**INTRODUCTION**

The general administration of pharmaceutical care established several pharmacy practice program for pediatrics for high alert medications [1]. It included national total parental nutrition and Intravenous national therapy [2-3]. The administration established a strategic plan for the national Total parental nutrition (TPN) program included the standardized concentration of TPN. Three hospitals in Riyadh city started to formulate specific physician order form as first initiatives program in the Kingdom of Saudi Arabia. Several publications showed the application of the standardized concentration of TPN around the world to improve outcome and reduce the cost related issues [4-7]. Half of the hospital only had standardized concentration formulation in the TPN for pediatrics in Saudi Arabia [8]. Also, the formulation will prevent dosing errors, and any drug therapy omission prevents by the pharmacist. The formulation of standardized concentration prevented nutrition-related problems in pediatrics and reduced the cost related to nutrition in the Kingdom of Saudi Arabia. The author is not familiar with any investigations published in Saudi Arabia, and Gulf countries or the Middle East described the standardized formulation of Pediatrics' Total Parenteral nutrition.

**PEDIATRICS TOTAL PARENTERAL NUTRITION STANDARDIZED FORMULATION IN SAUDI ARABIA**

It is the standardized formulation of total parental nutrition for pediatrics. The formulation drove from current literature and American Society for Parenteral and Enteral Nutrition (ASPEN) guidelines for pediatrics' population with an average of fifteen-kilogram body weight [9]. The formulation consisted of several parts demographic data of the patients, total macronutrients, total micronutrients, the calculated total calories and non-protein calories over nitrogen ratio, and pharmacy preparation part. The formulation consisted of first three consequence days of starting

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**REFERENCES**

1. The Past General Manager of General Administration of Pharmaceutical Care and Head, National Clinical pharmacy, and Pharmacy Practice and Pharmacy R & D Administration, Ministry of Health, Riyadh, KSA
2. Supervisor of IV Admixture Services, Aleman Hospital, Ministry of Health, Riyadh, Saudi Arabia
3. Intravenous Admixture Supervisor, Pharmacy Services, King Salman Hospital, Riyadh, Saudi Arabia
4. TPN Pharmacist, Pharmacy services, Alyamma Hospital, Ministry of Health, Riyadh, Saudi Arabia
5. Head, Pharmacy services, King Salman Hospital, Ministry of Health, Riyadh, Saudi Arabia

**Acknowledgment**

The formulation of Pediatrics' Total Parenteral Nutrition: Initiative and implementation of standardized formulation in Saudi Arabia is the project tools of starting new idea until finding in the ground.

**Keywords:** Adult total parenteral nutrition, formulation, Pharmacy, Ministry of Health, Saudi Arabia.
TPN through central line administration. Each day contained one-third of the quantities of the total fluid requirements, total calories, carbohydrates, protein, electrolyte, trace elements and multivitamins as explored in appendix 1, 2 and 3.

**SWOT ANALYSIS**

The analysis of benefits and risk done by SWOT (Strength, Weakness, Opportunities, and Threats) analysis method. The strength of the pediatrics formulations including all information of starting total parental nutrition is available, dosing of TPN component is available, prevent mistakes in writing TPN pediatrics orders are available. The weak points are including the formulation is not individualized for all patients. It is not contained the TPN administration instruction. Also, it cannot apply to several disease renal or hepatic failure. The opportunity that is including it is straightforward to form convert them into computerized, and physician order entry; it can calculate all TPN statistical information. The threat point is including the physician or pharmacist not used the formulation.

**Implementations Steps of Pediatrics' Total Parenteral Nutrition Standardized Formulation**

The pharmacy department Organize Consultation Committee from expert pharmacist especially from Intravenous admixture and total parental nutrition services and clinical pharmacists inside the pharmacy department. The committee should extensively review then approve the standardized formulation of pediatrics total parenteral nutrition. The head of the committee will contact the surgical and medical department for final revisions of the drafting and approval. The head of pharmacy services will submit the final draft of the formulation to the Pharmacy and Therapeutic committee for review and approval. The head of the committee will arrange with Computer department to make an electronic order form. The pharmacy education coordinator arranges with all department including nursing, surgical and medical department to Educate and train the medical staff of using the formulation with additional to pharmacy staff. The pharmacy quality management will set up the key performance indicators (KPI) to measure the impact of the project. All pharmacy concern team including TPN Preparation, clinical pharmacist will Collect the KPI of the project retrospectively in the past three to six months, then collect the data prospectively in the coming months. The head of the committee will contact nursing, and surgical departments started with one surgical department as the pilot trial. The pharmacist will Review the pilot trial and correct the form according to the pharmacy consultation committee. The team will expand to all surgical department and medical department. Review and alter the shape accordingly through the committee. The head of the committee will expand to all hospital departments including pediatrics' critical care. Review and adjust the formulation accordingly. The pharmacy quality management coordinator will measure the impact of the project by comparing the KPI before and after starting the project. The head of the committee will analyze the results and review by the consultation committee. The head of the pharmacy will submit the final report to the Pharmacy and the therapeutic committee for final touch and comments. The consultation team will Review the last comments on the project, update it accordingly, and continue the project for the next year.

**CONCLUSION**

The pediatrics' standardized formulation of the total parental nutrition is new initiative of pharmacy quality and medications safety project. It assists for the high alert product in preventing medical errors and related issues at Hospitals in Kingdom of Saudi Arabia.

**Acknowledgment:** None

**Conflict of Interest:** None

**Abbreviation Used:** TPN: Total parental nutrition, ASPEN: American Society for Parenteral and Enteral Nutrition, SWOT: Strength, Weakness, Opportunities, and Threats. KPI: Key Performance Indicators

**REFERENCES**


## Appendix 1

**TOTAL PARENTERAL NUTRITION PEDIATRICS FORM**

### Prescriber to Complete Nos. 1 Up to 8

<table>
<thead>
<tr>
<th>NO.</th>
<th>Date</th>
<th>Day(s) of TPN</th>
<th>1st Day</th>
<th>(Begin with 1)</th>
<th>Central</th>
<th>Peripheral</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10/01</td>
<td>1000</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### NO. 2

- **Dextrose**: 150 gm/day (616 mg/kg/min, or 6.4-23 gm/kg/day)
- **Amino Acids**: 10 gm/day (start at 0.5 gm/kg/day, then increase by 0.5 gm/kg/day, up to a maximum of 2.5 gm/kg/day, then to 3 gm/kg/day, then to 4.5 gm/kg/day, then to 6 gm/kg/day, then to 7 gm/kg/day, then to 8 gm/kg/day, then to 9 gm/kg/day, then to 10 gm/kg/day).

### NO. 3

- **Total volume of TPN**: 500 ml/day
- **Total volume of IVF**: 50 ml/day (Type of IVF: 

### NO. 4

- **TPN rate**: ml/hr
- **FAT rate**: ml/hr over hours (max. rate: 0.11 gm/kg/hr)

### NO. 7

<table>
<thead>
<tr>
<th>Additives</th>
<th>Prescribed amount</th>
<th>Maintenance Range</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>30</td>
<td>2-4 Mmol/kg/day</td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td>10</td>
<td>2-4 Mmol/kg/day</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>2.3</td>
<td>0.25-0.5 Mmol/kg/day</td>
<td>Give as Calcium Gluconate Pompey: check Ca/Po4 compatibility</td>
</tr>
<tr>
<td>Magnesium</td>
<td>3</td>
<td>0.25-0.5 Mmol/kg/day</td>
<td></td>
</tr>
<tr>
<td>Phosphate</td>
<td>3</td>
<td>0.5-1.5 Mmol/kg/day</td>
<td>NaPO4[ml]=(3 Mmol Phosphate &amp; 4 Mmol Na)</td>
</tr>
<tr>
<td>Chloride</td>
<td>30</td>
<td>2-4 Mmol/kg/day</td>
<td></td>
</tr>
<tr>
<td>Acetate</td>
<td>As needed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat soluble vit.</td>
<td>2.5</td>
<td>Neumunic acid (2.5 mg/kg)</td>
<td></td>
</tr>
<tr>
<td>Water soluble vit.</td>
<td>0.5</td>
<td>&gt;10 kg: 10 ml/day</td>
<td></td>
</tr>
<tr>
<td>Trace Elements</td>
<td>0.5</td>
<td>0 mg/kg of Multivit.</td>
<td></td>
</tr>
<tr>
<td>Insulin, regular</td>
<td>As needed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heparin</td>
<td>0.5-1 units/ml/each ml of TPN</td>
<td>USE FOR PERIPHERAL TPN, Check with prescriber</td>
<td></td>
</tr>
<tr>
<td>Hydorcortisone</td>
<td>0.5-1 units/ml/each ml of TPN</td>
<td>USE FOR PERIPHERAL TPN and to prevent photopheresis</td>
<td></td>
</tr>
</tbody>
</table>

### Ward

- **Wt.**: 15 kg
- **Age**: 15 kg
- **cm**:
- **Diagnosis**:  

### TPN indication(s)

<table>
<thead>
<tr>
<th>NO. 8</th>
<th>Daily Calories intake</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dextrose (gm/day) = 3.4 * (150) = 510 Kcal/day</td>
</tr>
<tr>
<td></td>
<td>Fat (gm/day) = 10 * (10) = 100 Kcal/day</td>
</tr>
<tr>
<td></td>
<td>Total = 610 Kcal/day</td>
</tr>
<tr>
<td></td>
<td>Total/Wt = 40.6 Kcal/kg/day</td>
</tr>
</tbody>
</table>

Non Protein Calories/ Nitrogen:

(Recommended ratio = 150/1)

### Name:
P1

<table>
<thead>
<tr>
<th>Hospital No:</th>
<th>Nationality:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatings physician:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(TPN Formula for Pediatrics 15 kg Non-diabetic normal kidney &amp; liver function)</td>
</tr>
</tbody>
</table>

### Additives

- **Base Solution**:
  - _400 ml Dextrose_ 50%
  - _100 ml Amino Acid_ 10%
  - _10 ml Sterile Water_ |

- **Additives**
  - _10 ml Sodium_ |
  - _10 ml Potassium_ |
  - _10 ml Calcium_ |
  - _10 ml Magnesium Sot_ |
  - _10 ml Potassium_ |
  - _ml_ |
  - _ml_ |
  - _ml_ |

### Fat

- **Volume**: ml

### Prescriber name & sign.

<table>
<thead>
<tr>
<th>Prescriber ID</th>
<th>RPh name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse name</td>
<td>Technician</td>
</tr>
</tbody>
</table>

* Check with IV team before hand changing
Appendix 2
TOTAL PARENTERAL NUTRITION
PEDIATRICS FORM

**Prescriber To Complete No. 1 up to 8**

**NO. 1**
Date: / / 200... Day(s) of TPN: 2nd Day... (Begin with 1) ☐ Central ☐ Peripheral

**NO. 2**
Dextrose: 200 gm/day
(6-16mg/kg/min=8.64-23 gm/kg/day)

**NO. 3**
Amino Acids: 20 gm/day
(start with 0.5gm/kg/day, increment by 0.5gm/kg/day, up to 3 gm/kg/day)-monitor BUN

**NO. 4**
Fat 20%: 20 gm/day (start with 0.5 gm/kg/day, increment by 0.5gm/kg/day, up to 2.5-3gm/kg/day)-monitor TGs

**NO. 5**
Total volume of TPN: 750 ml/day
Total volume of FAT: 100 ml/day
Total volume of IVF: ml/L/day (Type of IVF: ...)
Total volume of PO: ml/day
Total fluid intake: ml/day

**NO. 6**
TPN rate: ml/hr
FAT rate: ml/hr over hrs (max. rate: 0.11 gm/kg/hr)

**NO. 7**
Additives | Prescribed amount/day | Maintenance Range | Notes | FOR PHARMACY ONLY
---|---|---|---|---
Sodium | 60 | 2.4 Mmol/kg/day |
Potassium | 20 | 2.4 Mmol/kg/day |
Calcium | 4.6 | 0.25-0.5 Mmol/kg/day |
Magnesium | 8 | 0.25-0.5 Mmol/kg/day |
Phosphate | 6 | 0.5-1.5 Mmol/kg/day |
Chloride | 60 | 2.4 Mmol/kg/day |
Acetate | As needed |
Fat soluble vit. | 5 | Neonates, <2.5kg: 4 ml/kg Children, >2.5kg: 10 ml/day |
Water soluble vit. | 0.75 | >10kg: 10 ml/day |
Trace Elements | 1 | 0.1 ml/kg of Multivitam. 4 Pediatric |
Insulin, regular | As needed |
Heparin | 0.5-1 unit/mL of TPN |
Hydrocortisone | USED FOR PERIPHERAL TPN. Check PEPT, avoid in case of HFP or thrombocytopenia |

**Ward**
Age
Wt. kg
Height cm
Diagnosis

**TPN indication(s)**

**NO. 8**
Daily Calories intake
Dextrose (gm/day) × 3.4 = ( 200 ) × 3.4 = 680 Kcal/day
Fat (gm/day) × 10 = ( 20 ) × 10 = 200 Kcal/day
Total = 880 Kcal/day
Total Wt = 58.6 Kcal/kg/day
Non Protein Calories/ Nitrogen:
(Recommended ratio = 150 / 1)

Name: ____________
Hospital No: ____________
Nationality: ____________
Treating physician: (TPN Formula for Pediatrics 15 kg Non-diabetic normal kidney & liver function)

<table>
<thead>
<tr>
<th>Additive</th>
<th>Required amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Solution</td>
<td>ml Dextrose 50%</td>
</tr>
<tr>
<td></td>
<td>ml Amino Acid 10%</td>
</tr>
<tr>
<td></td>
<td>ml Sterile Water</td>
</tr>
<tr>
<td>Additives</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ml Sodium</td>
</tr>
<tr>
<td></td>
<td>ml Potassium</td>
</tr>
<tr>
<td></td>
<td>ml Calcium</td>
</tr>
<tr>
<td></td>
<td>ml Magnesium So4</td>
</tr>
<tr>
<td></td>
<td>ml Potassium</td>
</tr>
<tr>
<td></td>
<td>ml</td>
</tr>
<tr>
<td></td>
<td>ml</td>
</tr>
<tr>
<td></td>
<td>ml</td>
</tr>
<tr>
<td>Fat</td>
<td>ml</td>
</tr>
</tbody>
</table>

Prescriber name & sign: ____________
Bleep of prescriber: ____________
RPh name: ____________
Prescriber ID: ____________
Nurse name: ____________
Technician: ____________

*Check with IV Room for brand changing*
### Total Parenteral Nutrition Pediatrics Form

**Prescriber to complete Nos. 1 up to 8**

<table>
<thead>
<tr>
<th>NO.</th>
<th><strong>Date:</strong> / /202...</th>
<th><strong>Day(s) of TPN:</strong> 3rd Day... (Begin with 1)</th>
<th><strong>Central</strong></th>
<th><strong>Peripheral</strong></th>
</tr>
</thead>
</table>

**NO. 2**
- **Dextrose:** 450 gm/day  
  (6-16mg/kg/min=8.64-23 gm/kg/day)  
- **Amino Acids:** 30 gm/day  
  (start with 0.5gm/kg/day, increment by 0.5 gm/kg/day, up to 3 gm/kg/day)-monitor BUN

**NO. 4**
- **Fat 20%:** 30 gm/day (start with 0.5 gm/kg/day, increment by 0.5 gm/kg/day, up to 2.5-3 gm/kg/day)-monitor TGs

**NO. 5**
- **Total volume of TPN:** ml/day
- **Total volume of FAT:** ml/day
- **Total volume of IVF:** ml/day (Type of IVF: ............)
- **Total volume of PO:** ml/day
- **Total fluid intake:** ml/day

**NO. 6**
- **TPN rate:** ml/hr
- **Fat rate:** ml/hr over hrs (max. rate: 0.11 gm/kg/hr)

**NO. 7**

<table>
<thead>
<tr>
<th><strong>Additives</strong></th>
<th><strong>Prescribed amt/day</strong></th>
<th><strong>Maintenance Range</strong></th>
<th><strong>Notes</strong></th>
<th><strong>FOR PHARMACY ONLY</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>45</td>
<td>2-4 MmEq/kg/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td>30</td>
<td>2-4 MmEq/kg/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>6.9</td>
<td>0.25-0.5 MmEq/kg/day</td>
<td>Given as Calcium Gluconate</td>
<td>PHARMACY: check Ca/Po4 compatibility</td>
</tr>
<tr>
<td>Magnesium</td>
<td>12</td>
<td>0.23-0.5 MmEq/kg/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphate</td>
<td>9</td>
<td>0.5-1.5 MmEq/kg/day</td>
<td>NaPO4(1ml=3 MmEq PO4 &amp; 4 MmEq Na)</td>
<td>KPO4(1ml=3 MmEq PO4 &amp; 4 MmEq Na)</td>
</tr>
<tr>
<td>Chloride</td>
<td>45</td>
<td>2-4 MmEq/kg/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetate</td>
<td>As needed</td>
<td>Acetate and Cl should be in 1:1, unless it is indicated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat soluble vit.</td>
<td>10</td>
<td>Neumones, &lt;2.5 kg: 4 ml/kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water soluble vit.</td>
<td>10</td>
<td>&gt;10 kg: 10 ml/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trace Elements</td>
<td>1</td>
<td>0.1 ml/kg of Multiene® &amp; Pediatric®</td>
<td>Contains: Vit A, B1, B2, thiamine, riboflavin, niacin, pantothenic acid, Follic acid, Vit C</td>
<td></td>
</tr>
<tr>
<td>Insulin, regular</td>
<td>As needed</td>
<td>As needed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heparin</td>
<td>0.5-1 unit/each mL of TPN</td>
<td>USED FOR PERIPHERAL TPN</td>
<td>Check PIT/PTT, avoid in case of HIT or thrombocytopenia</td>
<td></td>
</tr>
<tr>
<td>Hydrocortisone</td>
<td></td>
<td>USED FOR PERIPHERAL TPN and to prevent thrombosis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NO. 8**
- **Daily Calories intake**
  - Dextrose (gm/day) \times 3.4 = Kgcal/day
  - Fat (gm/day) \times 10 = Kgcal/day
  - Total = Kgcal/day
  - Total/Wt = Kgcal/kg/day

**Non Protein Calories/ Nitrogen:** /  
(Recommended ratio = 150/1)

---

**Prescriber name & sign.**

**Bleep of prescriber**

**RPh name**

**Prescriber ID**

**Nurse name**

**Technician**

---

*Check with IV Room for brand change/kg*