Catch-up Scheduling for Childhood Vaccination

**Project Summary**

We outline the development of the optimization technology used within a decision support tool to help caretakers and providers in constructing catch-up schedules for childhood immunization. These schedules ensure that a child continues to receive timely vaccination against vaccine-preventable diseases in the likely event that one or more doses have been delayed.

The tool is being advocated by both the CDC and the American Academy of Pediatrics (AAP) as a means of encouraging caretakers and providers to take a more proactive role in ensuring timely vaccination coverage of children under their care, as well as ensuring the accuracy and quality of a catch-up regime.

**Motivation**

**The Recommended Immunization Schedule**

**The Problem of Erroneous and Untimely Vaccination**

- Only 9% of children received all recommended vaccines at the recommended ages.
- 55% of children did not receive all recommended doses by 2 years of age.
- 8% of children received at least 1 vaccination dose too early to be considered valid.

**Reasons for Incorrect and Untimely Vaccination**

- Parental negligence and misinformation
- Incomplete or incorrect schedules constructed by health professionals due to:
  - Insufficient knowledge and addition of new vaccines to the lineup
  - Problem complexity and tedious process of manual construction.
- Missed opportunities for vaccination
- Environmental, logistical, and socioeconomic standpoints.

**Rules and Guidelines for Catch-up Immunization**

Given past vaccination history for a child, each remaining dose that can be feasibly administered and not contraindicated must be scheduled.

**Feasibility requirements:**
1. Minimum and maximum age requirement for each dose of each vaccine.
2. Minimum gap between (not necessarily successive) doses of the same vaccine. Gap may vary by vaccine, dose, current age and/or age at which previous dose is administered.
3. "Live-virus" vaccines may be administered during the same visit or at least 28 days apart.

**Contraindications:**
1. The previous dose is administered at an age that no longer warrants further vaccination.
2. The current age of the child no longer warrants further vaccination.

**Program Flow Summary**

**The Vaccine Modeling Language and User input**

A tabular encapsulation of all the rules and guidelines for individual vaccines. Allows quick and easy updates to the tool without having to change the core components of the scheduling algorithms.

**The Output Charts**

**The Scheduling Algorithm**

**Identifying Dominance of One Schedule over another**

**Dominance criteria:**
1. The number of doses administered in SX is no less than SY.
2. The timing of each critical dose administered in SY is no earlier than in SX.
3. The total delay in administering doses in common is less in SX.

**Proposition**

If SX dominates SY then any completion of SY cannot be better than the completion of SX and thus, SY is unwarranted.

**Immediate benefits:**
- Eliminate human error.
- Speedup process.
- Improve public accessibility to vital information.

**Long-term benefits:**
- Alleviate missed opportunities.
- Improve timely vaccination rates.
- Improve awareness and parental participation.

Freely available from: [http://www.cdc.gov/vaccines/recs/scheduler/catchup.htm](http://www.cdc.gov/vaccines/recs/scheduler/catchup.htm)

- 10,000+ downloads in first two months of release.
- Presented to the Committee on Infectious Diseases (US Department of Health and Human Services).