Concerns regarding therapeutic choices that are inexpensive yet offer optimal results have lead to the use of pharmaco-economic analysis (CEA) in different countries. Cost-effectiveness analysis simultaneously identifies, calculates, and compares costs and outcomes of therapeutic approaches using clinical units as impact measures. These units include outcome (results or impact of the interventions, including monetary and humanistic components) and effectiveness (the measure of the outcomes in real-life situations). Effectiveness measures are presented as cost per unit of success — eg, cost per patient with no complications. Thus, CEA results are expressed as a quotient of the cost and the effectiveness (cost/effectiveness).

Peripheral catheter dressing use is common but information about cost-effectiveness remains limited. A prospective, descriptive 3-month study was conducted to 1) assess the cost-effectiveness of two dressings used for peripheral venous catheters and 2) identify statistical associations between the effectiveness variables and the patient's gender and age, category of the professional involved in care, and length of time the dressing was in place. The study was conducted among a homogenous sample of 120 adult patients; the majority (71/59.2%) were women, mean age 54.5 (± 18.8) years. All catheters were inserted in the surgical unit of the University of São Paulo Hospital: 54 traditional (microporous tape) and 66 transparent film dressings were applied. Clinical effectiveness was defined as dressing adherence and the absence of complications. Cost effectiveness was assessed using incremental analysis and potential statistical associations. The measured outcomes are expressed in terms of the cost per unit/patient of success or effect. Traditional dressings were found to have a lower total cost ($12.53) but were less adherent (P <0.001) compared to film dressings. The rate of complications in each group was similar. Results confirm that traditional dressings may be used for short-term use catheter care (approximately 3 days); whereas, film dressings may be more cost effective for longer-term use. Larger studies assessing the cost-effectiveness of various dressings to secure longer-term use catheters are needed.

**KEYWORDS:** dressing, pharmaco-economics, cost effectiveness, peripheral catheter

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Suzana Aron discloses that she is an employee of Politec Importação e Comércio Ltda. Politec Importação e Comércio Ltda, São Paulo, Brazil donated the transparent film dressings for use in the study.
Cost effectiveness analysis of health interventions represents an important tool in clinical and administrative decisions, especially in fields where developing technology can yield significant advances. Products and techniques employed in topical therapy of wounds and dressings for acute and chronic wounds, catheters, tubes, and drains are evidence of areas of progress in wound care.5-8

In Brazil, despite the common use of microporous adhesives and gauze to secure and dress peripheral venous catheters, discussions regarding appropriate catheter site cleansing and dressing options continue. Approaches related to preventing complications (eg, loss of catheter, dermatitis, discomfort) are already well-established internationally.9-11 However, concerns remain about the accumulation of moisture in the skin that may increase the risk of thrombus, phlebitis, and infection in the catheter insertion area; thereby, reducing the viability of both catheter and dressing.9,10

Microporous dressings are water-permeable and non-sterile and may be replaced when they detach and become dirty or wet.11,12 As a result, frequent dressing changes are usually necessary. Another type of dressing, transparent film, is impermeable to water and permeable to water vapor and can stay in place up to 7 days,9,10 providing it remains attached and dry and the patient is non-allergic.12 Extended use of transparent film dressings increases skin moisture under the dressing.11,13 Manufacturers seeking to develop products to reduce the accumulated moisture under the dressing through increased permeability to water vapor have developed a variety of new products, including OPSITE IV3000™ (Smith & Nephew, Largo, Fla) used in this study. Comparative studies11,12,13 between traditional and transparent film dressings have evaluated the infection risks and costs of these products. In Brazil, transparent films are not yet standard of care for catheters and traditional dressings; usually, gauze covered with a microporous is dressing used. Such practice justifies the need to study transparent films as compared to porous dressings.

Because cost-effectiveness and CEA data are limited in international literature, this prospective, descriptive study was conducted to 1) assess the cost-effectiveness of two dressings used for peripheral venous catheters and 2) identify statistical associations between the effectiveness variables and the patient’s gender and age, category of the professional involved in care, and length of time the dressing was in place.

**Methods and Procedures**

A prospective, descriptive 3-month study was conducted from August to October 2004 in the Surgical Clinic (SC) inpatient unit at University of São Paulo Hospital (HUUSP), São Paulo, Brazil. This is a public and secondary hospital serving the general population as well as university staff, students, and their relatives. The hospital is subsidized by the University and the public healthcare system. All data were collected by researchers and SC nursing staff with the approval of the HUUSP Ethics Committee.

The SC unit consists of 54 beds distributed in two rows of 27. These rows were used to distribute the dressings — catheters of patients in one row (Group A) received traditional (microporous) dressing; the transparent film dressing was used on catheters in the other row (Group B).

**Inclusion criteria.** Patients selected for this study were adults whose closed system IV catheter was placed...
at the SC unit to instill antibiotic and electrolyte solutions. Patients agreed to participate in the study and signed the Informed Consent form. Only patients whose catheters were expected to be left in place for less than 72 hours were able to participate (some catheters actually remained in place longer). From the potential population of 150 patients, 120 patients met the inclusion criteria and were selected to participate. They used a total of 120 dressings (54 traditional dressings and 66 transparent film dressings). Patients taking part in this study were routinely followed-up throughout catheter use, independent of reason for placement.

**Staff.** At the HUUSP, only licensed bachelor-prepared nurses may prescribe care but a variety of staff members (nurses, nursing auxiliaries, and technicians) are responsible for catheter care and all participated in data collection. Of the 31 clinician participants, 10 were nurses, 14 were nursing auxiliaries, and seven were technicians.

**Data collection form.** The data collection form contained patient information (age, gender), staff member responsible for care, and the dressing (type, replacement frequency, adherence, complications, and reasons for dressing change (eg, “routine,” “moisture under the dressing,” “catheter insertion site bleeding,” and “other”). Participating unit staff were trained and signed an agreement regarding dressing maintenance and care documentation.

**Products.** The traditional (microporous) dressing used is permeable to water and non-sterile. In the SC unit, standard use of such dressing consists of three strips (5 cm x 10 cm) of microporous adhesive. The dressing is not routinely changed unless a situation such as bleeding or catheter loss and dislodgment occur.

The transparent film dressing’s molecular structure provides enhanced permeability to moisture vapor (moisture vapor transmission rate [MVTR] = 3,000 g/m²/24 hour) and is designed to prevent the accumulation of moisture under the dressing. The film dressing was replaced once every 7 days or when necessary as determined by staff when complications such as hyperemia or edema at the catheter insertion point, and loss of dressing adherence. To compare these outcomes, the number of patients who exhibited no complications was divided by the total number of patients using the dressings.

For the effectiveness variables, each patient was considered one unique case. In situations involving catheter loss, participation in the study was completed. If a new catheter was inserted, the patient was considered to be a new case. Catheters and dressings were assessed and conditions documented every day on the respective data collection instruments.

**Cost-effectiveness analysis.** Cost effectiveness analysis simultaneously identifies, calculates, and compares costs and outcomes of therapeutic approaches using clinical units as impact measures. In this study, CEA results were expressed as the ratio between the estimated cost (C) of the treatment for 600 patients (annual average population for this SC unit) and effectiveness (E) according to the variables purchase costs (direct costs) were obtained from the manufacturers and the HUUSP stockroom — $1.00 for the transparent film and $0.02 for the amount of microporous dressing used for each dressing change (all dollars are US).

**Effectiveness variables.** Relative measure of dressing effectiveness was determined using adherence of the dressing to the skin and absence of dressing-related complications. Complications included skin-related issues (dermatitis/maceration) and/or partial or total catheter dislodgment due to inadequate dressing fixation.

*Microporous dressing adherence* was defined as adequate fixation of the dressing on the catheter and surrounding skin between daily general hygienic procedures. *Transparent film adherence* specified that the dressing remained intact and adherent (entire perimeter) to the skin during catheter use and/or up to 7 days. To compare dressing adherence outcomes, the number of patients with an adequately adherent dressing was divided by the total number of patients using a particular dressing.

*Absence of complication* was defined as the absence of any unexpected event related to the use of the dressings — ie, dermatitis, maceration, partial or total catheter dislodgment and loss of the catheter, hyperemia or edema at the catheter insertion point, and loss of dressing adherence. To compare these outcomes, the number of patients who exhibited no complications was divided by the total number of patients using the dressings.
studied (adherence and complications). The measured outcomes are expressed in terms of the cost per unit of success or effect or effectiveness unit per patient. A complementary CEA measure is the incremental analysis. This analysis assesses the cost and effectiveness differences between therapy options — in this study, traditional and transparent film dressings used.

Data analysis. Data were analyzed using descriptive and inferential statistics. Pearson’s chi-square test was used to compare the frequency distributions of the qualitative variables in the groups. Fisher’s Exact Test was used when the expected values were <5. To compare averages before tests, the hypothesis of a normal distribution of the results was analyzed using the Kolgoromov-Smirnov Test. When the hypothesis of normality was not rejected, Student’s t-test was performed; otherwise, Mann-Whitney’s non-parametric test was applied. Statistical significance was obtained when \( P < 0.05 \).

**Results**

Of the 120 patients in this study, 71 (59.2%) were women; this majority predominated in each group (29/53.7% and 42/63.6% in Group A and B, respectively). The mean age of all participants was 54.5 (± 18.8) years — 53.5 (± 21.1) in Group A and 55.2 (± 17.1) in Group B. Catheters were in place an average of 2.9 (± 2.4) days. In Group A, catheters were in place an average of 2.9 (± 2.4) days (range 1 – 13); in Group B, the average placement time was 2.6 (± 2.0) days (range 1 – 11). No statistically significantly difference in age, gender, catheter insertion site, and duration of catheter placement was found between the two groups.

Nursing auxiliaries comprised the majority of the involved professionals for both the traditional (68.5%) and transparent film (66.6%) groups. The most frequent reasons for dressing changes were patient discharge (31.7%; 37.0% and 27.3% for Group A and B, respectively); followed by moisture under the dressing (23.3%) — the second most frequent reason in the traditional dressing group at 24.1%); and dermatitis (20.0%) — the second most frequent reason in the film dressing group (25.8%). No statistically significant difference was noted for these variables between the two dressing groups (see Table 1).

Dressing adherence was adequate in 12 (22.2%) patients in Group A and in 61 (95.3%) patients in Group B; obviously, significantly higher for transparent film (\( P < 0.001 \)). No association was observed between adherence and complications (\( P = 0.784 \)) (see Table 2).

Compared to transparent film dressings, traditional dressings cost less ($12.53) and have a lower
adequate adherence rate (22%). In the cost-effectiveness analysis of cases where the dressing remained attached to the skin, the cost was $0.56 per patient over the course of treatment. Transparent film is more expensive ($600.00 over the course of treatment), more effective (95.3%), but less cost effective ($6.29) than the traditional (microporous) dressing (see Table 3).

Incremental analysis demonstrated that film dressing involved an additional cost of $8.03 per person for the entire treatment period when a secondary dressing was required.

In the absence of complications, the traditional dressing is more cost effective, costing $0.17 per patient per treatment period. Transparent film costs more per use per patient ($8.64) (see Table 4). Incremental analysis demonstrated that film dressing involved an additional cost of $255.43 per patient for the entire treatment period.

Mann-Whitney’s test showed no relationship between the effectiveness variables (adherence and absence of complications) and gender, age, and the professional status of the caregiver. Inadequate adherence was the prevalent cause for dressing failure in patients with longer catheterization (P = 0.012) (see Figure 1).

### Discussion

The need for pharmaco-economic studies has increased for many reasons: limited financial resources for existing and increasing demands; restrictions/regulations on clinical practice, especially for choosing therapies; options shaped by monetary indicators; and the interest in maximizing profits and obtaining a greater effectiveness in resource application. Thus, refusal to adopt new technologies — eg, using transparent film dressing for venous catheters — may be based on the myth of high product cost, not on controlled CEA studies as evidenced by the lack of such data in Brazil. Cost-effectiveness analysis is fundamental to the clinical practice of nursing care in general and wound care in particular—a healthcare niche that is growing more specialized every day.

Transparent film dressings have been evaluated for use in central catheters. However, data are lacking with regard to peripheral catheters. Most randomized dressing studies have evaluated dressing change intervals, dressing integrity, and signs of inflammation. None have considered cost or cost-effectiveness.

This study aimed to examine cost as well as clinical effectiveness using two effectiveness variables that can easily be examined as part of clinic routine: adherence and absence of complications. Analysis included 120

### Tables

**Table 3**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Total Cost (USD)</th>
<th>Adequate Adherence (%)</th>
<th>Cost-Effectiveness per Patient (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>12.53</td>
<td>22.2</td>
<td>0.56</td>
</tr>
<tr>
<td>Transparent film</td>
<td>600.00</td>
<td>95.3</td>
<td>6.29</td>
</tr>
</tbody>
</table>

**Table 4**

<table>
<thead>
<tr>
<th>Types of Dressing</th>
<th>Total Cost (USD)</th>
<th>Absence of Complications (%)</th>
<th>Cost-Effectiveness per Patient (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>12.53</td>
<td>71.7</td>
<td>0.17</td>
</tr>
<tr>
<td>Transparent film</td>
<td>600.00</td>
<td>69.4</td>
<td>8.64</td>
</tr>
</tbody>
</table>

**Figure 1.** 95% Confidence interval; mean time (days) of catheter placement and adherence.
dressing applications and removals, randomly distributed according to the type of dressing. The groups were homogeneous regarding the variables studied except for an observed predominance of medium-level professionals dealing with the patients, a common feature of nursing teams in Brazil.

**Dressing adherence.** The present study revealed that the transparent film adhered more effectively, confirming previous research.11,13 Transparent film also may provide more security and protection for the catheter, reducing risk of catheter dislodgment or accidental removal.10,14 The traditional (microporous) dressing was found to be significantly less adherent; this may facilitate dressing detachment and consequent catheter dislodgment, leading to more frequent changes.11,14

**Cost.** Pharmaco-economic analysis revealed that the microporous dressing was less expensive per patient under investigation than the transparent film. This may be the result of increased peripheral catheter changes. This also might have negatively influenced the results for the transparent films because the recommended period of utilization for this dressing is 7 days and the mean period in this study was 2.56 days. In a randomized study comparing transparent polyurethane dressing (n = 49) to dry sterile gauze dressing (n = 31) use for intravenous catheters in cardiology unit patients, Madeo, Martin, and Nobbs observed that the only significant difference between the two groups was the better dressing condition in the transparent group (P = 0.006). They concluded that traditional dressing should be a viable option for short-term use catheters.

The Centers for Disease Control and Prevention (CDC) recommends changing peripheral catheter dressings whenever they are dirty, loose, or wet.12 The Center for Hospital Infection of HUUSP does not have a formal protocol for peripheral catheter dressings. Thus, traditional dressings are not replaced daily and frequently become moist, increasing the risk of complications. However, this study showed that both types of dressings were equally effective (no statistically significant differences) with regard to complications.

One of the greatest infection risks in central catheters is the presence of skin micro-organisms. Many studies aim to demonstrate the relationship between catheter infection and the type of dressing used.11-14 However, the dressing is not the only influence on the presence of micro-organisms; puncture location, dressing placement, antisepsis procedures prior to placement and replacement, the administered

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drug, dressing material, patient age and gender, and permeability of the dressing to water vapor also may affect infection risk.13

A prospective, randomized clinical study15 compared the safety related to sources of infection of two types of polyurethane transparent dressings — conventional (n = 127) and a highly permeable (n = 185) — with standard gauze and tape (control, n = 130) in 442 adult patients with pulmonary artery catheters. The authors concluded that the pulmonary artery catheter-related bloodstream infections (five/1.1%) were caused by multiple sources: mainly, cutaneous colonization at the insertion site and contamination of solution and catheter hubs. The polyurethane dressings appeared to be safe for use with this kind of catheter and might be left for up to 5 days between dressing changes. The limited duration of catheter/dressing use in this study, low infection rates of peripheral catheters, and limited number of patients in the study did not enable evaluation of infection rates.

Results of the incremental analysis comparing dressing efficiency found that the transparent film has an additional cost of $255.43 for one patient without complications. In Brazil, the differences noted after incremental analysis are particularly relevant considering the health system is subsidized. Based on the results, especially the reduced incidence of complications using both types of dressings, Brazilian institutions may determine that using traditional dressings for peripheral catheters is the better, if not less cost effective, option.

 Peripheral catheter care costs have not been routinely evaluated. Pharmaco-economic studies contribute to dissemination of the most accurate clinical, technical, and financial information available to not only improve the use of resources, but also to standardize peripheral catheter dressing use in Brazil.

Limitations
The small number of participants and the characteristics homogeneity of the sample might have confounded the final results; the study did not analyze some clinical variables such as comorbidities, mobility, activity, and type of treatment. Nevertheless, study results confirm previously reported recommendations. Short-term use peripheral catheters (up to 3 days) may be fixed with traditional dressings because even with frequent dressing changes, they are still more cost effective; whereas, transparent film dressings may be a better option for longer-term use. To increase the evidence-base of catheter protocols of care, future studies should include analysis of other effectiveness variables — eg, length of hospitalization and personnel costs — and compare the cost effectiveness of dressings used for different catheter types.

Conclusion
To secure and protect peripheral catheter insertion sites, microporous dressings are less expensive than transparent film dressings but adherence of transparent film dressings was found to be higher. No difference in the rate of complications was noted between the two dressings. Pharmaco-economic analysis suggests that cost-effectiveness is related to dressing adherence. The results confirm that traditional dressings may be used for short-term use catheter care (approximately 3 days) and film dressings may be more cost-effective for longer-term use.

Acknowledgment
The authors thank Politec Importação e Comércio Ltda for donating the transparent film dressings used in the study. They also thank Felipe Torquato Salles for the translation of the manuscript to English. - OWM

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5. Campbell K, Woodbury MG, Whittle H, Labate T,

**CORRECTIONS TO BUYERS GUIDE (JULY 2007)**

According to the Product Index of the July 2007 Buyers Guide, information regarding the Qoustic Wound Therapy System (Arobella Medical, LLC, Minnetonka, Minn), a debriding and cleansing product, appears on pages 100 and 140. The information for this product actually appears on pages 100 and 123.

In addition, Mepilex® Ag Antimicrobial Soft Silicone Absorbent Foam Dressing (Mölnlycke Health Care, Norcross, Ga) inadvertently was not included with the antimicrobial dressings in the Wound Care section (pages 86–92). A full description of the product is available in the Foam Dressings section, page 107.

The Editors sincerely regret the errors.