Executive Summary Checklist

In order to establish a program to eliminate Venous Thromboembolism (VTE), an implementation plan with the following actionable steps is recommended as best practice science to reduce patient harm. The following core action items and prevention strategies are outlined below using an interdisciplinary, best practice approach:

- Hospital governance and senior administrative leadership must champion efforts in raising awareness around the high incidence of VTEs and prevention strategy measures.
- Healthcare leadership should support the design and implementation of standards and provider training programs on VTE reduction and prevention strategies by:
  - Accurately stratifying risk by ensuring that providers perform a VTE Risk Assessment
  - Measure appropriate quality measures related to VTE to close performance gap
  - Complete in depth chart review for hospital-associated thrombosis events to identify opportunities for improvement and then acting on lessons learned
  - Adhere to VTE best practices from national organizations such as Agency for Healthcare Research and Quality’s VTE Safety Toolkit\(^1\). The toolkit contains 10 components that are evidence-based guidelines for preventing, diagnosing, treating, and educating patients and providers about VTE. The components are as follows:
    - VTE prophylaxis guidelines, VTE risk assessment tool, DVT diagnostic algorithm, PE diagnostic algorithm, HIT (heparin-induced thrombocytopenia) assessment, VTE treatment pathway, DVT outpatient treatment order set, Vascular laboratory requisition, Neural-axial anesthesia guidelines, Patient education (prevention and treatment) pamphlets
    - Ensure healthcare professionals receive, at the least, annual training on new VTE policies and processes
- Assess risk for VTE among patients hospitalized with:
  - Injury to vein: fracture, surgery
  - Slow blood flow: bedrest, limited mobility, paralysis
  - Increased estrogen: birth control, pregnancy and recent childbirth, hormone replacement therapy
  - Chronic illness: cancer, heart/lung disease, atrial fibrillation, inflammatory bowel disease (Crohn’s and Ulcerative Colitis)
  - Other: personal or family history of DVT/PE, age, obesity, central lines, or clotting disorders
- Educate patient and families on VTE risks, complications, and importance of mechanical and medication prophylaxis.
- Select technologies that show early evidence to reduce VTEs and positively impact both patient and provider outcomes in the clinical settings
  - Implement an EHR with prompt decision making support to ensure that every patient has a valid VTE prevention plan in place at all times during their hospitalization.

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The Performance Gap

A venous thromboembolism (VTE) is defined as a blood clot in the lung (pulmonary embolism or PE) or in deep veins of the arm or leg (Deep Vein Thrombosis or DVT). VTEs are associated with increased mortality, poor patient outcomes, increased length of stay and decreased patient satisfaction. It is the most common preventable hospital complication as well as the most common cause of preventable mortality in hospitals. It is estimated that 60,000 to 100,000 Americans die from VTE each year and 10-30% of those patients will die within one month of diagnosis. VTE affects all races, ages and genders. It is estimated that over 50% of all VTE in a given community are associated with hospitalization. Healthcare institutions should take all precautions in order to prevent blood clots in their patients.

It is important to realize that even though trauma and surgery contribute to the risk for VTE, at least half of all hospital-acquired VTE occur in patients hospitalized with medical illnesses. Although classic clinical symptoms of DVT include red or painful swelling of a limb, the clinical examination for DVT is notoriously poor in both sensitivity and specificity. In some studies of hospitalized patients, only a minority of those found to have DVT have classical clinical findings to suggest the diagnosis. Because of this, clinical decision rules have been developed to help guide the diagnostic evaluation. Although patients with acute PE typically endorse shortness of breath, tachypnea, and/or tachycardia, sudden cardiac arrest is the first symptom in 25% of PE patients. Thus one must maintain a high level of clinical suspicion to diagnose VTE. The better policy, both from a patient safety and a cost-consciousness point of view, is primary prevention to avoid their occurrence to begin with. All patients admitted to the acute care setting should be evaluated for their risk of VTE, and then guideline appropriate VTE prophylaxis should be reliably administered. This strategy results in significant reduction in the incidence of hospital-acquired VTE.

Once clinically suspected, clinical prediction rules should be utilized to guide appropriate diagnostic evaluation. Diagnostic imaging for confirmation includes venous doppler, V/Q scans or the highly sensitive computerized tomography angiography (CTA) of the chest. With the latter, small subsegmental, possibly non-clinical, pulmonary emboli can now be detected thus increasing a hospital’s reported VTE rate.

Patients who develop a VTE have a higher in-hospital mortality rate, and will have approximately 33% chance of developing another clot within 10 years. Patients identified to have an acute VTE will require a secondary prophylaxis program. For most patients, this entails prolonged anticoagulation and close follow-up to carefully manage the risk and benefits of secondary prophylaxis.

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Leadership Plan

**Identify:** Senior executive leadership that is committed to a reduction in VTE
- Team ideally is led by a physician and administrative champions, ideally the Chief Nursing Officer
- Gather staff that have an in-depth knowledge base of disease process and prevention of VTE such as:
  - Physicians
  - Nursing Leaders
  - Advance Practice Providers such as Physical and Occupational Therapists
  - Physicians in training
  - Residents
  - Bedside Nurses
  - Quality Improvement staff
  - Safety/Risk
  - Pharmacy
  - Information Technology team with Electronic Medical Record

**Plan:** Senior executive leadership and clinical /safety leaders should agree on the best implementations in order to close their performance gap.
- Plan should include measurable appropriate quality metrics

**Timeline set:** Senior executive leadership should select a goal and set a timeline to achieve said goal

**Resources allocated:** Senior executive leaders should set specific budget for said goal and plan

**System leadership and engagement:** Clinical and safety leaders should act as change agents and drive implementation

Practice Plan

**Complete** in depth chart review of hospital-associated thrombosis events. Identify trends such as:
- Service line
- Physician
- Diagnosis
- Risk score ([Appendix A](#)): Caprini Score, Padua Prediction Score, IMPROVE score, or “3-bucket” model
- Hospital units
- Pharmacological prophylaxis ordered
  - Pharmacological prophylaxis missed doses
  - Patient Refusal of pharmacological prophylaxis
- Mechanical prophylaxis ordered
  - Patient refusal of mechanical prophylaxis
- Patient mobility

**Identify** gaps in care that promote VTE development

**Adhere** to the Agency for Healthcare Research and Quality’s Venous Thromboembolism Safety Toolkit: A System’s Approach to Patient Safety
Implement interventions that reduce VTE

- Ensure interventions are patient-centered
- Incorporate VTE Risk Assessment into EHR for all new admissions
  - Reassess risk periodically upon change in level of care, clinicians, and prior to discharge.
- Ensure the ordering of appropriate VTE prophylaxis according to risk assessment and BMI
  - Consider adoption of VTE power plans/order sets
  - Continue VTE prophylaxis past discharge if recommended
- Ensure timely and reliable delivery of pharmacological and/or mechanical prophylaxis as indicated
  - Track/trend
    - Missed doses
    - Patient refusals
  - Ensure that patient resistance or refusal is met with education about the purpose of prophylaxis and risks if not administered.
- Develop specific and reliable protocols, endorsed by local surgical champions, for reliable mechanical or pharmacologic prophylaxis to be applied prior to induction of anesthesia, as appropriate
- Consider nursing protocol for application of mechanical prophylaxis in pre-op areas
- Understand your staff’s perception of the importance of VTE prophylaxis
  - Educate knowledge deficits
  - Consider yearly competence in VTE
  - Ensure that all team members - physicians, nurses, patient care assistants, trainees, pharmacists, transport personnel, physical therapists, patients and family members are aware of their role in VTE-P.
  - Patient Mobility
    - Utilize mobility trackers
- Design and implement a plan when pharmacological prophylaxis is contraindicated, such as proactive monitoring.

Educate patients and families about the risks, complications, the importance of VTE prophylaxis, and the symptoms of DVT and PE.

Technology Plan

Suggested technologies are limited to those proven to show benefit or are the only known technologies with a particular capability. Other technology options may exist or emerge after the publication of this APSS, please send information on any additional technologies, along with appropriate evidence, to info@patientsafetymovement.org.

With regard to VTE, there are a few novel technology platforms that offer a low entry cost that work alongside the Electronic Health Record (EHR). These technology platforms are secure with multimedia functions and can host checklists, education and much more to improve best practices and engagement across the care continuum. There is also technology that is important in the prevention of blood clots, like compression devices. Examples of those devices and technology solutions are detailed below and may be helpful in VTE prevention.

- Compression Devices
  - Either Graduated Compression Stockings (GCS) and/or Intermittent Pneumatic Compression Device (IPC), or AE (anti-embolic) pumps should be used adjunct to other forms of prevention, like pharmacological solutions
    - GCS such as:
      - Anti-embolism stockings, anti-thrombosis stockings, elastic support hose, graduated compression elastic stockings, Jobst stockings, surgical hose, TED hose, white hose, thrombosis stockings. When using GCS, appropriate fitting is
essential to ensure safety from injury and effectiveness. Notably, 15-20% of patients cannot effectively wear AES because of unusual limb size or shape.\textsuperscript{8}

- IPC AE pumps such as:
  - Alternating Leg Pressure (ALP), atthrombic pumps-calf/thigh, Continuous Enhanced Circulation Therapy (CECT), DVT boots-calf/thigh, EPC cuffs/stockings-External pneumatic compression-calf/thigh, Flotron/Flotron DVT system-thigh, Impulse pump-thigh, Intermittent pneumatic compression stockings, Intermittent compression device (ICD), KCI stockings, Leg pumpers, PAS (Pulsatile anti-embolic stockings), Plexipulse-calf/thigh, Pneumatic intermittent impulse compression device, Rapid inflation asymmetrical compression (RIAC) devices, Sequential compression device, Sequential pneumatic hose, Thromboguard, Thrombus pumps-calf/thigh, Vascutherm, VasoPress DVT System, Venodyne boots-calf/thigh

- Electronic Health Record (EHR)
  - Web-based/EHR predictive algorithms that elicit specific data such as but not limited to vital signs (BP, Temp, HR, RR, and SpO2) lab values, nurses notes, and event reports.
  - The EHR can be a key component of a VTE prevention program by enabling computerized decision support to ensure that every patient has a valid VTE prevention plan at all times during their hospitalization.\textsuperscript{9,10}

\textsuperscript{10} Doyle, C., Kings College Hospital., NHS Foundation Trust. (n.d.). VTE Prevention; Electronic Solutions. [Powerpoint Slides].
Metrics

Process measures such as rates of VTE risk assessment and appropriate thromboprophylaxis may be measured however defining a robust, reproducible and meaningful approach to performance monitoring remains a challenge to healthcare systems. Identifying real world outcomes such as hospital-associated VTE case numbers and mortality is even more of a challenge, with well documented coding difficulties as well as ascertainment bias. The Patient Safety Movement offers known measurement specifications to hospitals looking to improve their metrics.

**Topic:**

**Hospital Acquired Potentially Preventable Venous Thromboembolism Rate (VTE-6)**

VTE-6 assesses the number of patients diagnosed with confirmed VTE during hospitalization (not present at admission) who did not receive VTE prophylaxis between hospital admission and the day before date of the first positive VTE diagnostic test.

**Process Measure Formula:**

_Numerator:_ Patients who received no VTE prophylaxis prior to the day before the date of the first positive VTE diagnostic test.

_Denominator:_ Patients who developed confirmed VTE during hospitalization.

*Rate is typically displayed: Numerator/Denominator*1000

**Metric Recommendations:**

**Indirect Impact:**

All admitted patients

**Direct Impact:**

All admitted patients

**Lives Saved**

\[
\text{Lives Spared Harm} = (\text{VTE Rate}_{\text{baseline}} - \text{VTE Rate}_{\text{measurement}}) \times \text{Total Patient Days}_{\text{baseline}}
\]

\[
\text{Lives Saved} = 0.104 \times (\text{Total VTEs}_{\text{baseline}} - \text{Total VTEs}_{\text{measurement}})
\]

**Notes:**

Measure exclusions age < 18, LOS > 120 days, comfort measures only, clinical trials, principal diagnosis of VTE or VTE present on admission, provider reason for not administering mechanical and pharmacologic prophylaxis.

**Data Collection:**

Chart abstraction.

**Mortality (will be calculated by the Patient Safety Movement Foundation):**

Estimated mortality per VTE is 0.104

**Reference:**

- Mortality and Cost per Case Information from AHRQ
<table>
<thead>
<tr>
<th>PIP Hospital Acquired Condition (HAC) for 2010-2014</th>
<th>Estimated Additional Cost per HAC (2010 dollars)</th>
<th>Estimated Additional Inpatient Mortality per HAC</th>
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<td>Adverse Drug Events</td>
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</tr>
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<td>Catheter-Associated Urinary Tract Infections</td>
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<td>.023</td>
</tr>
<tr>
<td>Central Line-Associated Bloodstream Infections</td>
<td>$17,000</td>
<td>.185</td>
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<tr>
<td>Falls</td>
<td>$7,234</td>
<td>.055</td>
</tr>
<tr>
<td>Obstetric Adverse Events</td>
<td>$3,000</td>
<td>.0015</td>
</tr>
<tr>
<td>Pressure Ulcers</td>
<td>$17,000</td>
<td>.072</td>
</tr>
<tr>
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<tr>
<td>Postoperative Venous Thromboembolism</td>
<td>$8,000</td>
<td>.104</td>
</tr>
</tbody>
</table>
Topic:
Hospital Acquired Venous Thromboembolism Rate
Rate of patients having a hospital acquired VTE

Process Measure Formula:
Numerator: Number of patients having a VTE
Denominator: Total patient days
* Rate is typically displayed: VTEs/Total Patient Days*1000

Metric Recommendations:
Indirect Impact:
All admitted patients

Direct Impact:
All admitted patients

Lives Saved
\[ \text{Lives} = (\text{VTE Mortality}_{\text{baseline}} - \text{VTE Mortality}_{\text{measurement}}) \times \text{Total Patient Days}_{\text{baseline}} \]

Notes:
Hospital acquired VTEs are identified through ICD diagnosis codes. The ICD9 diagnosis codes are: 4534, 45341, 45342, 41511, 41513, and 41519. The ICD10 diagnosis codes are: I824Z3, I82449, I82491, I82423, I2602, I824Y1, I82421, I2692, I82441, I824Y2, I82412, I82429, I82432, I82499, I82422, I82439, I82493, I824Y9, I82419, I2609, I2699, I824Z2, I824Z9, I824Y3, I824Z1, I82413, I82442, I82443, I82492, I82411, I82431, I82433. Qualifying diagnoses that are present on admission are excluded from the numerator.

Total patient days come from daily census counts for each inpatient nursing unit. Census counts are electronically derived at the same time of day each day. These counts may be collected manually if an electronic source is not available.

Data Collection:
Data collected from final diagnosis codes for encounter as determined by a professional health information coder.

Mortality (will be calculated by the Patient Safety Movement Foundation):
Estimated mortality per VTE is 0.104
Reference:
- Mortality and Cost per Case Information from AHRQ
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<td>Postoperative Venous Thromboembolism</td>
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<td>.104</td>
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Workgroup

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Revision History

<table>
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<th>Primary Author(s)</th>
<th>Description of Version</th>
<th>Date Completed</th>
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<tr>
<td>Version 1</td>
<td>Michael Becker, Kate ONeill, Steven Barker, Mike Durkin, Brandyn Lau, Brendan Miney, Timothy Morgenthaler, Amy Sofranko, Todd Pollock, Vonda Vaden Bates, Michael Ramsay, Ariana Longley, Joe Kiani</td>
<td>Initial Release and Executive Review</td>
<td>January 2017</td>
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Appendix A

Calculation of the Caprini Risk Score

The table below depicts the different scores for the factors represented in the Caprini score. The Caprini score is calculated by adding the scores of all factors present in the patient. The Caprini score is interpreted in the following way:

#### Table: Calculation of the Caprini Risk Score

<table>
<thead>
<tr>
<th>5 points</th>
<th>3 points</th>
<th>2 points</th>
<th>1 point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke (in the previous month)</td>
<td>Age ≥ 75 years</td>
<td>Age: 61-74 years</td>
<td>Age 41-60 years</td>
</tr>
<tr>
<td>Fracture of the hip, pelvis, or leg</td>
<td>Prior episodes of VTE</td>
<td>Arthroscopic surgery</td>
<td>BMI &gt; 25 Kg/m2</td>
</tr>
<tr>
<td>Elective arthroplasty</td>
<td>Positive family history for VTE</td>
<td>Laparoscopy lasting more than 45 minutes</td>
<td>Minor surgery</td>
</tr>
<tr>
<td>Acute spinal cord injury (in the previous month)</td>
<td>Prothrombin 20210 A</td>
<td>General surgery lasting more than 45 minutes</td>
<td>Edema in the lower extremities</td>
</tr>
<tr>
<td></td>
<td>Factor V Leiden</td>
<td>Cancer</td>
<td>Varicose veins</td>
</tr>
<tr>
<td></td>
<td>Lupus anticoagulants</td>
<td>Plaster cast</td>
<td>Pregnancy</td>
</tr>
<tr>
<td></td>
<td>Anticardiolipin antibodies</td>
<td>Bed bound for more than 72 hours</td>
<td>Post-partum</td>
</tr>
<tr>
<td></td>
<td>High homocysteine in the blood</td>
<td>Central venous access</td>
<td>Oral contraceptive</td>
</tr>
<tr>
<td></td>
<td>Heparin induced thrombocytopenia</td>
<td></td>
<td>Hormonal therapy</td>
</tr>
<tr>
<td></td>
<td>Other congenital or acquired thrombophilia</td>
<td></td>
<td>Unexplained or recurrent abortion</td>
</tr>
</tbody>
</table>

---


## Scoring and Recommended Prophylaxis

<table>
<thead>
<tr>
<th>Caprini Score</th>
<th>Risk</th>
<th>VTE Incidence</th>
<th>Recommended Prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>Very low-low</td>
<td>&lt;1.5%</td>
<td>Early ambulation, IPC</td>
</tr>
</tbody>
</table>
| 3-4           | Moderate    | 3%            | LMWH; UFH; or IPC<br>
If high bleeding risk, IPC until bleeding risk diminishes. |
| 5-8           | High        | 6%            | LMWH + IPC; or UFH + IPC<br>
If high bleeding risk, IPC until bleeding risk diminishes. |
| >8            | Very high   | 6.5-18.3%     | LMWH + IPC; or UFH + IPC<br>
If high bleeding risk, IPC until bleeding risk diminishes. Consider extended duration prophylaxis. |

* Abdominal or pelvic surgery for cancer should receive extended VTE prophylaxis with LMWH x 30 days.1

IPC = intermittent pneumatic compression
LMWH = low-molecular-weight heparin
UFH = unfractionated heparin

---

Calculation of the Padua Prediction Score

The table below depicts the Padua Predictive score for VTE among hospitalized patients.\(^\text{14}\)

A score of:
- \( \geq 4 \): high risk of VTE
- \( \leq 4 \): low risk for VTE

<table>
<thead>
<tr>
<th>Variable</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active cancer</td>
<td>3</td>
</tr>
<tr>
<td>Previous VTE</td>
<td>3</td>
</tr>
<tr>
<td>Decreased mobility</td>
<td>3</td>
</tr>
<tr>
<td>Thrombophilia</td>
<td>3</td>
</tr>
<tr>
<td>Previous trauma or surgery within that last month</td>
<td>2</td>
</tr>
<tr>
<td><strong>Age(\geq 70)</strong></td>
<td>1</td>
</tr>
<tr>
<td>Heart and/or respiratory failure</td>
<td>1</td>
</tr>
<tr>
<td>Ischemic stroke or acute myocardial infarction</td>
<td>1</td>
</tr>
<tr>
<td>Acute rheumatologic disorder and/or acute infection</td>
<td>1</td>
</tr>
<tr>
<td>Obesity</td>
<td>1</td>
</tr>
<tr>
<td>Hormonal therapy</td>
<td>1</td>
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</table>

Calculation of the IMPROVE Predictive Score

The IMPROVE score for VTE assesses the risk of VTE among hospitalized patients. The predictive score includes 4 independent risk factors for VTE, which are present at admission. The associative score includes 7 variables present either at admission or during hospitalization.  

**IMPROVE Predictive Score**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior episode of VTE</td>
<td>3</td>
</tr>
<tr>
<td>Thrombophilia</td>
<td>3</td>
</tr>
<tr>
<td>Malignancy</td>
<td>1</td>
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<tr>
<td>Age more than 60 years</td>
<td>1</td>
</tr>
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**Interpretation of the IMPROVE Predictive Score**

<table>
<thead>
<tr>
<th>Score</th>
<th>Predicted VTE risk through 3 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.5%</td>
</tr>
<tr>
<td>1</td>
<td>1.0%</td>
</tr>
<tr>
<td>2</td>
<td>1.7%</td>
</tr>
<tr>
<td>3</td>
<td>3.1%</td>
</tr>
<tr>
<td>4</td>
<td>5.4%</td>
</tr>
<tr>
<td>5-8</td>
<td>11%</td>
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**IMPROVE Associative Score**

<table>
<thead>
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<th>Variable</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td>Prior episode of VTE</td>
<td>3</td>
</tr>
<tr>
<td>Thrombophilia</td>
<td>2</td>
</tr>
<tr>
<td>Paralysis of the lower extremity during the hospitalization</td>
<td>2</td>
</tr>
<tr>
<td>Current malignancy</td>
<td>2</td>
</tr>
<tr>
<td>Immobilization for at least 7 days</td>
<td>1</td>
</tr>
<tr>
<td>ICU or CCU admission</td>
<td>1</td>
</tr>
<tr>
<td>Age more than 60 years</td>
<td>1</td>
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**Interpretation of the IMPROVE Associative Score**

<table>
<thead>
<tr>
<th>Score</th>
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<tbody>
<tr>
<td>0</td>
<td>0.4%</td>
</tr>
<tr>
<td>1</td>
<td>0.6%</td>
</tr>
<tr>
<td>2</td>
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<td>3</td>
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<tr>
<td>4</td>
<td>2.9%</td>
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<td>5-10</td>
<td>7.2%</td>
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