Introduction
Pain is a source of immense economic burden on the US health care system. Inadequately controlled pain leads to multiple emergency department visits, hospitalizations, longer hospital stay, and higher mortality. Cancer-related pain represents a challenge to manage medically. Most patients will require high doses of opioid analgesics due to receptor downregulation, which puts them at risk of opioid addiction and death. Furthermore, inadequate pain control can disrupt cancer treatment, which can affect prognosis and leads to a higher cost. Optimal noninvasive medical treatment can provide adequate pain control for the majority of cancer patients, but about 30% of patients will have refractory pain and will need invasive pain procedures to achieve partial or complete relief. There are different types of invasive pain procedures, such as anterolateral cordotomy, spinal cord stimulation (SCS), and intrathecal drug delivery. The cordotomy cause interruption of the pain signal transmission, while the SCS modulate pain transmission. The intrathecal drug delivery system achieves pain control through the delivery of minute doses of opioids. Here, we present a cost analysis of in-hospital intravenous narcotics, anterolateral cordotomy, and intrathecal pain pump placement in terminal cancer patients.

Case Presentation
Case 1
A 53-year-old female with metastatic breast cancer with an expected survival of less than 1 year. She was admitted due to severe somatic pain caused by cancer invasion of the right side of her chest wall. She had failed oral narcotics regimens and was admitted for opioids (Dilaudid) patient-controlled analgesia (PCA). During her hospital stay, she was consuming 300 mg/day of Dilaudid with a residual pain level of 5/10 on the visual analog scale (VAS). After 7 days of treatment with no improvement, she underwent a left-sided C1-2 cordotomy using intraoperative flat-panel fluoroscopy for guidance. The procedure was uneventful, she experienced immediate pain relief and the PCA was weaned over two days. The patient was discharged home on her own pain regimen with a stable neurological exam. The total cost of her care during that admission was $108,346. It included $18,462 for the cordotomy and $89,884 for the hospital stay. The expenses of 7 days of hospital stay with the use of PCA was about $62,918.8 (table 1). Of note, the patient did not undergo any special testing besides basic preoperative labs, and throughout her hospital stay, she remained in a progressive care unit.

Case 2
A 66-year-old female with metastatic breast cancer with an expected survival of less than 1 year. She was admitted for because of severe somatic pain caused by invasion of her left knee. She had failed multiple treatment lines including oral narcotics, local nerve blocks, and the use of local polyethylene/epichlorohydrate (PMMA), so she was admitted for opioids (Dilaudid) PCA. She was consuming 72 mg/day of Dilaudid with a residual pain of 7/10 on the VAS. On day 3 post-admission, she underwent an intrathecal pain pump (ITPP) placement for morphine delivery. The procedure was uneventful. Initially, she experienced partial pain relief and the PCA was weaned gradually over 7 days, which was the time needed to titrate the intrathecal morphine dose to achieve adequate pain control. She was discharged home with a stable neurological exam. The total cost of her care during that admission was $165,589. It included $80,603 for the ITPP placement procedure (including the implants), and $84,786 for the hospital stay. The expenses of 8 days of hospital stay with the use of PCA was about $67,828.8 (table 1). Of note, the patient did not undergo any special testing besides basic preoperative labs, and throughout her hospital stay, she remained in a progressive care unit.

Table 1. Costs of the pain procedures.

<table>
<thead>
<tr>
<th>Procedure cost</th>
<th>Case 1</th>
<th>Case 2</th>
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<tr>
<td>ITPP - $80,603 (including cost of implants)</td>
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<td>C1-2 ALC $18,462</td>
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<td>Hospital stay cost - $89,884 (10 days)</td>
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<tr>
<td>Hospital stay for IV opioids - $62,918.8 (7 days)</td>
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<td>Total - $108,346</td>
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Abbreviations: ITPP; intrathecal pain pump; IV; intravenous, ALC; anterolateral cordotomy.

Conclusion
In an era with the increased influence of health care economics. Furthermore, new cancer cases are expected to rise over the next two decades, which supports the prediction of a rise in the number of patients with cancer-related pain. There is an obvious need for cost-effective treatments with immediate and long-lasting effects on somatic pain.

References