Implementation of Electronic Medical Records System in A Neonatal Intensive Care Unit

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Abstract

Background: Neonatal care is an extremely data- intensive activity. The computerization of the medical records has resulted in the storage of a wealth of clinical data. This abundance of data creates a great opportunity generating new knowledge by mining the data and using it to improve patient care. Availability of quality data enhances identification of problems in treatment and finds solutions to prevent extra costs due to ineffective treatment, thus making care delivery less expensive.

Methodology: Implementation of the designed electronic medical records software on all cases in Om- El- Attebaa Pediatric Hospital neonatal intensive care unit for 12 months [June 2014 till May 2015].

Results: One hundred ninety five cases were recorded from June 2014 till May 2015. One hundred and twenty five male (64.1%) and 70 female (35.9%) are reported. Preterms were 30.4% while term infants were 69.6% of the admitted cases with no post term. Eighty five point 1 percent 85.1% of the admitted cases were improved, 11.3% died and 3.6% were referred to other hospital. Unspecified bacterial sepsis of new born had the longest stay, mean 13.4± 8.6 days. Fifty sex cases had blood and/or tracheal aspirate culture. In 86 cultures, organisms were isolated in 35 cultures (40.7%). Klebsiella were isolated in 26 cultures (74.3%), p value0.044. In culture positive cases there is significant correlation of prematurity and final status of the infant improved or died, p value0.004.

Conclusion: Neonatal sepsis is a major cause of morbidity and mortality. The commonest encountered organisms in NICU were Klebsiella species. Endotracheal intubation and assisted ventilation were identified risk factors for sepsis in NICU.

Key words: Electronic medical records, Sepsis, Neonates

إنشاء نظام سجلات إلكترونية للمرضى يتم تطبيقه فى وحدة العناية المركزة لحديثى الولادة.

تهدف هذه الدراسة إلى إنشاء نظام سجلات إلكترونية للمرضى يتم تطبيقه فى وحدة العناية المركزة لحديثى الولادة.

رعاية الأطفال حديثى الولادة هو نشاط يتميز بتدفق البيانات المكثف. قواعد بيانات المواليد تدعم جمع، وعرض، وتحليل البيانات. يمكن أن تكون هذه قاعدة بيانات داعمة جدا لممارسة السريرية ومراقبة الأمراض المعدية. بجانب نتائج التسجيل، هذه الأنظمة هى مفيدة للغاية لدعم تقييم وتحسين الجودة، فضلا عن البحوث. وقد أدت حوسبة السجلات الطبية الى تخزين ثروة من البيانات السريرية، بما فى ذلك الوثائق السريرية، العلامات الحيوية، والنتائج المختبرية، وسجلات الصيدلية، ورموز التشخيص. هذه الوفرة فى البيانات تخلق فرصة كبيرة لتنشأ معرفة جديدة عن طريق التنقيب فى البيانات واستخدامها لتحسين رعاية المرضى.

السجلات الطبية القياسية صممت ليتم استخدامها فى وحدة العناية المركزة لحديثى الولادة. استرشادا بالسجلات الورقية الطبية المستخدمة فى وزارة الصحة (وزارة الصحة) ووحدة العناية المركزة لحديثى الولادة بجامعتى القاهرة وعين شمس.

فى هذه الدراسة تم تصميم وتطوير هذا البرنامج لتخزين واسترجاع السجلات الطبية لحديثى الولادة.

تم تشغيل إصدار البرنامج الأساسى للتجربة وتعديله لجعل إدخال البيانات واسترجاعها أسهل وأضافة خيار اصدار التقارير.

تم تطبيق استخدام إصدار البرنامج النهائى للسجلات الطبية الإلكترونية فى وحدة العناية المركزة لحديثى الولادة بمستشفى أم الأطباء للأطفال

وقد تم تحليل البيانات التى تم جمعها من خلال نظام السجلات الطبية المحوسبة التى كتبها SPSS أظهرت نتائج التحليل الإحصائى المعلومات الهامة مثل. درسنا البيانات المسجلة من ٥٦ حديثى الولادة (٣٨ ذكور، ١٨ إناث) مع الشك السريرى للعدوى حديثى الولادة ٨٦ الدم وإي. تي. وقد أجريت الثقافات إفراز.

كان بكتيريا كليبسيلا الكائن الحى المعزول الأكثر شيوعا [(فى ٢٦ من أصل ٣٥ مزرعة ميكروبات إيجابية) (٧٤,٣%)، قيمة P ٠,٤٤].

وفيما يتعلق حساسية العقاقير للكائنات المعزولة سلبية غرام ٦٤,٢٩% كانت مستجيبة للجنتاميسين تليها ٥٣,٥٧% مستجيبة للأميكاسين. كانت ٨٩,٢٩% من العزلات سلبية غرام مقاومة للأوجمنتين تليها مقاومة للسيفترياكسون ٦٤,٢٩%. وفقا لذلك أوصينا عدم استخدام أوجمنتين من الاختيار الأول من العلاج بالمضادات الحيوية وإضافة الجنتاميسين.

توفر هذه البيانات نوعية تعزز تحديد المشاكل فى العلاج وتوجه إلى حلول لمنع تكاليف إضافية بسبب المعاملة غير فعالة، مما يجعل تقديم الرعاية أقل تكلفة.

Background:

Neonatal care is an extremely data- intensive activity. Neonatal databases assist with collecting, displaying, and analyzing data from multiple sources. Even though such database construction can be difficult, it can be very supportive to clinical practice including surveillance of infectious diseases. Beside the recording outcomes, such systems are extremely useful for the support of assessment and quality improvement as well as research, Battin M et.al. (2009).

The computerization of the medical record has resulted in the storage of a wealth of clinical data, including clinical documents, vital signs, laboratory results, pharmacy records, and diagnosis codes. This abundance of data creates great opportunity generating new knowledge by mining the data and using it to improve patient care.

Infants admitted to NICUs are at a high risk for developing health care associated infections (HAIs). These are considered as hospital- acquired if occurring more than 48 hours after admission to hospital. Hospital acquired blood stream infections (HABSIs) is one of the most important HAIs in NICUs. HABSIs are often related to certain clinical procedures, such as the insertion of invasive devices including central venous catheters (CVCs) in the presence of reduced immunological function and birth weight of premature infants, Folgori L, et.al. (2013).

Invasive procedures (e.g. endotracheal intubation), Premature or VLBW infants and Lack of enteral feeding with breast milk are risk factors for neonatal sepsis, Shah BA, Padbury JF, 2014. Pathogens vary considerably between different neonatal units. In developing countries, gram- negative organisms may be far more prevalent as neonatal pathogens with a higher incidence of antimicrobial resistance. Overuse of antibiotics results in the development of antimicrobial resistant organisms. Therefore, ongoing surveillance of microbiological isolates and their sensitivity patterns is mandatory to guide the selection of empiric antibiotic therapy.

Availability of quality data enhances identification of problems in treatment and finds solutions to prevent extra costs due to ineffective treatment, thus making care delivery less expensive.

Methodology:

This study was carried out on 56 neonates (38 males, 18 females). They were recruited from NICU, Om- El- Atebaa pediatrics hospital in the period from (June 2014- May 2015). All neonates were included after a written consent from their parents.

Clinical Samples:

1. Tracheal aspirate was obtained for microbiological assay. The samples were collected in sterile containers and sent to the lab, NRC within 1 hour of collection. Samples collected at night were stored at 4°c overnight and sent to the lab. by 10 a.m. next day.
2. Blood sample for blood culture was collected; from each patient 3 ml of blood was withdrawn, and added to thioglycolate broth bottle, for aerobic and anaerobic culture. Blood samples were taken just before the next dose of the prescribed antibiotic.

Microbiological study using: Blood agar medium, Mac Conkey medium, Thioglycolate broth bottles for blood culture and Muller Hinton agar (for antibiotic susceptibility tests).

Statistical Analysis:

Standard computer program SPSS for Windows, release 12.0 (SPSS Inc, Tulsa, USA) was used for data entry and analysis. All qualitative variables were expressed as count and percent. Chi- square (χ^2) test was used to compare frequency of qualitative variables among the different groups. For all tests a probability (p) less than 0.05 was considered significant.

Results:

In this study, data recorded using electronic medical records for all cases admitted in Om- El- Attebaa Pediatric Hospital neonatal intensive care unit for 12 months duration. There were 195 cases' medical records. In this study, investigators studied 56 neonates (38 males, 18 females) with clinical suspicion of neonatal infection and different body fluid cultures were performed.

Mean gestational age was 36.96± 2.65 weeks, mean weight on admission was 2.77± 0.76 kg, mean age on admission was 7.8± 9.4 days. Mean length of stay was 11.6± 8.9 days. Diagnosis of cases was recorded according to ICD 10 (the 10th version of International Classification of Diseases).

Table (1) Frequency Of Final Diagnosis According ICD 10

Final Diagnosis	Frequency	Percent
(P20- P29) Respiratory and cardiovascular disorders specific to the perinatal period	8	14.3
(P35- P39) Infections specific to the perinatal period	9	16.1
P07.3 Other preterm infants	4	7.1
P36.9 Bacterial sepsis of newborn, unspecified	26	46.4
P55.1 ABO isoimmunization of fetus and newborn	2	3.6
P91.6 Hypoxic ischemic encephalopathy of newborn	7	12.5
Total	56	100.0

Table (1); Shows that (P36.9) Bacterial sepsis of newborn, unspecified was the final diagnosis in 46.6% of the sample cases.

Table (2); Relation Between Types Of Organisms And Type Of Samples

Isolated Organism	Sample		Total
	Blood	E.T Secretion	
Candida	0	1	1
Klebsiella	4	16	20
MRSA	0	1	1
No Growth	24	6	30
Psuedomonus	0	1	1
Staph. Aureus	2	0	2
Strept. Pneumoniae	0	1	1
Total	30	26	56

Chi- Square Tests

	Value	df	Asymp. Sig. (2- sided)
Pearson Chi- Square	23.8	6	0. 001

Thirty cases show no growth in culture and organisms were isolated in

26 cases as shown in table (2) with significant Chi- Square tests (P value 0.001). Klebsiella was isolated in 20 cases, 16 of it were isolated from E. T secretion and only 4 from blood cultures.

Table (3) Frequency Of Mechanical Ventilation And Isolated Organisms

Isolated Organism	Mechanical Ventilation		Total
	No	Yes	
Candida	1	0	1
Klebsiella	6	14	20
MRSA	0	1	1
No Growth	21	9	30
Psuedomonus	0	1	1
Staph. Aureus	2	0	2
Strept. Pneumoniae	1	0	1
Total	31	25	56

Chi- Square Tests

	Value	df	Asymp. Sig. (2- sided)
Pearson Chi- Square	13.5	6	0.036

Table (3) shows significant correlation between mechanical ventilation and isolated organisms. Fourteen out of 20 cases with Klebsiella isolation were ventilated [P value (0.036)]. In the 56 recorded cases 22 (39.3%) died, 34 (61.9%) improved. Eighty six cultures were done to the 56 cases, 51 cultures show no growth and organisms were isolated in 35 cultures.

Table (4) Frequency Of Isolated Organisms In Positive Cultures

	Isolated Organism							Total
	Acineto- bacter	Candida	Klebsiella	MRSA	Psuedomonus	Staph. Aureus	Strept. Pneumoniae	
Blood	0	0	4	0	0	3	1	8
E.T Secretion	1	1	22	1	1	0	1	27
Total	1	1	26	1	1	3	2	35

Chi- Square Tests

	Value	df	Asymp. Sig. (2- sided)
Pearson Chi- Square	12.969	6	0.044

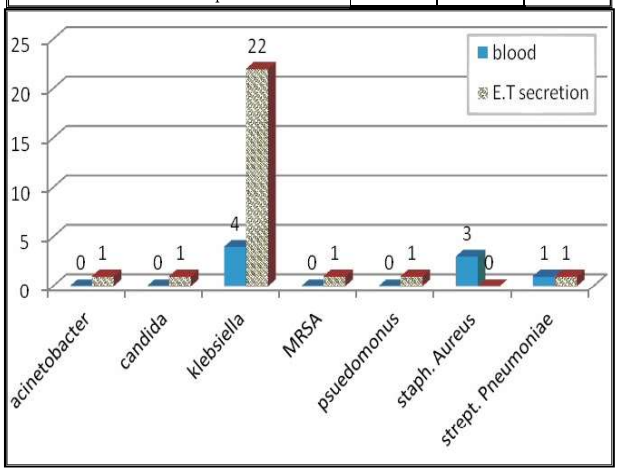

Figure (1) Frequency Of Isolated Organisms In Positive Cultures

Table (4), Figure (1) shows the frequency of isolated organisms in the positive cultures. Klebsiella was the most common isolated organism 26 out of 35 (74.3%), P value 0.44).

Table (5) Relation of types of organisms and drug sensitivities

Drug Sensitive To	Gram negative organisms (Klebsiella, Psuedomonus and Acinetobacter)	Gram positive organisms (Strept. Pneumoniae, Staph. Aurous& MRSA)
Gentamicin	64.29%	
Amikacin	53.57%	
Tienam	46.43%	
Ciprofloxacin	35.71%	16.67%
Co- Trimoxazole	32.14%	
Norfloxacin	28.57%	16.67%
Clindamycin		66.67%
Erythromycin		66.67%
Vancomycin		50.00%

Table (5) shows drug sensitivity for gram negative isolated organisms which represent 80% of the positive cultures compared to drug sensitivity of gram positives. 64.29% of gram negative isolates were susceptible to gentamicin followed by 53.57% susceptible to Amikacin.

Table (6); Relation Of Types Of Organisms And Drug Resistance

Drug Resistant To	Gram negative organisms (Klebsiella, Psuedomonus& Acinetobacter)	Gram positive organisms (Strept. Pneumoniae, Staph. Aurous& MRSA)
Augmentin	89.29%	33.33%
Ceftriaxone	64.29%	
Co- Trimoxazole	61%	
Ceftazidime	46.43%	
Norfloxacin	39.29%	
Cefepime		33.33%
Gentamicin		33.33%

Table (6) shows drug resistance for gram negative isolated organisms which represent 80% of the positive cultures compared to drug sensitivity of gram positives. 89.29% of gram negative isolates were resistant to Augmentin followed by 64.29% resistant to Ceftriaxone. 33.33% of Gram positive organisms were resistant to Augmentin, Cefepime and gentamicin equally.

Discussion:

In this study, we studied recorded data of 56 neonates (38 males, 18 females) with clinical suspicion of neonatal infection. 86 blood and E.T. secretion cultures were done. 51 cultures show no growth (59.3%) and organisms were isolated in 26 cases. Klebsiella was the most common isolated organism (26 out of 35) (74.3%), P value0.44), in agreement with Sally AF El- Sahrigy (2015) and Zaidi AK, et.al. (2005).

As regards drug sensitivity for gram negative isolated organisms 64.29% were susceptible to gentamicin followed by 53.57% susceptible to Amikacin. 89.29% of gram negative isolates were resistant to Augmentin followed by 64.29% resistant to ceftriaxone. This is in agreement with Sally AF El- Sahrigy (2015) and Zaidi AK, et.al. (2005).

Sixty six point 7 percent of Gram positive isolates were susceptible to erythromycin and clindamycin and 50% were susceptible to vancomycin. 33.3% of Gram positive isolates were resistant to gentamycin and cefepime, again in agreement with Sally AF El- Sahrigy (2015). There is significant correlation between mechanical ventilation and isolated organisms. Fourteen out of 20 cases with klebsiella isolation were ventilated [P value (0.036)], in agreement with retrospective case control

study by Behnaz Basiri et.al. (2015). Hwang et.al. (2004), found that endotracheal intubation and assisted ventilation were identified risk factors for sepsis in NICU due to colonization of humidified air with hydrophilic micro- organisms, physical trauma of passing an endotracheal tube and transient bacteremia during routine suction

In the 56 studied cases 22 (39.3%) died, 34 (61.9%) improved which means that the clinically diagnosed neonatal infection mortality rate is 39.3%, in agreement with previous studies by El- Sahrigy SAF et.al. (2015) and Cailes B. (2015). The World Health Organization estimates that 4 million neonatal deaths occur each year, of which more than one third are related to serious infections and one quarter of those are attributed to neonatal sepsis syndrome/ pneumonia. In developing countries, neonatal mortality is responsible for 60% of infant mortality, with sepsis being one of the primary causes of death in, Qazi SA and Stoll BJ, 2009.

Conclusion:

1. Neonatal sepsis is a major cause of morbidity and mortality.
2. The commonest encountered organisms in NICU were Klebsiella species.
3. Endotracheal intubation and assisted ventilation were identified risk factors for sepsis in NICU.
4. Continuous study to the risk factors contribute to neonatal sepsis is important tool to minimize neonatal mortality and improve health and to minimize expenses.
5. Neonatal infection surveillance studied is recommended on larger scale to understand the epidemiology of neonatal infections and associated levels of antimicrobial resistance is required to reduce infection rates and effectively prevent the development of resistance
6. Computerization of the medical record data creates great opportunity of generating new knowledge by mining the data and using it to improve patient care.

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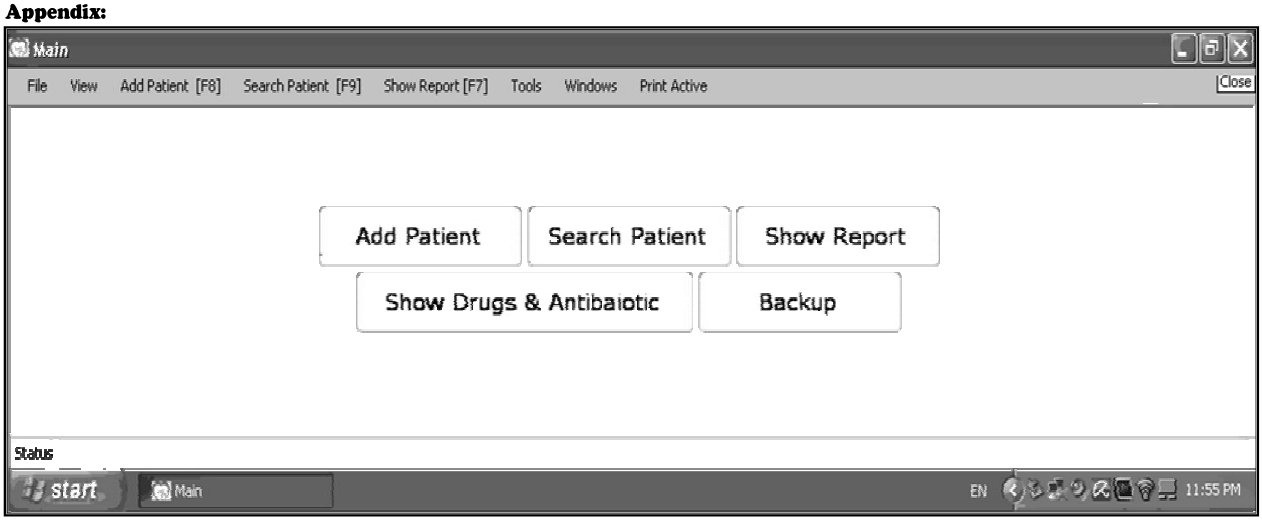
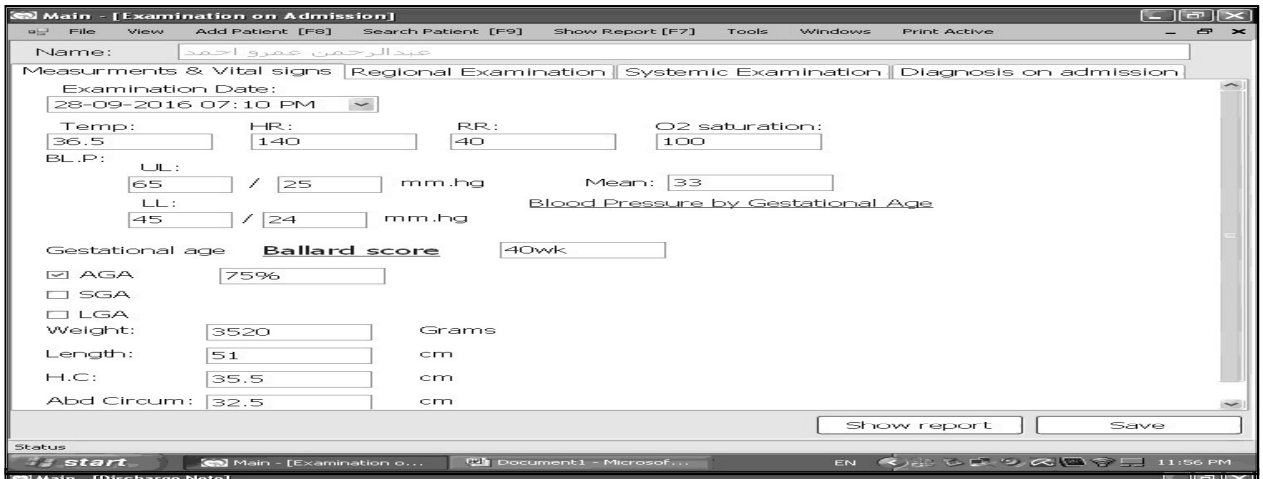
Appendix:

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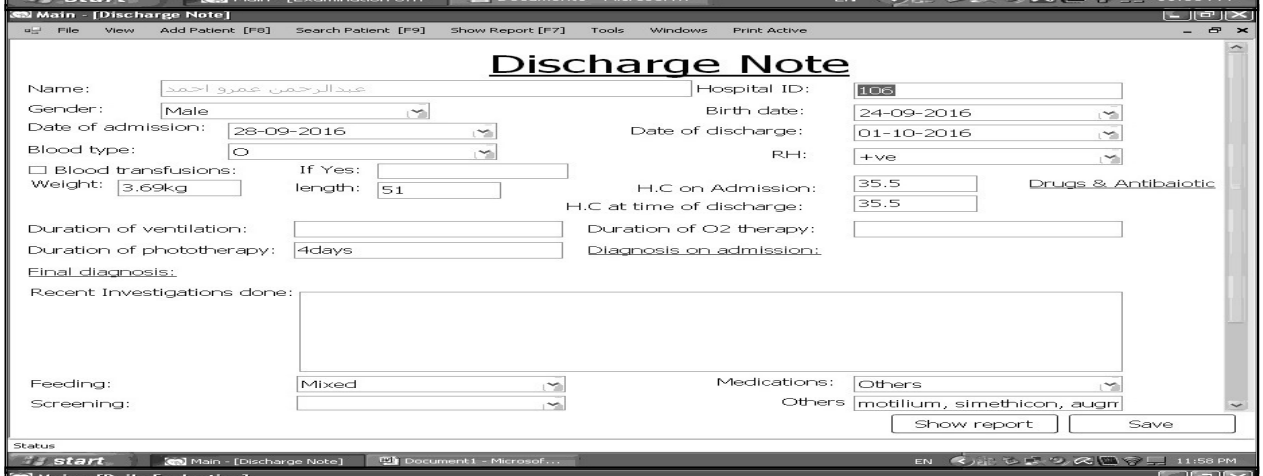
Measurments & Vital signs | Regional Examination | Systemic Examination | Diagnosis on admission
Examination Date: 28-09-2016 07:10 PM
Temp: 36.5
HR: 140
RR: 40
O2 saturation: 100
BL.P:
UL: 65 / 25 mm.hg
Mean: 33
LL: 45 / 24 mm.hg
Blood Pressure by Gestational Age
Gestational age
Ballard score
40wk
AGA 75%
SGA
LGA
Weight: 3520 Grams
Length: 51 cm
H.C: 35.5 cm
Abd Circum: 32.5 cm
Show report
Save
Status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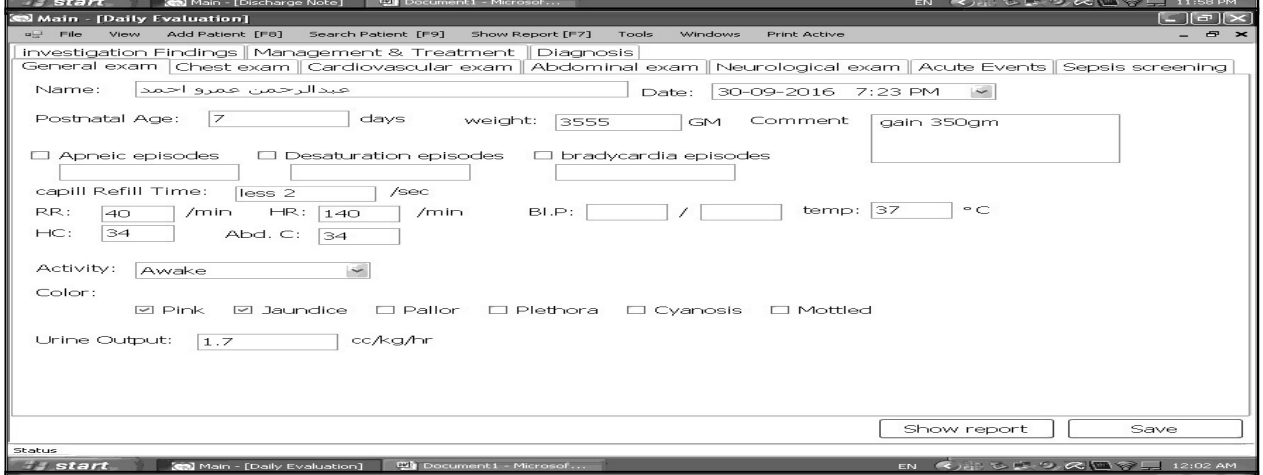
Name: عبدالرحمن عمرو احمد
Hospital ID: 106
Gender: Male
Birth date: 24-09-2016
Date of admission: 28-09-2016
Date of discharge: 01-10-2016
Blood type: O
RH: +ve
Blood transfusions:
If Yes:
Weight: 3.69kg
length: 51
H.C on Admission: 35.5
H.C at time of discharge: 35.5
Drugs & Antibaiotic
Duration of ventilation:
Duration of O2 therapy:
Duration of phototherapy: 4days
Diagnosis on admission:
Final diagnosis:
Recent Investigations done:
Feeding: Mixed
Screening:
Medications: Others
Others: motilium, simethicon, augm
Show report
Save
Status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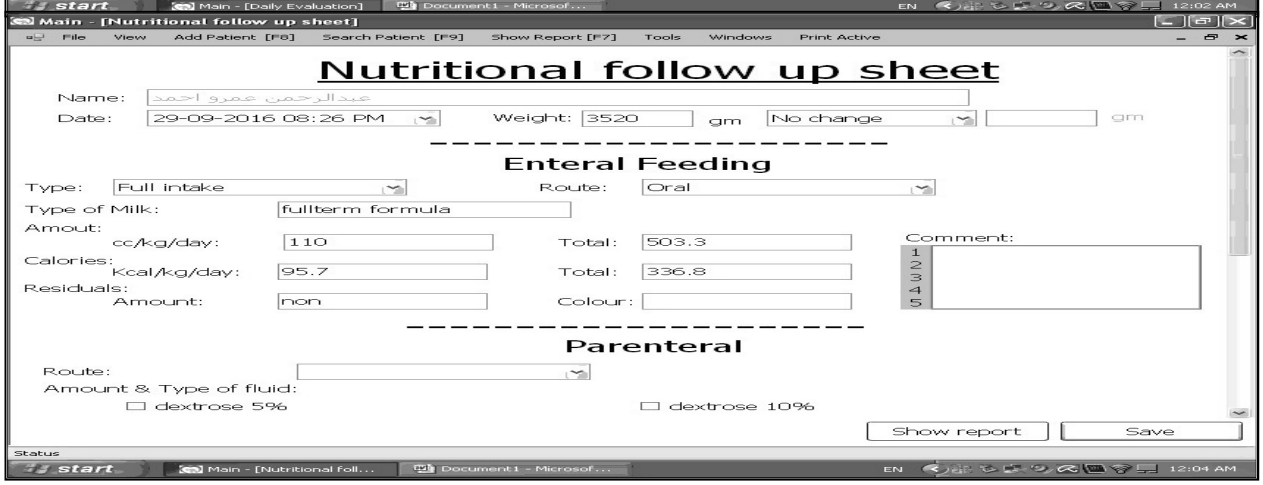
investigation Findings | Management & Treatment | Diagnosis
General exam | Chest exam | Cardiovascular exam | Abdominal exam | Neurological exam | Acute Events | Sepsis screening
Name: عبدالرحمن عمرو احمد
Date: 30-09-2016 7:23 PM
Postnatal Age: 7 days
weight: 3555 GM
Comment: gain 350gm
Apneic episodes
Desaturation episodes
bradycardia episodes
capill Refill Time: less 2 /sec
RR: 40 /min
HR: 140 /min
Bl.P: /
temp: 37 °C
HC: 34
Abd. C: 34
Activity: Awake
Color:
Pink Jaundice Pallor Plethora Cyanosis Mottled
Urine Output: 1.7 cc/kg/hr
Show report
Save
Status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Nutritional follow up sheet
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Date: 29-09-2016 08:26 PM
Weight: 3520 gm
No change
Enteral Feeding
Type: Full intake
Route: Oral
Type of Milk: fullterm formula
Amout:
cc/kg/day: 110
Total: 503.3
Calories:
Kcal/kg/day: 95.7
Total: 336.8
Residuals:
Amount: non
Colour:
Comment:
Parenteral
Route:
Amount & Type of fluid:
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dextrose 10%
Show report
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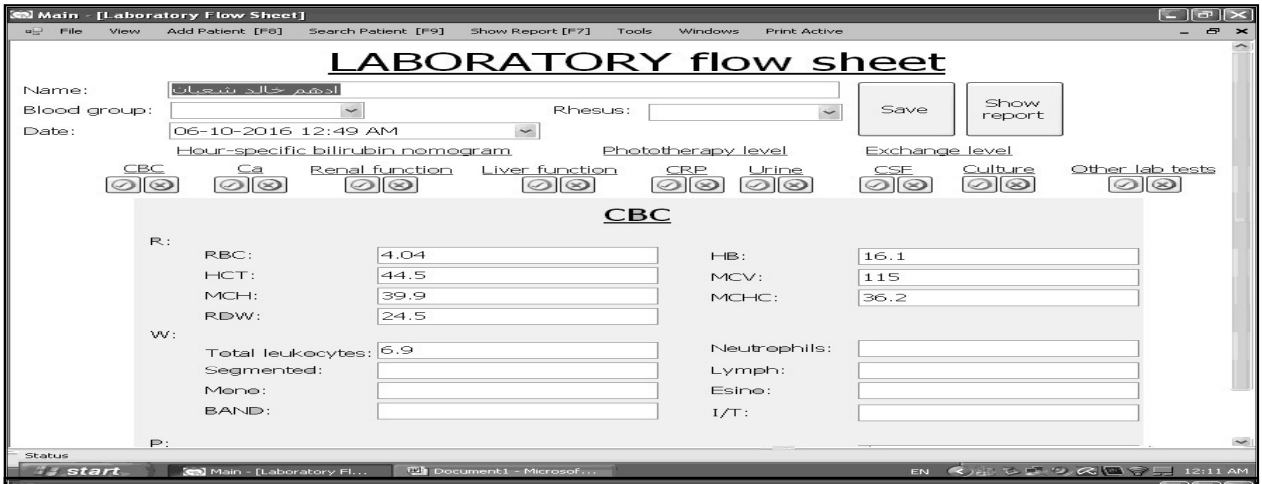
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Name: ادهم خالد شعبان
Blood group:
Rhesus:
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Show report
Hour-specific bilirubin nomogram
Phototherapy level
Exchange level
CBC Ca Renal function Liver function CRP Urine CSF Culture Other lab tests
CBC
R:
RBC: 4.04
HCT: 44.5
MCH: 39.9
RDW: 24.5
HB: 16.1
MCV: 115
MCHC: 36.2
W:
Total leukocytes: 6.9
Segmented:
Mono:
BAND:
Neutrophils:
Lymph:
Esino:
I/T:
P:
Status
start
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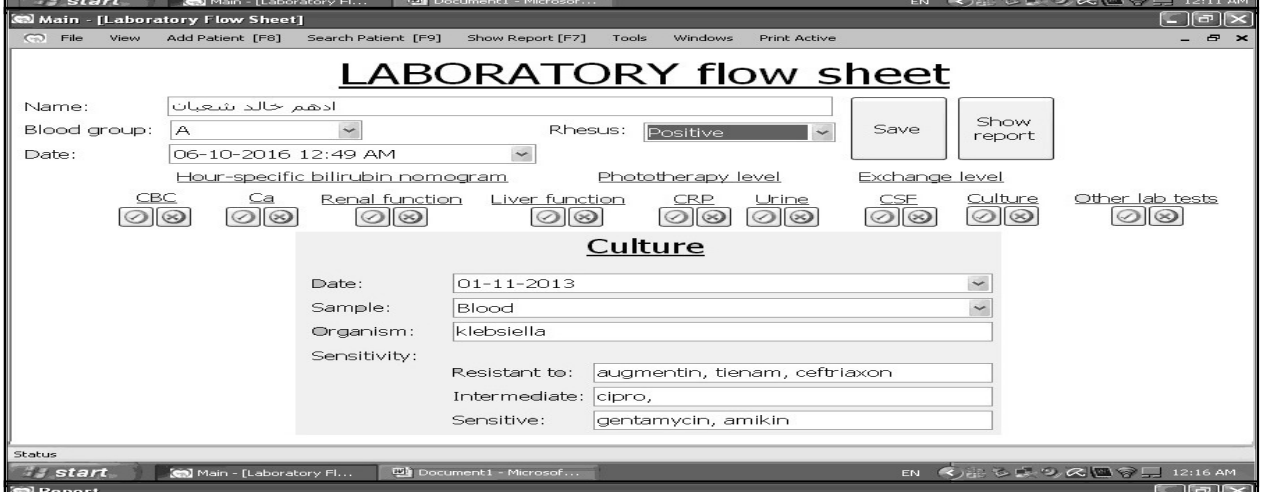
12:11 AM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Rhesus: Positive
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Show report
Hour-specific bilirubin nomogram
Phototherapy level
Exchange level
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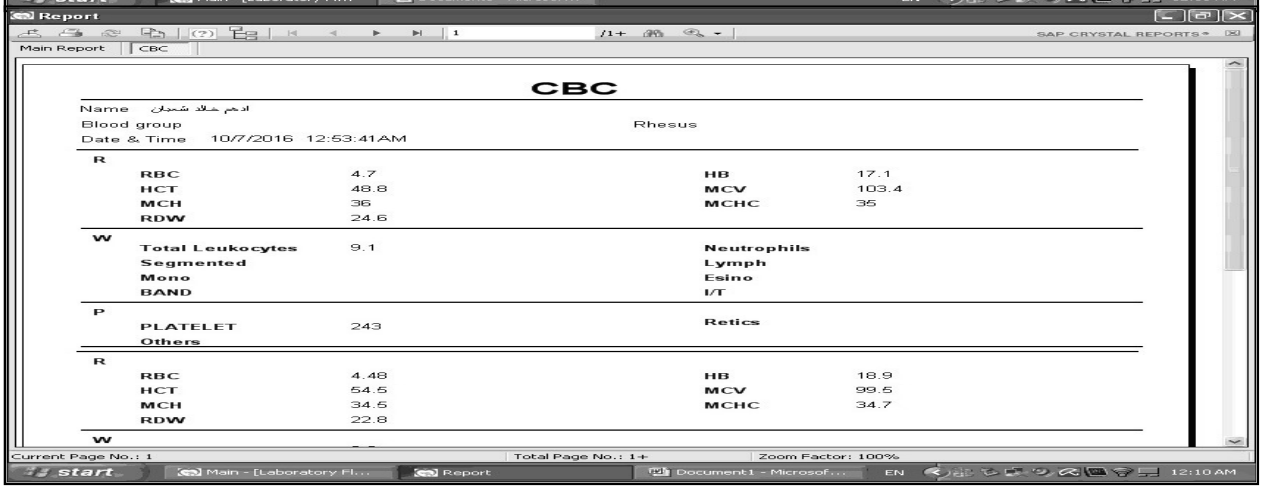
Culture
Date: 01-11-2013
Sample: Blood
Organism: klebsiella
Sensitivity:
Resistant to: augmentin, tienam, ceftriaxon
Intermediate: cipro,
Sensitive: gentamycin, amikin
Status
start
Main - [Laboratory Fl...
Document1 - Microsof...
EN
12:16 AM


Report
Main Report
CBC
SAP CRYSTAL REPORTS
CBC
Name ادهم خالد شعبان
Blood group
Rhesus
Date & Time 10/7/2016 12:53:41AM
R
RBC 4.7
HCT 48.8
MCH 36
RDW 24.6
HB 17.1
MCV 103.4
MCHC 35
W
Total Leukocytes 9.1
Segmented
Mono
BAND
Neutrophils
Lymph
Esino
I/T
P
PLATELET 243
Others
Retics
R
RBC 4.48
HCT 54.5
MCH 34.5
RDW 22.8
HB 18.9
MCV 99.5
MCHC 34.7
W
Current Page No.: 1
Total Page No.: 1+
Zoom Factor: 100%
start
Main - [Laboratory Fl...
Report
Document1 - Microsof...
EN
12:10 AM