ***(Adamkin, 2011)***.

I. History: The family, maternal, pregnancy, perinatal, and social history should be reviewed.

II. Routine physical examination of the newborn: the first routine examination probably reveals more abnormalities than any other physical examination.

General examination for normal and dysmorphic features.

Vital signs and measurements (Table 1).

Table (1): Vital signs and measurements

Vital sign	Normal range
Heart rate	120 to 160 beats per minute*
Respiratory rate	40 to 60 breaths per minute
Systolic blood pressure	60 to 90 mm Hg
Temperature	36.5°C to 37.5°C
Weight	Females: 2.8 to 4.0 kg Males: 2.9 to 4.2 kg
Length	48 to 53 cm
Head circumference	33 to 37 cm

(Lewis and Eisenhower, 2014)

Cardio-respiratory system

Color. The healthy newborn should have a reddish pink hue, except for the possible normal cyanosis of the hands and feet (acrocyanosis)

Rapiratory pattern. At rest, a newborn should exhibit unlabored breathing without grunting, nasal flaring or intercostal retractions.

Heart. Observe precordial activity, rate, rhythm, the quality of heart sounds, and the presence or absence of murmurs.

(Johnson and Cochran, 2014)

Thorax. Thorax should be inspected for shape and symmetry, accessory nipples in the mammary line, clavicles should be palpated to exclude fractures.

Abdomen. Ispection and palpation of the abdomen should be done with umbilical stump inspection.

Genitalia and anus: I. Male: both testes should be descended into the scrotal sac. Retractile testes can be milked into the scrotum and do not require intervention. Bilateral undescended testes, a micropenis (penile length for a term newborn is 2.5 to 3.5 cm), 14 or a bifid scrotum should prompt investigation for ambiguous genitalia. Evaluation of the scrotum may reveal an inguinal hernia or hydrocele.

II. Female: Term female newborns have prominent labia majora, whereas preterm female newborns have prominent labia minora and clitoris. A white discharge or small amount of blood may be present and is a normal response to maternal estrogen withdrawal. Signs of ambiguous genitalia include clitoromegaly and fused labia. III. Anus: The anus should be checked carefully for patency, position, and size ***(Lewis and Eisenhower, 2014)***.

Skin. Here are numerous, mostly benign, skin findings commonly seen in newborns:

1. Dryness, sometimes accompanied by cracking or peeling of the skin, is common especially in the postmature newborn.
2. Milia, which are inclusion cysts filled with keratinous debris, are tiny, discrete, often solitary, white papules commonly seen on the face and scalp. Milia re-solve spontaneously in the first weeks to months of life.