

THEATRIS

PRODUCT INFORMATION

WHAT IS THEATRIS?

Theatris is a software tool that uses statistical modelling to construct surgical schedules.

WHY USE THEATRIS?

Theatris builds schedules that:

1. Maximize throughput while constraining overtime.
2. Respect clinical constraints such as being ready for care
3. Prioritize patients who are overdue or nearly overdue
4. Account for variability among patients and surgeons.

In addition *Theatris* enables:

1. Visibility. All patients, surgeons and sessions are listed in one place and are easily searchable. Everyone is literally on the same page so no one slips through the cracks and staff can work from the same source of truth.
2. Scheduling staff to focus their time on the nuances of complex situations rather than building routine schedules.

BUT WE HAVE EXPERIENCED PEOPLE WHO BUILD EFFICIENT SCHEDULES

A few extra percent of throughput is achievable no matter how much experience the scheduling staff have. The reason is that scheduling is hard. Very hard. Juggling historical outcomes with upcoming constraints means keeping track of lots of information. To do this consistently, optimally and without bias every day is impossible for a human brain - it's just too much data. To do this consistently, optimally and without bias every day is easy for a computer. But a computer can't account for everything. *Theatris* does the part that's hard for people, freeing them up to manage the nuances that a computer can't.

WHAT'S WITH THE NAME?

Theatris is a cross between *Theatre* and *Tetris*. Think of surgical scheduling as *Theatre Tetris* – we pack the available sessions as efficiently as possible without overfilling them. The differences are that surgical scheduling has far more variability in the "pieces" (cases) in Tetris, and, more importantly, we don't know the size (duration) of a piece (case) until after it has happened. That's where the statistical modelling comes in.

WHAT DOES IT LOOK LIKE?

Theatris has 3 tabs:

1. **View:** View and search the proposed schedule as well as lists of all other patients, surgeons and sessions.
2. **Edit:** Modify proposed schedules where necessary and observe the change in the probability that the session will finish on time.
3. **Monitor:** Explore the performance of *Theatris* with this interactive dashboard.

THE VIEW TAB

The *View* tab displays the following four tables.

THE PROPOSED SCHEDULE

Each row in the proposed schedule describes a patient and the session to which s/he is assigned. The patient may already be booked into the session, planned but not booked, or proposed by *Theatris* based on clinical urgency, availability and estimated duration.

Crucially, the proposed schedule includes the probability that the proposed session will finish early, on time, late, etc. See Figure 1 below.

| View Edit Monitor | | | | | | | | | | | | Welcome Jock | | | | |
|------------------------------|------|---------|-----------|--------------|-------------|-----------|----------|-----------|----------------|--------------------|---|-------------------------|---------------------------|-------------------------|--------------------------|------------------------|
| Search: YVES HELOURY | | | | | | | | | | | | | | | | |
| Lists created on: 2016-03-31 | | | | | | | | | | | | | | | | |
| Proposed Schedule | | | | | | | | | | | | Search: YVES HELOURY | | | | |
| Show 10 entries | | | | | | | | | | | | | | | | |
| Session ID | Date | Theatre | UR Number | Patient Name | Surgeon | Specialty | Category | Overdue % | Booking Status | Estimated Duration | Procedure Description | Prob >45 mins early (%) | Prob 15-45 mins early (%) | Prob Within 15 mins (%) | Prob 15-45 mins late (%) | Prob >45 mins late (%) |
| | | TH09 | | | YVESHELOURY | URO | 2 | 57 | Booked | 60 | MAGPI & FORESKIN RECONSTRUCTION | 9 | 29 | 34 | 17 | 12 |
| | | TH09 | | | YVESHELOURY | URO | 2 | 36 | Booked | 30 | CYSTOSCOPY & REMOVAL OF JJ STENT & RENAL BIOPSY | 9 | 29 | 34 | 17 | 12 |
| | | TH09 | | | YVESHELOURY | URO | 3 | 12 | Booked | 90 | URETHROPLASTY +/- CHORDEE CORRECTION & CIRCUMCISION | 9 | 29 | 34 | 17 | 12 |
| | | TH09 | | | YVESHELOURY | URO | 2 | 36 | Booked | 30 | CYSTOSCOPY & REMOVAL OF JJ STENT | 9 | 20 | 27 | 19 | 25 |
| | | TH09 | | | YVESHELOURY | URO | 2 | 62 | Booked | 120 | CLOSURE OF HYPOSPADIAS FISTULA REPAIR URETHRAL | 9 | 20 | 27 | 19 | 25 |

Figure 1: The *Proposed Schedule* in the *View* tab. Note the probabilities in the columns to the right.

UNPLACED PATIENTS

This table contains patients who weren't proposed in the schedule because they either didn't fit into the time available, or they had a lower priority than the patients in the proposed schedule.

| Unplaced Patients | | | | | | | | Search: YVESHELOURY | |
|-------------------|--------------|-------------|-----------|----------|-----------|--------------------|-----------------------|---------------------|--|
| Show 10 entries | | | | | | | | | |
| UR Number | Patient Name | Surgeon | Specialty | Category | Overdue % | Estimated Duration | Procedure Description | | |
| | | YVESHELOURY | URO | 2 | 1 | 30 | BOTOX TO BLADDER | | |

Showing 1 to 1 of 1 entries (filtered from 1,267 total entries) Previous **1** Next

Figure 2: The list of *unplaced patients* in the *View* tab.

PATIENTS WITH DATA ISSUES

This table contains patients who were not eligible to be scheduled for one of the following reasons:

1. The patient's data is insufficient for the scheduling algorithm to use. For example, the patient's surgeon is missing from the data.
2. The patient is planned or booked for a date that is after the proposed schedule's time frame.
3. The patient is not ready for care during the proposed schedule's time frame.

Patients With Data Issues

Show 10 entries Search: YVESHELOURY

| UR Number | Patient Name | Surgeon | Specialty | Category | Overdue % | Estimated Duration | Procedure Description | Data Issue |
|-----------|--------------|--------------|-----------|----------|-----------|--------------------|--|---|
| | | YVES HELOURY | URO | 3 | 0 | 75 | TIP +/- NESBIT & CIRCUMCISION | Patient is planned for 2016-05-06, but YVES HELOURY has no sessions that day. |
| | | YVES HELOURY | URO | 2 | 62 | 240 | BLADDER AUGMENTATION | Patient is not ready for care until 2016-06-01, which is after 2016-05-15. |
| | | YVES HELOURY | URO | 3 | 0 | 75 | TIP & CIRCUMCISION | Patient is not ready for care until 2016-08-01, which is after 2016-05-15. |
| | | YVES HELOURY | URO | 3 | 10 | 75 | CORRECTION OF CHORDEE & TIP & CIRCUMCISION | Patient is planned for 2016-09-28 (the proposed list extends only to 2016-05-15). |
| | | YVES HELOURY | URO | 2 | 50 | 60 | CORRECTION OF CHORDEE & PENOSCROTAL TRANSPOSITION | Patient is not ready for care until 2016-06-01, which is after 2016-05-15. |
| | | YVES HELOURY | URO | 3 | 0 | 30 | CYSTOSCOPY & RESECTION OF BLADDER TUMOUR | Patient is not ready for care until 2016-07-01, which is after 2016-05-15. |
| | | YVES HELOURY | URO | 3 | 0 | 90 | HYPOSPADIAS, REPAIR & CORRECTION OF CHORDEE +/- CIRCUMCISION +/- PREPUTIAL RECON | Patient is planned for 2016-05-11, but YVES HELOURY has no sessions that day. |
| | | YVES HELOURY | URO | 3 | 44 | 150 | CORRECTION OF CHORDEE + URETHROPLASTY + CIRCUMCISION | Patient is planned for 2016-05-12, but YVES HELOURY has no sessions that day. |
| | | YVES HELOURY | URO | 3 | 56 | NA | ESWL FOR RIGHT LOWER POLE STONE | Estimated procedure duration is missing. |
| | | YVES HELOURY | URO | 3 | 16 | 180 | PROXIMAL HYPOSPADIAS, REPAIR +/- CORRECTION OF CHORDEE & CIRCUMCISION | Patient is planned for 2016-05-18 (the proposed list extends only to 2016-05-15). |

Showing 11 to 20 of 23 entries (filtered from 2,611 total entries) Previous 1 2 3 Next

Figure 3: The *Data Issues* table in the *View* tab.

EMPTY SESSIONS

This table describes sessions that remain empty because the surgeon's patients were all scheduled in other sessions. This happens relatively rarely.

Empty Sessions

Show 10 entries Search: MIKE O'BRIEN

| Session ID | Date | Theatre | Surgeon | Specialty |
|------------|------|---------|--------------|-----------|
| | | TH09 | MIKE O'BRIEN | URO |

Showing 1 to 1 of 1 entries (filtered from 208 total entries) Previous 1 Next

Figure 4: The *Empty Sessions* table in the *View* tab.

THE EDIT TAB

Although *Theatris* respects many constraints, there will always be constraints that it hasn't accounted for. A common example is a patient not being ready for care when his/her current data says otherwise. In these situations the proposed lists must be changed manually. *Theatris* enables this in the *Edit* tab. When a session is edited *Theatris* will recalculate the session probabilities so that users can evaluate the effect of their changes. Examples of changes include adding or removing patients, and changing a patient's session, surgeon or estimated procedure duration.

The Edit tab contains the same four tables as the View tab, but also includes the ability to add or remove patients, and changing a patient's session, surgeon or estimated procedure duration. Figure 5 shows the *Proposed Schedule* table in the Edit tab. In this case the estimated duration of the second case is being modified. Note also the *Delete Selected Row* button for removing a patient. When all desired changes have been made the user can press the *Update Probabilities* button and the probabilities in the right-most columns will update accordingly.

Update Probabilities

Proposed Schedule

Delete Selected Row

Show 10 entries

Search: YVESHELOURY

| Session ID | Date | Theatre | UR Number | Patient Name | Surgeon | Specialty | Category | Overdue % | Booking Status | Estimated Duration | Procedure Description | Prob >45 mins early (%) | Prob 15-45 mins early (%) | Prob Within 15 mins (%) | Prob 15-45 mins late (%) | Prob >45 mins late (%) |
|------------|------|---------|-----------|--------------|-------------|-----------|----------|-----------|----------------|--------------------|---|-------------------------|---------------------------|-------------------------|--------------------------|------------------------|
| | | TH09 | | | YVESHELOURY | URO | 2 | 57 | Booked | 60 | MAGPI & FORESKIN RECONSTRUCTION | 9 | 29 | 34 | 17 | 12 |
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| | | TH09 | | | YVESHELOURY | URO | 3 | 12 | Booked | 90 | URETHROPLASTY +/- CHORDEE CORRECTION & CIRCUMCISION | 9 | 29 | 34 | 17 | 12 |
| | | TH09 | | | YVESHELOURY | URO | 2 | 36 | Booked | 30 | CYSTOSCOPY & REMOVAL OF JJ STENT | 9 | 20 | 27 | 19 | 25 |
| | | | | | | | | | | | CLOSURE OF | | | | | |

Figure 5: The *Proposed Schedule* in the *Edit* tab.

THE MONITOR TAB

The *Monitor* tab enables users to evaluate the performance of the scheduling tool via an interactive dashboard. Specifically, the dashboard compares the observed results to an estimate of the results that would have been obtained had the tool been applied during the same period.

An example is shown in Figure 6. The left-hand panel with the coloured background contains controls that enables users to slice and dice the results by specialty, surgeon and date range. As users manipulate these inputs the dashboard will update on the fly. The example shows results for a specific orthopaedic surgeon from mid-April to late December 2015.

The right-hand panel shows the results for two scenarios: Observed and Proposed. Reading along the rows we have:

1. **Time spent**

Total scheduled time (blue) plus total overtime (orange) in hours. The columns show the results for the observed and proposed scenarios respectively. The example shows that both scenarios had the same amount of time scheduled, but the proposed scenario would have resulted in less overtime.

2. **Time benefits**

This chart shows what you get for the time spent. Specifically it shows anaesthetic time (blue), procedure time (orange), change-over time (green) and idle time (red).

3. **Cost-benefit**

This chart measures the efficiency of the observed (blue) and proposed (orange) scenarios. The vertical axis shows WIES per scheduled hour, while the horizontal axis shows overtime per scheduled hour. Ideally the bubbles would be to the top-left of the chart. The example shows that for this surgeon *Theatris* would have achieved more WIES per scheduled hour with less over time.

4. **Throughput**

This chart compares case numbers for the two scenarios, but does not reflect the cases' complexity or urgency.

5. **Overdue**

This chart measures the patients' urgency. It shows the distribution of the overdue statistic for the cases treated under each scenario. The overdue statistic is calculated as the time spent on the waiting list over the target time for the patient's surgery priority category (1, 2, 3), adjusted for days spent not ready for care.

6. **WIES**

Finally we have WIES, which in Victoria is simultaneously a measure of the financial impact of the patient as well as the complexity of the patient's condition. The example shows that for this surgeon *Theatris* would have achieved more WIES with less over time.



Figure 6: The *Monitor* dashboard filtered on a specific orthopaedic surgeon from mid-April to late December 2015.

Where is *Theatris* installed?

Theatris is installed on a central Linux server within the hospital firewall. The server can be hosted on a virtual machine or bare metal.

How do users access *Theatris*?

Users access *Theatris* from their browser; they don't need any new software.

How long does *Theatris* take to install?

Typically 4 to 8 weeks depending on the following factors:

1. The data available. HRO provides the hospital with a data specification together with example data files that *Theatris* requires to function. There may be some consultation and modification to adapt to the data available. Similarly, if the available data is richer than required, HRO can investigate its potential to enhance the statistical models, and thus the resulting schedules.
2. The testing period. HRO stress tests the statistical models and optimization routines on the hospital's data.

Does *Theatris* require access to our systems?

No. *Theatris* can read csv files that have been exported from your systems. The files must be updated at the desired frequency, typically daily. Therefore a batch job is appropriate on Windows systems (a cron job is suitable on Linux/Unix systems).

Does *Theatris* write data to our systems?

No. When users modify a proposed schedule, the changes are only stored in the browser. Users still book cases into your systems the usual way.

Is *Theatris* secure?

Yes. *Theatris* has the following security measures:

1. *Theatris* is hosted within the hospital firewall. Therefore access from outside the firewall would require successfully hacking it. Users can still access *Theatris* from off-site via VPN to the hospital network if they are permitted to do so.
2. *Theatris* requires login credentials even from within the hospital firewall.
3. Passwords are salted and hashed before being stored.
4. *Theatris* uses HTTPS on all pages, so data flow between the *Theatris* server and the user's browser is encrypted.

CONTACT US

Please don't hesitate to contact us with any questions or to request a demonstration at your hospital.

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