

# Roster Optimisation in General Medicine

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## Introduction

Effective management within a hospital is vital for providing quality service. The General Medicine Department at Auckland Hospital currently generates registrar rosters manually, with no explicit modelling of the impact this has on ward patient numbers. Registrars are faced with increasing workload, causing many patient transfers between teams to evenly distribute the workload across the wards. Our goal was to automatically generate registrar rosters with fairer workloads and improved continuity of care for the patients.

## Roster Optimisation

The mixed integer programming model automatically assigns shifts to registrars, meeting all roster requirements using a cyclic roster. There are four wards in General Medicine: White, Black, Gold and Red. The main objective of our model is to minimise the maximum number of patient transfers.

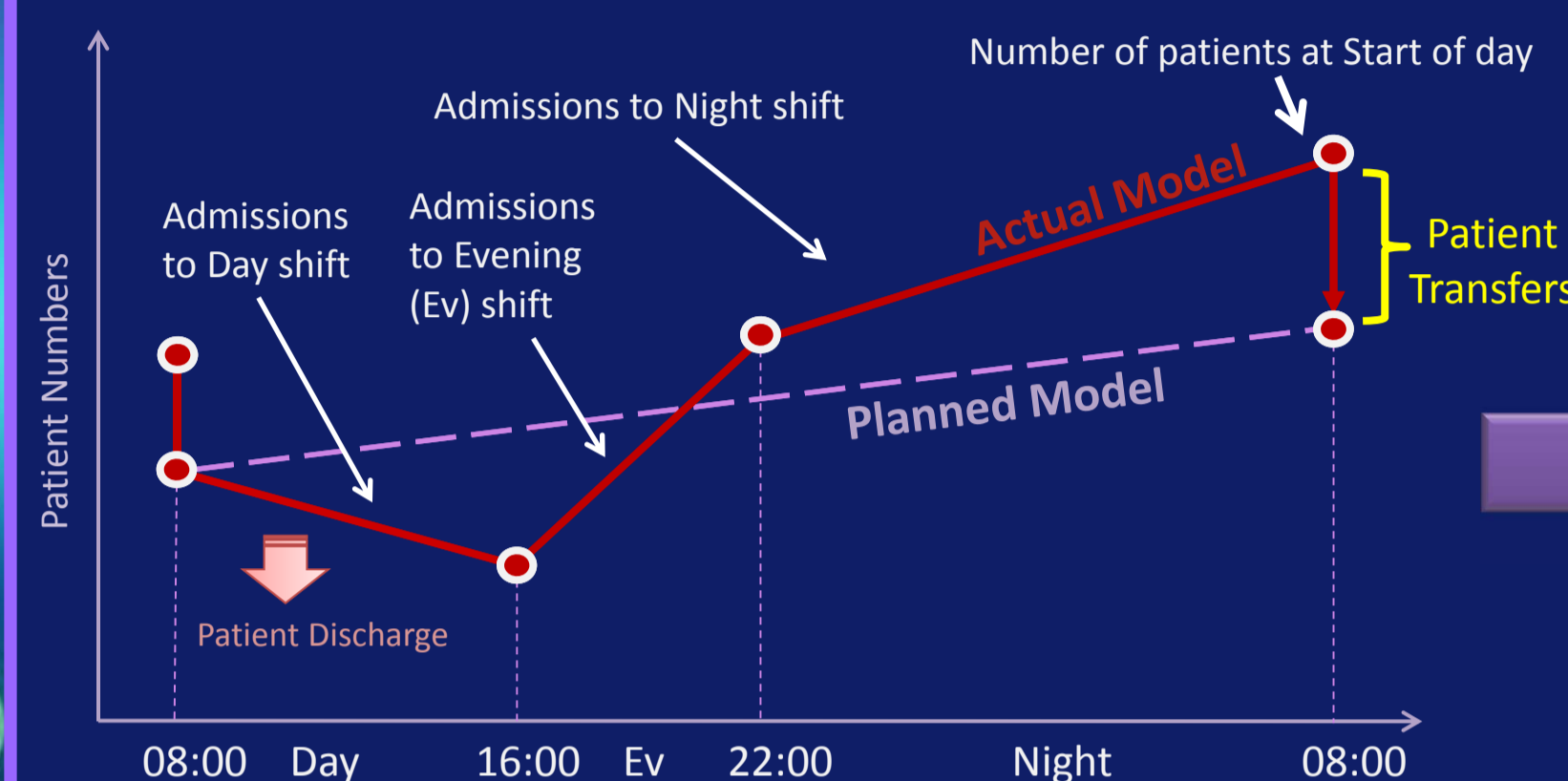
Monday to Friday there is one registrar for A, B, C and D shifts respectively. One registrar is also scheduled on Night Duty (N) all week. Weekends have different requirements with an A shift and post-acute (P) shifts. Weekend requirements also affect Friday's shifts.

| On Call Shifts: |        |        |        |        |  |  |  |  |  |  |  |  |
|-----------------|--------|--------|--------|--------|--|--|--|--|--|--|--|--|
|                 | A Call | B Call | C Call | D Call |  |  |  |  |  |  |  |  |
| 8:00            |        |        |        |        |  |  |  |  |  |  |  |  |
| 9:00            |        |        |        |        |  |  |  |  |  |  |  |  |
| 10:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 11:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 12:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 13:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 14:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 15:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 16:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 17:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 18:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 19:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 20:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 21:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 22:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 23:00           |        |        |        |        |  |  |  |  |  |  |  |  |
| 0:00            |        |        |        |        |  |  |  |  |  |  |  |  |
| 1:00            |        |        |        |        |  |  |  |  |  |  |  |  |
| 2:00            |        |        |        |        |  |  |  |  |  |  |  |  |
| 3:00            |        |        |        |        |  |  |  |  |  |  |  |  |
| 4:00            |        |        |        |        |  |  |  |  |  |  |  |  |
| 5:00            |        |        |        |        |  |  |  |  |  |  |  |  |
| 6:00            |        |        |        |        |  |  |  |  |  |  |  |  |
| 7:00            |        |        |        |        |  |  |  |  |  |  |  |  |
| 8:00            |        |        |        |        |  |  |  |  |  |  |  |  |

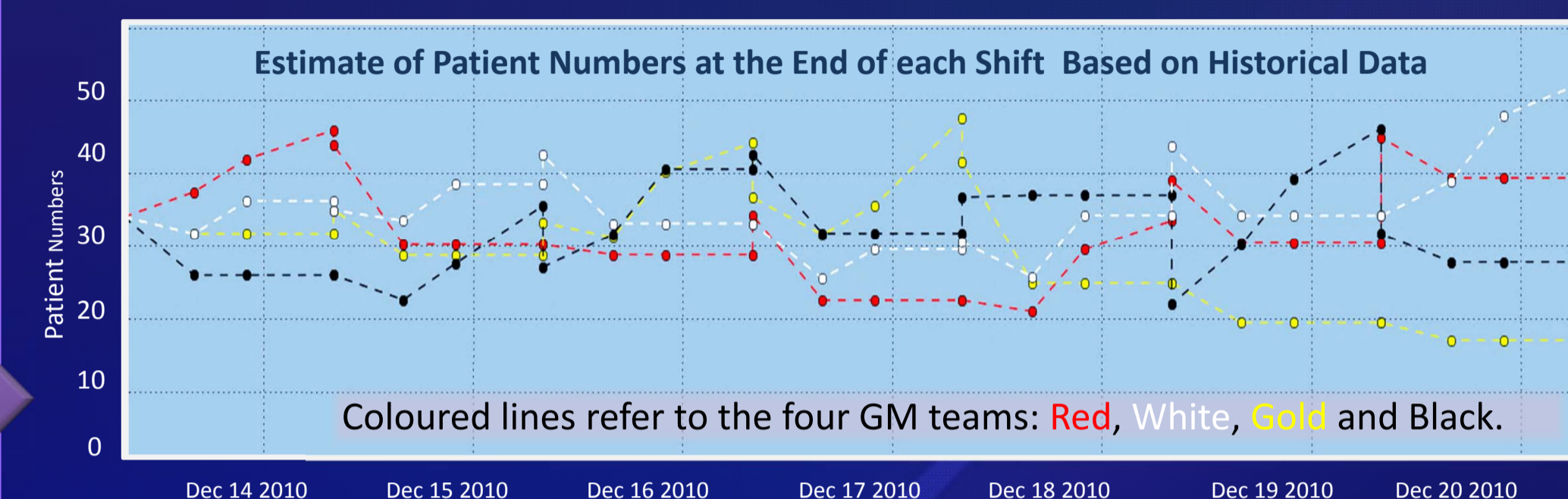
  

| Team    | Mon | Tue | Wed | Thu | Fri | Sat | Sun |
|---------|-----|-----|-----|-----|-----|-----|-----|
| White 1 |     | D   |     | C   |     | X   | X   |
| White 2 | C   |     | D   |     |     | X   | X   |
| White 3 |     |     |     |     |     | X   | X   |
| Black 1 | A   |     |     |     | A   | P   | P   |
| Black 2 | N   | N   | N   | N   | N   | X   | X   |
| Black 3 |     | B   |     | B   |     | X   | X   |
| Gold 1  |     | C   |     |     | B   | P   | A   |
| Gold 2  |     |     | C   |     | C   | X   | X   |
| Gold 3  |     |     | B   |     | D   | X   | X   |
| Red 1   |     | A   |     | D   |     | A   | P   |
| Red 2   |     |     |     | A   |     | X   | X   |
| Red 3   | D   |     | A   |     |     | X   | X   |
| Relief  | B   |     |     |     |     | X   | X   |

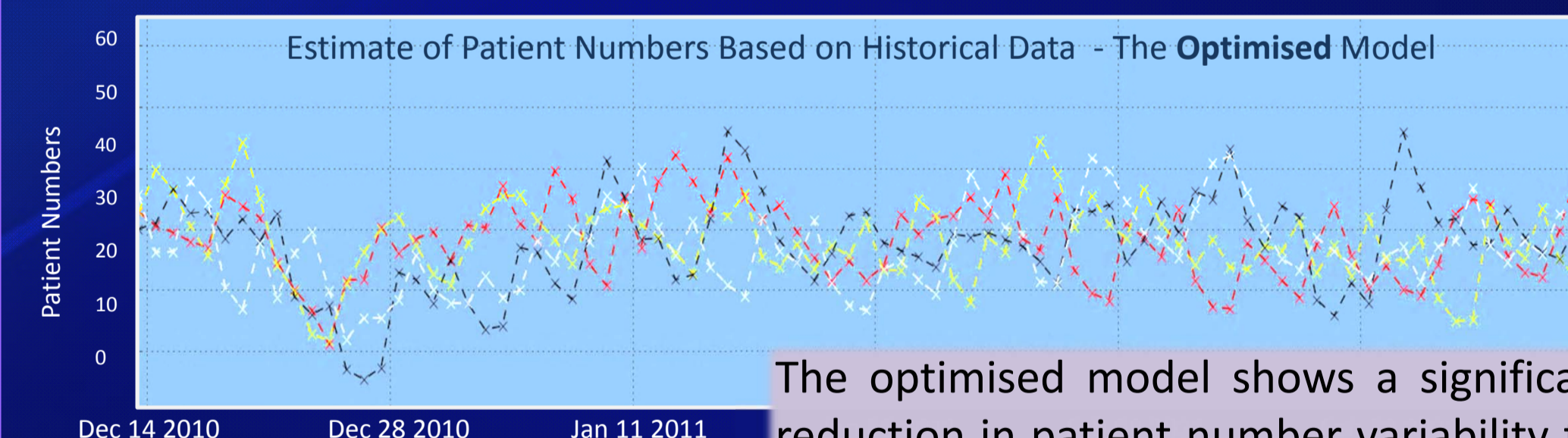
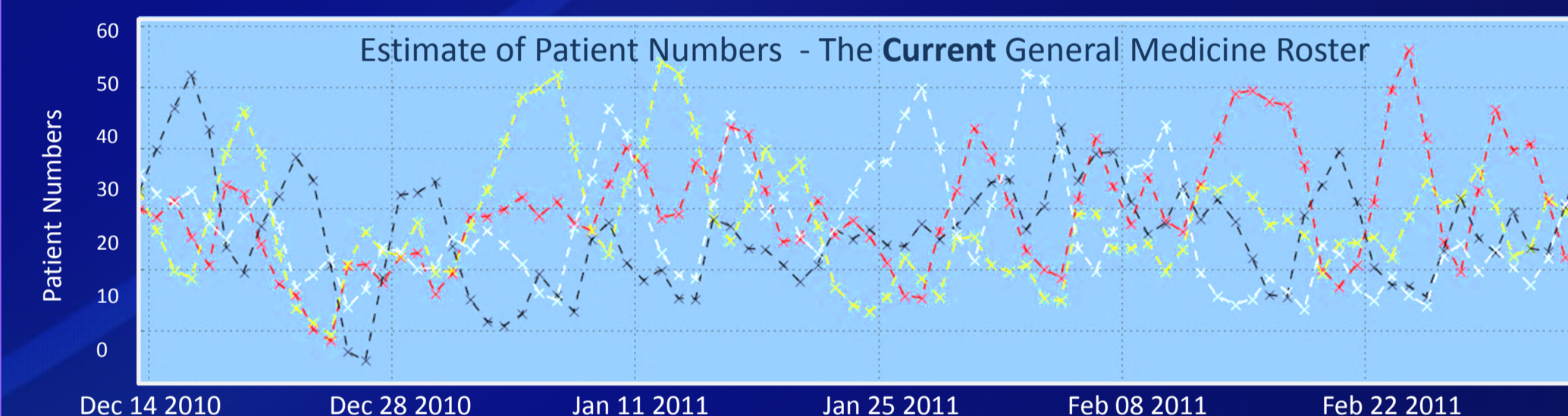
## Planned vs. Actual Workload



## Results



- The maximum number of transfers for any given ward has been reduced from **31.8 to 19.5**, enhancing continuity of patient care.
- The maximum number of patients seen in each ward has been reduced from **62.6 to 46.2**.



The optimised model shows a significant reduction in patient number variability for each ward compared to the current roster.

A cyclic roster ensures that each registrar completes the same shifts (at different times) and is completely fair.

| Week 1 |   |   |   |   |   |   |   | Week 2 |   |   |   |   |   |   |   |
|--------|---|---|---|---|---|---|---|--------|---|---|---|---|---|---|---|
|        | M | T | W | T | F | S | S |        | M | T | W | T | F | S | S |
| W1     |   |   |   |   |   |   |   | W1     |   |   |   |   |   |   |   |
| W2     |   |   |   |   |   |   |   | W2     | A | B | C | X | X |   |   |
| W3     | A | B | C | X | X |   |   | W3     |   |   |   |   |   |   |   |
| B1     |   |   |   |   |   |   |   | B1     |   |   |   |   |   |   |   |
| B2     |   |   |   |   |   |   |   | B2     |   |   |   |   |   |   |   |
| B3     |   |   |   |   |   |   |   | B3     |   |   |   |   |   |   |   |
| G1     |   |   |   |   |   |   |   | G1     |   |   |   |   |   |   |   |
| G2     |   |   |   |   |   |   |   | G2     |   |   |   |   |   |   |   |
| G3     |   |   |   |   |   |   |   | G3     |   |   |   |   |   |   |   |
| R1     |   |   |   |   |   |   |   | R1     |   |   |   |   |   |   |   |
| R2     |   |   |   |   |   |   |   | R2     |   |   |   |   |   |   |   |
| R3     |   |   |   |   |   |   |   | R3     |   |   |   |   |   |   |   |

## Conclusion

- The optimised model has significantly enhanced the quality of General Medicine rosters by explicitly modelling ward patient numbers throughout the day.
- We have successfully developed a model that solves the problem of generating a legal, equitable roster automatically.
- The model minimises patient transfers, and improves registrars' quality of life as each team rotates equally in the cyclic roster.