



# INTEGRATION OF MICROWAVE TECHNOLOGY TO REDUCE FIXATION AND PROCESSING TIME OF ROBOTIC PROSTATECTOMY SPECIMENS FOR WHOLE MOUNT EXAMINATION

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## Abstract

**Background:** Using the Lean tool of value stream mapping, we identified the preanalytic phase of processes from specimen receipt to tissue processing as the major source of time delay and non-value added effort in the value stream of whole mount prostatectomy evaluation.

**Design:** We targeted intact gland formalin fixation and tissue processing of whole mount (WM) sections. The initial condition consisted of 50-100ml formalin needle injection of intact robotic prostatectomies using a fine needle. Intact glands were then fixed overnight in 32 oz. formalin for avg. 15.8 hours. Glands were entirely sectioned at 4mm thickness and WM sections were fixed for 9 hrs. in macro-cassettes (LPC1000, Cancer Diagnostics Inc) and processed for 16.5 hrs. in a VIP 300E processor (Sakura Finetek USA, Inc, Torrance, CA). The redesigned condition retained formalin injection of glands that were then fixed intact in 32 oz. of formalin for 30 min. followed by microwave fixation in 32 oz. of formalin in a microwave processor (Model EBS42850, EBS Sciences, East Granby, CT) at 450W for 6 min. at 50°C. Glands over 50 grams were held for 15 additional min. in formalin at room temperature then microwaved again for 3.5 min. WM sections were then fixed in macro-cassettes for an additional 2 hrs. at room temperature. Total fixation time in the redesigned process was 2.53 hrs. WM sections were processed in 7 hrs. in macro-cassettes in a Pathos DELTA microwave processor (Milestone Medical Technologies, Inc, Kalamazoo, MI/Sirasole, Italy). Baselines were from 20 robotic prostatectomies. New conditions were tested on 5 autopsy and 10 clinical glands. The latter were parallel tested with WM slices from each gland in the VIP and Pathos DELTA processors. All microscopic sections were assessed by one GU pathologist.

**Results:** With process redesign fixation time was reduced by 90% from 24.8 to 2.53 hrs. Integrating microwave technology in tissue processing reduced processor time by 58% from 16.5 to 7 hrs. Overall, 32 hrs. of non-value added time waste was removed from the front end processes resulting in a 77% reduction from 41.3 to 9.5 hrs. Pathologic examination showed no significant variations in quality related to H&E staining, homogeneity, crust/edge effect, completeness of margins, nuclear preservation, autolysis or thermal artifact.

**Conclusions:** Lean process redesign targeting intact prostate gland fixation and integration of microwave technology in radical prostatectomy processing can be of great benefit in addressing total timeliness of pathologic reporting.

## Background

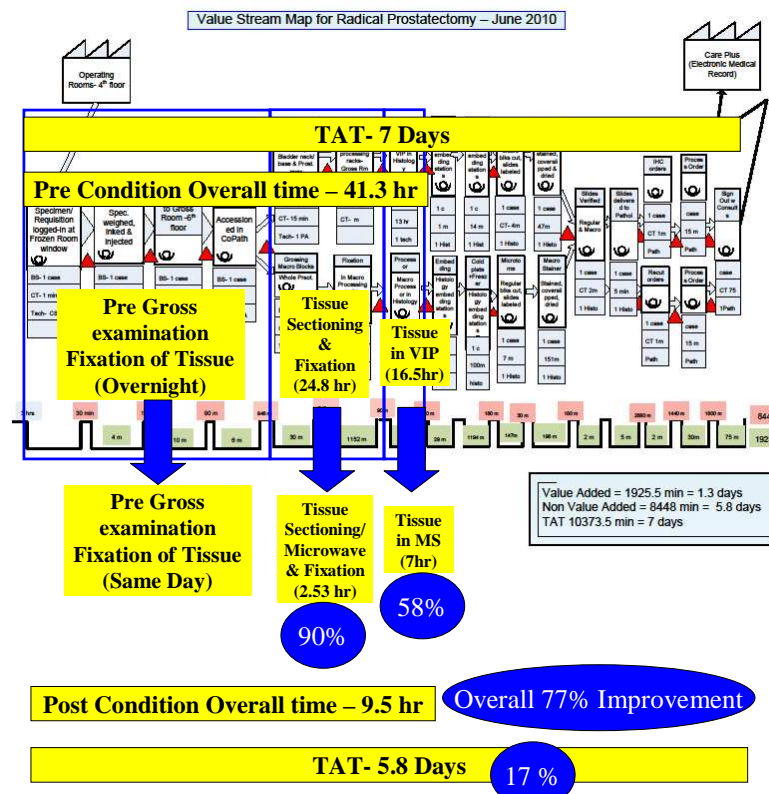
- Marked increase in the number of prostatectomies in recent years increased the workload in the surgical pathology laboratory
- It is important that the specimens are handled appropriately – incorrect practices might result in irreversible loss of information.
- The unique aspect of gross examination is that the entire surface of the gland (entire surgical margin) is sampled which makes grossing fresh, unfixed specimen impossible
- Therefore, specimens need to be fixed appropriately before sectioning
- Usually fixation of an intact prostate gland requires immersion in formalin for >1 day<sup>1</sup>
- Due to these technical demands, typical turnaround time for prostatectomy sign out is around 7 days

## Materials and Methods

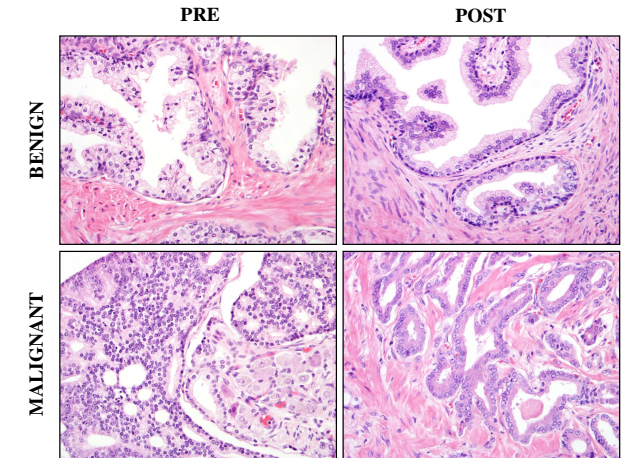
- Value stream map was created to analyze the process of prostatectomy processing in the surgical pathology laboratory
- Prostatectomy processing was arbitrarily subdivided into 3 steps
- Non-value added steps were identified in the fixation stage
- Cases with expected high tumor volume (judged on biopsy data) were assessed in 2 arms: conventional and microwave processing
- Slides were blindly reviewed by GU committed pathologist
- After perfecting various parameters, over 6 months, 46 prostatectomies were evaluated entirely processed in microwave (Milestone) processors

## Lean Design of Experiment

- Value Stream Map of the entire process performed, from specimen receipt to report sign out.
- Process divided into three steps:
  - Pre Gross Examination & fixation of tissue (injection & formalin fixation)
  - Tissue sectioning & further fixation with and without microwaves
  - Tissue processing in conventional or microwave (Milestone) processors



## Results



**Figure 1.** Histologic sections of fixed conventionally (PRE) and in Milestone processors (POST).

## Conclusions

- Using Lean tools allowed identification of the non-value added steps in the process
- PRE and POST fixation protocols were validated to yield identical morphological results
- Use of microwave technology improved tissue fixation time by 90%.
- Milestone microwave processor improved tissue processing time by 58%
- Overall time from start to end of tissue processing improved by 77%
- Total turnaround time to report sign out improved by 17%

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