Ensuring Safe Patient Access to Medical Marijuana Products in Massachusetts

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Marijuana Products

- Variety of products
- Different intended uses
- Varying cannabinoid content

Dried Flower

Concentrates

Edible MIPs

Non-edible MIPs
Primer: Commercial Marijuana Production

Cultivation

Potential for pesticide use and heavy metal accumulation

Harvest

Potential introduction of microbiological contamination

Processing

Potential residual solvents from manufacturing of cannabis extracts

Packaging

Potential microbial contamination from poor sanitary procedures

Retail
Overview

- Labs must be accredited to ISO 17025 by a third party accrediting body;
- Grow media (soil, water) and samples of all retail products (flower, oil, edibles) are tested
- Testing results evaluated according to food and drug industry standards described in DPH protocols
- Testing is required to ensure patient safety and to meet product labeling requirements

https://www.mass.gov/service-details/medical-use-of-marijuana-program-product-testing
Soil tested for metals, PCBs, and pesticides.

Pesticides and plant growth regulators applied to plant and grow media.

Plant parts (e.g., stem, leaf, flower) may accumulate different levels of contaminants.

Water and amendments applied to plant or plant grown hydroponically in water.

Grow media (e.g., soil and water) subject to contaminant testing (e.g., metals, pesticides, bacteriological contaminants).

Microbes (e.g., bacteria and mycotoxins) in the environment.

Soil may contain arsenic, cadmium, lead, mercury, and other contaminants.

Dried “Flower” or bud.

Plant may take up contaminants present in environmental media.
Medical Marijuana Product Safety and Quality Surveillance

Testing Results to Date

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Samples Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Metals</td>
<td>3,347</td>
</tr>
<tr>
<td>Pesticides</td>
<td>2,234</td>
</tr>
<tr>
<td>Residual Solvents</td>
<td>1,030</td>
</tr>
<tr>
<td>Microbes</td>
<td>5,440</td>
</tr>
<tr>
<td>Cannabinoid Profile</td>
<td>5,606</td>
</tr>
</tbody>
</table>

Monthly Laboratory Reports

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SFY 2016</th>
<th>SFY 2017</th>
<th>SFY 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy Metals</td>
<td>1,074</td>
<td>350</td>
<td>281</td>
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<tr>
<td>Pesticides</td>
<td>777</td>
<td>270</td>
<td>251</td>
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<tr>
<td>Residual Solvents</td>
<td>231</td>
<td>330</td>
<td>320</td>
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<tr>
<td>Microbes</td>
<td>846</td>
<td>319</td>
<td>308</td>
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<tr>
<td>Cannabinoid Profile</td>
<td>560</td>
<td>580</td>
<td>540</td>
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</table>

Product Characteristics

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Samples (%)</th>
<th>Reports (%)</th>
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</thead>
<tbody>
<tr>
<td>Flower</td>
<td>47</td>
<td>51</td>
</tr>
<tr>
<td>Concentrate</td>
<td>31</td>
<td>29</td>
</tr>
<tr>
<td>MIP</td>
<td>22</td>
<td>20</td>
</tr>
</tbody>
</table>
Comparison of Maximum Concentrations of Heavy Metals in Food and Medical Marijuana Product

<table>
<thead>
<tr>
<th>HEAVY METAL</th>
<th>MDPH Limit for Marijuana (µg/kg)</th>
<th>Leafy Greens&lt;sup&gt;2&lt;/sup&gt; (µg/kg)</th>
<th>Root Crops&lt;sup&gt;3&lt;/sup&gt; (µg/kg)</th>
<th>Marijuana Flower&lt;sup&gt;1&lt;/sup&gt; (µg/kg)</th>
<th>Marijuana Concentrate&lt;sup&gt;1&lt;/sup&gt; (µg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>200</td>
<td>43</td>
<td>43</td>
<td>2,485</td>
<td>491</td>
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<tr>
<td>Cadmium</td>
<td>200</td>
<td>1,088</td>
<td>112</td>
<td>820</td>
<td>156</td>
</tr>
<tr>
<td>Lead</td>
<td>500</td>
<td>136</td>
<td>64</td>
<td>48,200</td>
<td>11,400</td>
</tr>
<tr>
<td>Mercury</td>
<td>100</td>
<td>18</td>
<td>--</td>
<td>87</td>
<td>110</td>
</tr>
</tbody>
</table>

<sup>1</sup> Products tested through October 2017
<sup>2</sup> Leafy greens include: spinach, collards, iceberg lettuce, cabbage, leaf lettuce
<sup>3</sup> Root crops include: potato, carrot, beets, turnip, sweet potato
<sup>4</sup> U.S. Food and Drug Administration Total Diet Study, survey years 1991 - 2011

DRAFT FOR POLICY DISCUSSION ONLY
Cannabis contains approximately 421 different chemical compounds - including 60+ cannabinoids.

- Each is potent at a different amount or combination (i.e., based on the profile of the product).
- Heating or ingestion changes the cannabinoid profile and leads to different effects.
- Each cannabinoid is associated with a different effect (relaxation, anti-nausea, pain relief, etc.).

- THCa detected in 99.8% of flower samples
- $\Delta^9$-THC detected in 98.8% of concentrates
- CBD detected in 82.7% of concentrates

- In general, marijuana flower products are 19% THC (range: 0.03 – 34.69%)
Cannabinoid Concentration vs. Dose/Serving

100 grams of flower (25% THC by dry weight)

Processed into 19 grams of concentrate (80% THC by weight)

1 gram of concentrate incorporated into chocolate to make 80 individual candies

1 gram of concentrate = 800 mg THC

10 mg THC per chocolate (one serving)
Potency is not Dose

- In pharmacology and medicine
  - **Potency:** Amount of chemical to produce an *effect* of a given *intensity*.
  - **Dose:** A *quantity* of a chemical administered (either per dose/serving or per day).

Dose determines if a chemical will have a beneficial or harmful effect.

**BENEFICIAL EFFECT**
- 300-1,000 mg/day

**TOXIC EFFECT**
- 1,000 – 30,000 mg/day

LOW  MED  HIGH
Patterns of Cannabinoid use

- **Oro-Mucosal**
  - Rapid Onset
  - (Immediate)
- **Inhalation**
  - Quick Onset
  - (Within minutes)
- **Ingestion**
  - Variable Onset
  - (30 mins – 4 hrs)
- **Dermal**
  - Limited Effects
  - (N/A)
- **Rectal**
  - Slow Onset
  - (2 – 8 hrs)

NOTE: Onset times are shown for relative comparison. They are approximate and highly variable between individuals.
Inhaling versus Ingesting

- **Smoking/Inhalation**
  - Travels rapidly to brain - effects within minutes
  - Rapidly dissipate - 30 to 60 min
  - User able to adjust “titrate” dose
  - Highly variable between individuals based on technique

- **Eating/Ingestion**
  - Metabolized by liver to active form of THC
  - Effects noticeable 30 minutes - 2 hours and last several hours
  - Difficult to titrate dose due to delayed onset

Eating 10 mg of THC is **NOT** the same as smoking 10 mg of THC.

10 mg THC
(0.1 grams marijuana at 10% THC)
Primer: Commercial Marijuana Product Testing

**Legend:**
- **FPM:** Finished Plant Material
- **FMM:** Finished Medical Marijuana Product
- **CP:** Cannabinoid Profile
- **HM:** Heavy Metals
- **P+PGR:** Pesticide + Plant Growth Regulators
- **MC:** Microbiological Contaminants
- **RS:** Residual Solvents

**Diagram Description:**
- **FPM as FMM Tested for:**
  - CP: ✔
  - HM: ✔
  - P+PGR: ✔
  - MC: ✗
  - Not to be dispensed
  - Total Number of Reports: 1

- **FPM as FMM Re-tested for:**
  - MC: ✔
  - May be dispensed
  - Total Number of Reports: 2

- **Concentrate Tested for:**
  - CP: ✔
  - HM: ✔
  - MC: ✔
  - RS: ✔
  - Not to be dispensed
  - Total Number of Reports: 3

- **Concentrate Re-tested for:**
  - RS: ✔
  - May be dispensed
  - Total Number of Reports: 4

- **MIP as FMM Tested for:**
  - CP: ✔
  - MC: ✗
  - Not to be dispensed
  - Total Number of Reports: 5

- **MIP as FMM Tested for:**
  - CP: ✔
  - MC: ✔
  - May be dispensed
  - Total Number of Reports: 6
National Leadership to Ensure Product Safety and Quality

Guidance for State Medical Cannabis Testing Programs

1.0 Purpose and Application

The purpose of this Protocol is to provide Massachusetts-Registered Dispensaries (MRDs) with required and recommended best practices for the safe preparation and handling of finished medical marijuana (MMJ) products and marijuana-infused products (MIPs) to avoid common contamination threats and ensure the quality and safety of products. This Protocol is intended for laboratories performing testing and analysis of finished MMJ products and MIPs. This Protocol is subject to revision based on evolving best practices, updated scientific information or standards/guidelines, or other information relevant to the contents of the protocol.

1.1 Purpose

This Protocol is intended for laboratories performing testing of finished medical marijuana (MMJ) products and marijuana-infused products (MIPs) to avoid common contamination threats and ensure the quality and safety of products. This Protocol is subject to revision based on evolving best practices, updated scientific information or standards/guidelines, or other information relevant to the contents of the protocol.

1.2 Applicability and Scope

This Protocol applies only to Massachusetts-MRD operations that process, handle, and/or sell finished MMJ products and MIPs. This Protocol addresses all MMJ products and MIPs, including edible and non-edible products. This Protocol is subject to revision based on evolving best practices, updated scientific information or standards/guidelines, or other information relevant to the contents of the protocol. It is intended for laboratories that provide testing and analysis of MMJ products and MIPs. This Protocol provides guidance for finished MMJ products and MIPs or their ingredients. This Protocol focuses on the safety and preparation required for safe and effective use of MMJ products and MIPs under Massachusetts requirements.
Medical Marijuana Product Testing at DPH

Standardized Laboratory Reporting
- Accurate laboratory records across all laboratories using a universally accepted ISO format
- Development of standardized tools for patients and providers

Product Safety and Quality Surveillance
- National leader in evaluating contaminants and cannabinoids
- Comprehensive marijuana product evaluation

Standards for Potential Contaminants
- No established standards for hydrocarbons used in marijuana concentrate extractions
- DPH developed upper limit residual solvent standards for evaluating levels of contaminants
- Based on risk assessment of daily food consumption, daily oil consumption estimates, and an estimate of fried food intake
Design Considerations for the Reporting of Laboratory Analyses of Cannabinoids and Contaminants in Marijuana Products to Public Health Regulatory Agencies
Logan T. Bailey, Rachel E. Wilson, and Marc A. Nascarella
Environmental Toxicology Program, Bureau of Environmental Health, Massachusetts Department of Public Health
Corresponding Author: marc.nascarella@state.ma.us

ABSTRACT
Medical marijuana products that are sold in Massachusetts are required to be tested for contaminants and cannabinoid content by private analytical testing laboratories. The laboratory records from these private analytical testing laboratories are submitted to the Massachusetts Department of Public Health. The standardized reporting tool ensures the creation of a standardized record that meets international quality standards (ISO 17025), in a manner that is timely, accurate, and understood by all stakeholders. This standardization of a laboratory reporting tool across laboratories allows for the rapid assembly of a large amount of data, facilitating the ability to track and analyze trends in the characterization of medical marijuana products. The resultant tool was designed to be a comprehensive tool for determining the presence of harmful contaminants in the state.

RESULTS & DISCUSSION
The Standardized Reporting Tool Covers Four Types of Information:
- Data Identification (Boxes B thru C): General information on the analytical laboratory and the product providing the sample.
- Identification information that facilitates linkage to inventory, product listing, and compliance activities.
- Product Characterization (Boxes D thru F): Data fields that provide descriptive characteristics about the product, the product being sampled, and the production process. This information determines the specific regulatory requirements for the product being tested and is subject to examination.
- Laboratory Interpretation and Authorization (Boxes E thru F): Laboratory authorization and certification to perform the test. This information can be used to determine the level of acceptable test results and the appropriate regulatory requirements.

INTRODUCTION
DPI receives approximately 300 laboratory reports per month from private analytical testing laboratories. An individual report will contain 12 different elements, that are used by all stakeholders to determine the need for further investigation and action.

Development of a Residual Solvent Standard for Propane, n-butane, or iso-butane in Edible Medical Marijuana Products
Rachel E. Wilson, Andrea DiPerna, and Marc A. Nascarella
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Corresponding Author: marc.nascarella@state.ma.us

ABSTRACT
In Massachusetts, medical marijuana products are evaluated for residual solvent contamination. A solvent standard has been implemented to meet the requirements of state regulations. The product is tested by a private analytical laboratory for residual solvents, and the results are available as a report. The report is a standardized report that enters the database for each test conducted by the laboratory. This report is a standardized report that includes information on the laboratory, the test conducted, and the results of the test. The report is available to the public for review.

RESULTS & DISCUSSION
Table 1. Approach A: Exposure Assumptions

INTRODUCTION