

北京协和医院  
Peking Union Medical College Hospital

**以“营养筛查”为基础  
营养支持改善结局及成本效果比**

于康  
北京协和医院 健康医学系, 临床营养科

CSPEN 第一、二、六、七、八届“年会”主旨

**营养干预 核心目的**

**规范应用, 改善结局, 患者受益**

Reasonable Intervention  
Outcome Improving  
Benefit to the patients

**如何理解“患者受益”**

营养支持 Nutrition Support

临床结局 Clinical Outcome

成本-效果 Cost-effectiveness

单病组核算 营养保健食品协会  
“Diagnosis Related Group, DRG”

Dougherty D, Conway PH. The “3T’s” road map to transform US health care: the “how” of high-quality care. JAMA, 2008, 299(19):2319

Evidence: Nutrition support improves outcome  
Meta-analysis of  
27 RCTs with 1710 patients (complications) and  
30 RCTs 3250 patients (mortality)

Neurology, GI disease, liver disease, malignant disease, elderly, abdominal surgery, orthopaedic surgery, critical illness/injury, burns. Hospital or community  
Oral supplements or tube feeding

Complications	28% vs. 46%
Infections	24% vs. 44%
Mortality	17% vs. 24%

P < 0.001

Stratton RJ, Green CJ, Elia M. Disease-related malnutrition. CABI Publishing 2003

**Key point:**  
营养支持能否让“所有”患者受益?

NEJM (1991) Study

The New England  
Journal of Medicine

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Volume 325 AUGUST 22, 1991 Number 8

**PERIOPERATIVE TOTAL PARENTERAL NUTRITION IN SURGICAL PATIENTS  
THE VETERANS AFFAIRS TOTAL PARENTERAL NUTRITION COOPERATIVE STUDY GROUP\***

The New England  
Journal of Medicine

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Volume 325 AUGUST 22, 1991 Number 8

**PERIOPERATIVE TOTAL PARENTERAL NUTRITION IN SURGICAL PATIENTS  
THE VETERANS AFFAIRS TOTAL PARENTERAL NUTRITION COOPERATIVE STUDY GROUP\***

Subjects: n=395 (G-I, Lung cancer pts)

Design: RCT

Study group: TPN

Control: No NS (5% glucose normal saline)

- 无营养不良TPN组: 感染并发症发生率高于对照组
- 有营养不良TPN组: 非感染性并发症减少
- 提示: 无营养不良患者, 接受TPN无益

The New England Journal of Medicine

Volume 325 AUGUST 22, 1991 Number 8

PERIOPERATIVE TOTAL PARENTERAL NUTRITION IN SURGICAL PATIENTS  
THE VETERANS AFFAIRS TOTAL PARENTERAL NUTRITION COOPERATIVE STUDY GROUP\*

**Conclusion:**

The use of nutritional support *should be limited to patients who are "malnourished"*

**How were the patients actually selected?**

Do the patients selected for these studies have a common denominator for risk of nutrition related complications (=nutritional risk)

To develop a screening tool based on evidence that outcome will change.

Kondrup et al. Clin Nutr 2003; 22: 321-336

**营养风险 (nutritional risk) 概念分析**  
2002-2003 ESPEN提出, 2004 引入中国

- 营养风险 ≠ 营养不良风险
- Nutritional risk: risk of nutrition related complications if untreated
- The risk of malnutrition: 与结局无直接关联

Kondrup et al. Clin Nutr 2003; 22: 321-336

**Nutrition care algorithm (ASPEN, 2011)**  
营养筛查、营养评定、营养干预、营养监测  
营养诊疗流程四个“关键步骤”

ASPEN Clinical Guidelines, JPEN 2011, 35: 16-24

**中国神经外科重症患者消化和营养管理专家共识 2016**

**Screening & Assessment**

Screening: 确定患者是/否有营养支持适应证

Assessment: 对要营养支持患者制定个体化处方

Kondrup et al. Clin Nutr 2003; 22: 321-336

## Nutritional Screening tools

- Birmingham Nutrition Risk Score
- Malnutrition Screening Tool
- Malnutrition Universal Screening Tool
- Nutrition Risk Classification
- Nutritional Risk Index
- **Nutritional Risk Screening 2002**
- Prognostic Inflammatory and Nutritional Index
- Prognostic Nutritional Index
- Simple Screening Tool
- Short Nutrition Assessment Questionnaire

ASPEN Clinical Guidelines, JPEN 2011, 35: 16-24

## Nutrition Risk Screening NRS-2002

ESPEN

Clinical Nutrition (2003) 22(4): 415-421  
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doi:10.1016/S0261-5614(03)0098-0

**SPECIAL ARTICLE**

### ESPEN Guidelines for Nutrition Screening 2002

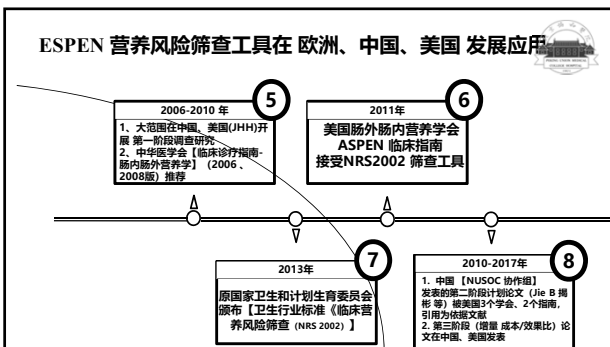
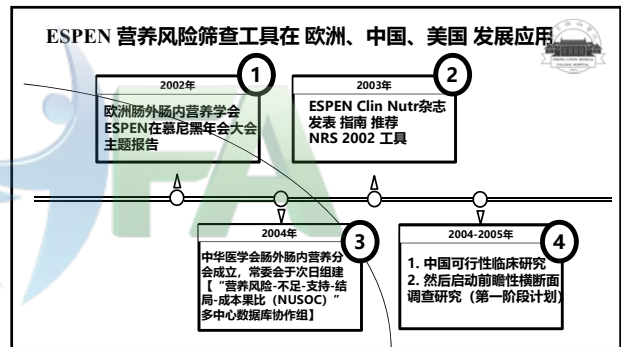
J. KONDRUP,\* S. P. ALLISON,† M. ELIA,‡ B. VELLAS,† M. PLAUTH†

**ESPEN及CSPEN推荐作为住院患者入院时营养筛查工具**

Table 2. Classification of controlled trials with respect to nutritional status, severity of disease and outcome.

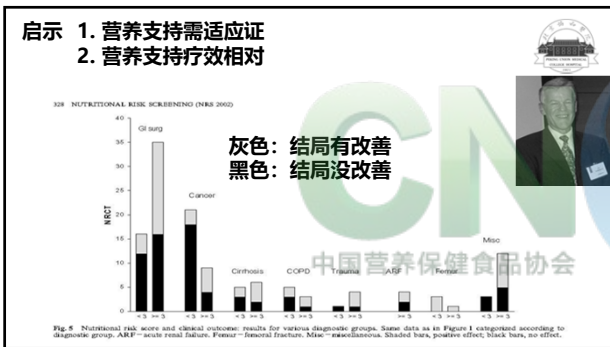
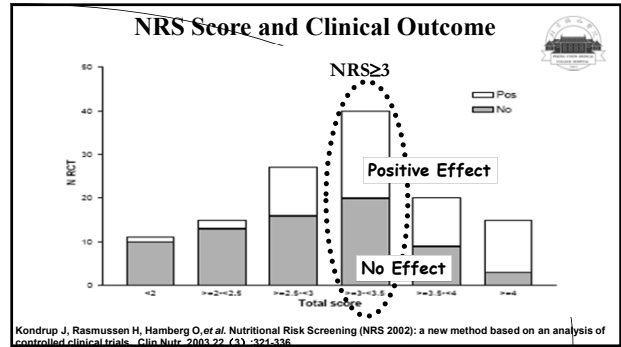
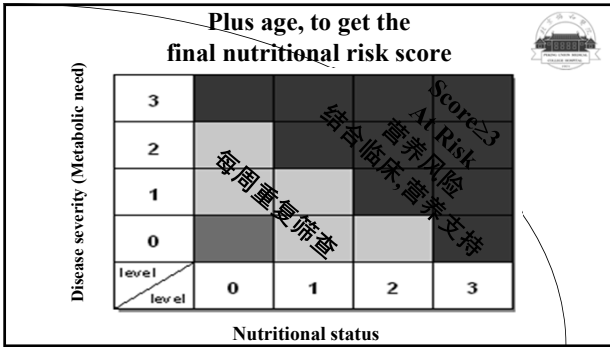
Nutritional Status	Severity of disease ≥1 & <2		≥2 & <3		≥3	
	Positive effect	No effect	Positive effect	No effect	Positive effect	No effect
<1	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)
≥1 & <2	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)
≥2 & <3	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)	10 refs (10/10)

Kondrup J. Clinical Nutrition, 2003



### NRS-2002 内容及评分标准

<b>[1] 疾病严重程度 (0—3分)</b>	
评1分: 一般恶性肿瘤 髓部骨折 长期血液透析 糖尿病 慢性疾病有急性并发症 (肝硬化、COPD)	
评2分: 腹部大手术 脑卒中 重症肺炎 血液恶性肿瘤	
评3分: 重症头部损伤 骨髓移植 急性生理与慢性健康II评分>=10分的重症监护患者	
<b>[2] 营养受损情况评分 (0—3分)</b>	
评1分: 3个月内体重下降>5%, 前一周内食物摄入量比正常需要量低25%~50%	
评2分: 2个月内体重下降>5%, 前一周内食物摄入量比正常需要量低50%~75%	
评3分: 1个月内体重下降>5%, 或三个月内体重下降>15%, BMI < 18.5Kg/m <sup>2</sup> , 且一般情况差或前一周食物摄入量比正常需要量低75%~100%	
<b>[3] 年龄评分 (0, 1分)</b>	
评1分: 年龄≥70岁	
NRS评分=疾病严重程度评分+营养受损情况评分+年龄评分 (0—7分)	



**是否所有筛查工具都能“真实反映结局”**

评价筛查工具核心标准：真实预测效率  
被该工具筛查 (+) 患者，可经营养支持获益

典型伪预测效率：Maastricht Nutritional Index

- 营养筛查/评定中存在问题**
- Failure to screen the nutritional risk of the majority of admission elderly patients.
  - Failure to assess the nutritional status of the majority of admission elderly patients.
  - Failure to refer patients at risk or undernourished patients to a dietitian.
  - Failure to document nutritional information in the medical notes.
  - *Lack of clear responsibilities for health authorities and healthcare staff.*
- Perman et al 2001, Waitzberg et al 2001, Kelly et al 2000

中华医学会 肠外肠内营养学分会 (CSPEN)  
营养风险筛查-营养不足-营养支持-临床结局与成本效果  
全国多中心协作组(NUSOC)

第一部分：描述性研究  
全国东中西部医院 营养风险、营养不良及营养支持状况

第二部分：前瞻性队列研究(I)  
营养支持对有营养风险患者临床结局的影响

第三部分：前瞻性队列研究(II)  
营养支持对有营养风险患者成本-效果的影响



### 营养不良(营养不足)发生率 (n=15098)

Malnutrition rate in China based on 15098 cases study

	Undernutrition (%)	NRS $\geq$ 3 (%)
General Surg	285 (10.1)	955 (33.9)
Thoracic Surg	254 (11.9)	751 (35.2)
Respiratory	278 (10.8)	937 (36.4)
G-I	313 (12.4)	1130 (44.7)
Nephrology	209 (9.0)	590 (25.5)
Neurology	95 (3.5)	1004 (36.6)
<b>Overall</b>	<b>1434 (9.5)</b>	<b>5367 (35.5)</b>

### 营养风险筛查 NRS $\geq$ 3分 (有营养风险者)

### 营养支持 (PN & EN) 应用情况 (n=15098)

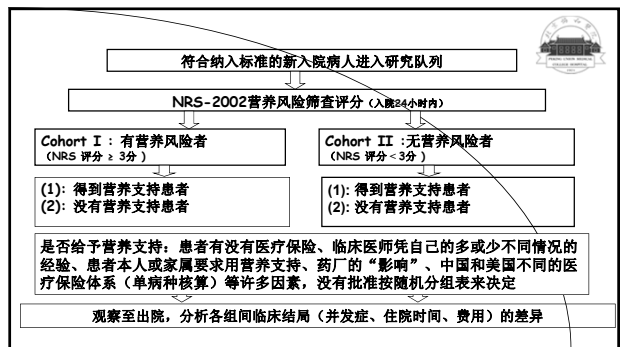
	Cases (%)	Surgery (%)	Thoracic (%)	Respiratory (%)	G-I (%)	Nephrology (%)	Neurology (%)
NRS<3 with NS	505 (27.1)	268 (19.4)	127 (7.8)	456 (32.7)	55 (3.2)	80 (4.6)	
NRS $\geq$ 3 with NS	519 (54.3)	281 (37.4)	187 (20.0)	562 (49.8)	57 (9.7)	150 (14.9)	
Ratio PN:EN	4.4 (945:214)	3.4 (484:144)	17.0 (306:18)	23.9 (1004:42)	8.6 (103:12)	2.3 (175:76)	

### 我们的研究: Nutrition, 2010, 26 :1088-1092

#### Impact of Nutrition Support on Clinical Outcome in Patients at Nutritional Risk? A Multi-center, prospective cohort study in Baltimore and Beijing teaching hospitals.

Applied nutritional investigation  
Impact of nutritional support on clinical outcome in patients at nutritional risk: A multicenter, prospective cohort study in Baltimore and Beijing teaching hospitals

Bin Jie M.S.N.<sup>a</sup>, Zhu-Ming Jiang M.D.<sup>b,c</sup>, Marie T. Nolan Ph.D.<sup>c</sup>, David T. Efron M.D.<sup>d</sup>, Shai-Nan Zhu M.P.H.<sup>e</sup>, Kang Yu M.S.<sup>f</sup>, Jens Kondrup M.D.<sup>g</sup>



**结果：患者基本资料 (n=1831)**

	PUMCH	JHH	BMTH
总例数 (内科/ 外科)	743 (336 /407)	218 (132 / 86)	870 (270 / 600)
年龄	52.4±15.4	50.7±14.9	53.3±15.6
BMI (kg/m <sup>2</sup> )	22.1±3.1 *	27.0±7.8	22.4±3.5*
NRS≥3, % (N)	44.8% (333) *	55.0% (120)	43.0% (374) *
住院时间(天)	16.2 (4-61) *	8.9 (4-38)	14.8 (4-63) *

PUMCH: 协和医院; JHH: 霍普金斯医院; BMTH: 北医三院

**结果：  
有营养风险者 有/无营养支持对并发症率影响**

	支持组	对照组	P 值
总并发症	20.3% (95/468)	28.1% (101/359)	0.009
感染性并发症	10.5% (49/468)	18.9% (68/359)	<0.001
非感染并发症	13.5% (63/468)	16.4% (59/359)	0.23

营养支持组总并发症率、感染性并发症率均显著降低

**有营养风险、且饮食减少评分≥1分者分层：  
营养支持组与对照组 感染性并发症率的比较**

	支持组	对照组	P 值
JHH	8.6% (3/35)	25.7% (19/74)	0.040
PUMCH	7.9% (11/139)	20.0% (26/130)	0.004
BUTH	11.3% (24/213)	20.6% (20/97)	0.030

营养支持组感染并发症显著降低 在三个医院均有显著性  
提示：住院前进食明显减少患者，接受营养支持改善结局明显

JHH: 霍普金斯医院; PUMCH: 北京协和医院; BUTH: 北医三院

**对总并发症率的多因素分析  
Nutrition support-protective factor in cohort study**

	OR (95%CI)	P 值
营养支持	0.54 (0.38-0.77)	<0.001
NRS中疾病严重程度评分	2.08 (1.34-3.23)	0.001
NRS中营养受损评分	1.29 (1.04-1.60)	0.02
年龄 ≥ 70岁	1.17 (0.79-1.72)	0.43
性别 (男: 女)	0.81 (0.58-1.13)	0.22
手术	1.48 (0.93-2.35)	0.10
医院: PUMCH: JHH	0.66 (0.41-1.08)	0.10
BUTH: JHH	0.64 (0.39-1.06)	0.08

营养支持 是并发症的保护因素 OR<1.0, p<0.001  
NRS中疾病严重程度、营养受损状况 OR> 1.0, p<0.05 是并发症危险因素

**营养支持对有营养风险患者成本/效果比影响**

n=3679 连续采样、登记、营养风险筛查  
n=986 符合预定诊断 (手术治疗 消化道肿瘤 等)  
n=440 符合所有入选标准 (均有营养风险)

有营养支持群体: 19例 感染并发症 (9.1%)  
无营养支持群体: 51例 感染并发症 (18.1%)  
有营养支持群体感染并发症发生率较低 (p=0.007)

倾向评分配对 Propensity Score Matching PSM: 基线可比

Zhang H, Wang Y, Jiang ZM, et al. <Nutrition> 2017-5

**规范营养支持对有营养风险老年患者  
临床结局和成本效果比(C/E ratio)影响**

连续采样3679患者，登记  
986患者 入院时 符合预定诊断 (消化道肿瘤手术...)

440 符合所有入选标准。为基线可比，通过  
倾向性评分匹配法 (Propensity Score Matching, PSM) 配对

PSM 后, 148 : 148 (296例)  
规范营养支持群体 与 接受糖电解质输液群体 感染并发症发生率有差别  
(9.1% vs 18.1%, P=0.0067)

Zhang H, Wang Y, Jiang ZM, Kondrup J, Fang H, Andrews M, Nolan MT, Mu SY, Zhang J, Yu K, Lu Q, Kang WM. Impact of nutrition support on clinical outcome and cost-effectiveness analysis in patients at nutritional risk: A prospective cohort study with propensity score matching[J]. Nutrition, 2017;37:53-59.

Accepted Manuscript

The impact of nutrition support on clinical outcome and cost-effectiveness analysis in patients at nutritional risk: a prospective cohort study with propensity score matching

Hui Zhang, MS, RN, Yang Wang, MS, Zhu-Ming Jiang, MD, FACS, Jena Kondrup, MD, Hai Fang, PhD, Marina Andrews, PhD, Mauro T. Tozan, PhD, RN, Ghafo-Yu Mu, RN, Jun Zhang, MD, Kang Yu, MS, Qian Liu, PhD, Wei-Ming Kang, MD

Table 4 Cost-effectiveness analysis of nutrition support versus no support for patients at nutritional risk (the propensity matched population, see text)

Item	Nutrition support n=149	No support n=149	Difference (Support-No support)	Difference bootstrap 95% CI*
Cost (USD)	6,219	6,161	58	(-559, 736)
Effectiveness (1-infectious complication rate)	90.6%	75.8%	14.8%	(4.0%, 23.6%)

ICER=392 USD  
Bootstrap 95% confidence interval of ICER (-4,344 to 9,598)

自然形成  
RWS 群体:

对比  
【规范营养支持】  
【糖电解质输液】

iCER  
增量 (i)  
成本 (C)  
效果 (E)  
比值 (R)

规范营养支持对有营养风险老年患者成本/效果

H. Zhang et al. / Nutrition

以临床研究为基础的  
Trial-based health-economic  
营养支持的卫生经济学

支付方角度  
Bootstrapping 算法  
 $X = \Delta$  无感染并发症比例  
 $Y = \Delta$  总的直接医疗成本

总成本无明显增加  
感染并发症发生率减少

Fig. 2. Scatter plot of the simulation results from 10 000 bootstrapping samples. The x axis represents the difference on infectious complication rate between the nutrition support and no-support cohorts. The y axis represents the difference on average total cost between the two cohorts.

Zhang H, Wang Y, Jiang ZM, Kondrup J, Fang H, Andrews M, Nolan MT, Mu SY, Zhang J, Yu K, Lu Q, Kang WM. Impact of nutrition support on clinical outcome and cost-effectiveness analysis in patients at nutritional risk: A prospective cohort study with propensity score matching. Nutrition. 2017;37:53-59.

NRS 2002 related with Reimbursement Drug List (2009) (Enteral Nutrition)

7.2 肠内营养药物	乙类	289	氨基酸型肠内营养剂	Enteral Nutritional Powder (AA)	口服散剂	◇, 限有营养风险和不能进食的重症患者
7.2.1 氨基酸型肠内营养药物						
7.2.2 短肽型肠内营养药物	乙类	290	短肽型肠内营养剂	Enteral Nutritional Powder (TP)	口服散剂 口服液体剂	◇, 限有营养风险和不能进食的重症患者
7.2.3 整蛋白型肠内营养药物						
	乙类	291	疾病特异型肠内营养剂	Disease-specific Enteral Nutrition Agent	口服散剂 口服液体剂	◇, 限有营养风险和不能进食的重症患者
		292	整蛋白型肠内营养剂	High Energy Enteral Nutritional Polymer Diet	口服散剂 口服液体剂	◇, 限有营养风险和不能进食的重症患者

NRS 2002 related with Reimbursement Drug List (2009) (Parenteral Nutrition)

7 营养治疗药物	甲类	275	复方氨基酸(18AA)	Compound Amino Acid (18AA)	注射剂	限有重度营养不良患者
7.1 肠外营养药物						
7.1.1 氨基酸类肠外营养药物						
7.1.1.1 平衡型氨基酸制剂	乙类	276	复方氨基酸(19AA-1)	Compound Amino Acid (19AA-1)	注射剂	限儿童
7.1.1.2 疾病适用型氨基酸制剂						
7.1.1.2.1 用于肾病的氨基酸制剂						
	乙类	277	复方氨基酸(9AA)	Compound Amino Acid (9AA)	注射剂	
7.1.1.2.2 用于肝病的氨基酸制剂						
	乙类	278	复方氨基酸(3AA)	Compound Amino Acid (3AA)	注射剂	

医保促进营养用药  
“规范应用、患者获益”及管理

2017年人社部医保目录  
凡例(十二)西药 234-247  
“胃肠外营养液”、262  
“丙氨酰谷氨酰胺注射液”  
1257“肠内营养剂”  
需明确有营养风险时方可按规定支付费用  
消化道有功能患者应首选肠内营养剂

学习 2017 年版医保药品目录肠外肠内营养用药支付限定以患者有营养风险为基础的体会

许静涵, 蒋东明. 学习 2017 年版医保药品目录肠外肠内营养用药支付限定以患者有营养风险为基础的体会. 中华临床营养杂志. 2017; 25(5): 268-71.

NUSOC协作组研究论文  
被美国三个学会 2016, 2017 两个《指南》引用为证据

Journal of Parenteral and Enteral Nutrition

Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.)

Stephen A. McClave, MD<sup>1</sup>, Beth E. Taylor, RD, DCN<sup>2</sup>, Robert G. Martindale, MD, PhD<sup>3</sup>, Malissa M. Warren, RD<sup>4</sup>, Debbie R. Johnson, RN, MS<sup>1</sup>, Carol Braun-Chswelt, RD, PhD<sup>5</sup>, Mary S. McCarthy, RN, PhD<sup>6</sup>, Evangelia Davanlou, PharmD<sup>7</sup>, Todd W. Rice, MD, MSc<sup>8</sup>, Gall A. Cresci, RD, PhD<sup>9</sup>, Jane M. Gervasio, PharmD<sup>10</sup>, Gordon S. Sacks, PharmD<sup>11</sup>, Pamela R. Roberts, MD<sup>12</sup>, Charlene Compher, RD, PhD<sup>13</sup>, and the Society of Critical Care Medicine<sup>14</sup> and the American Society for Parenteral and Enteral Nutrition

200  
Journal of Parenteral and Enteral Nutrition 40(2)

approval: Daniel Teitelbaum, MD; Ainsley Malone, MS, RD, CNSC; Phil Ayers, PharmD, BCNSP, FASHP; Albert Barrocas, MD, FACS, FASPEN; Bryan Collier, DO, CNSC, FACS; M. Molly McMahon, MD; Nilesh M. Mehta, MD; Lawrence A. Robinson, BS, MS, PharmD; Jennifer A. Woolley, MS, RD.

18. Jie B, Jiang ZM, Nolan MT, Zhu SN, Yu K, Kondrup J. Impact of preoperative nutritional support on clinical outcome in abdominal surgical patients at nutritional risk. Nutrition. 2012;28(10):1022-1027.

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**相关工作-1**  
**规范临床营养支持：DRG中的位置**

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**<营养风险-不足-支持-结局-成本/效果>**  
**多中心-全国分享数据库**

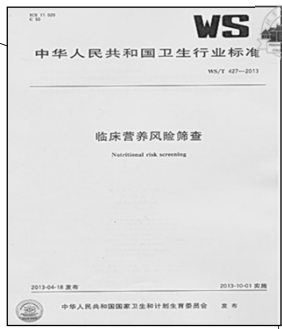
**<Nutrition risk-Undernutrition-Support-Outcome- Cost /effectiveness (NUSOC) Multi-center Database**

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**相关工作-2**

**卫生计生委  
 正式公布  
 卫生行业标准  
 WS/T 427-2013**

**临床营养风险筛查  
 Nutritional Risk Screening  
 2013-04-18 发布  
 2013-10-01 实施**



**结论**

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- 营养支持的第一步：营养筛查
- 营养筛查推荐工具：NRS-2002
- 以NRS-2002筛查为基础，规范营养支持治疗可改善临床结局及成本-效果比

中国营养保健食品协会

**谢谢关注!**

