Passing to Score Goals

How Hockey Players & Coaches Can Improve Offensive Zone Decision-Making

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1 Research Objectives

This analysis seeks to answer two fundamentally related questions:

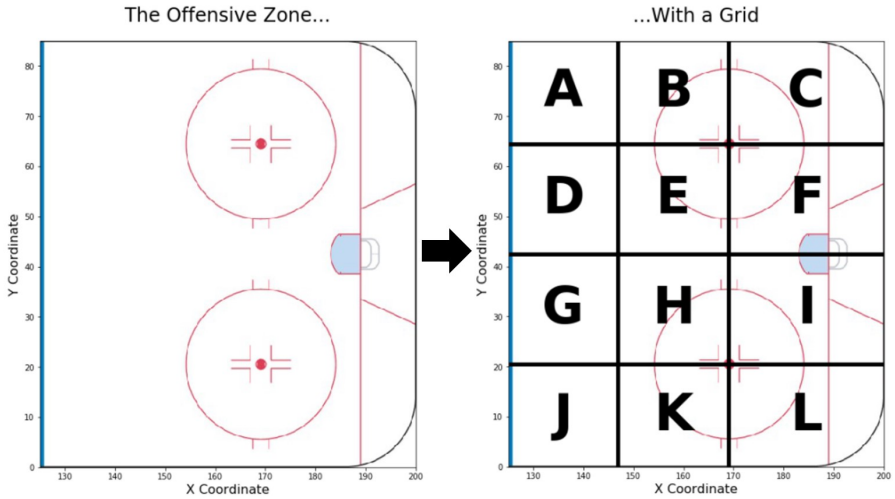
1. Which types of offensive zone passes are most/least likely to lead to a goal?
2. How can coaches and players use this information to improve decision-making?

Solving 1 is useless without addressing 2. I am much more interested in helping coaches and players improve how their team makes passing decisions in the offensive zone than identifying interesting but ultimately unhelpful information. Since an idea is only powerful when it is clearly understood, I will present my findings in plain, practical language structured into three sections: first principles, most dangerous passes, and option maps.

First principles are the key learnings that emerged from the data about which factors drive goal-scoring. These principles lead us to the highest-danger passing paths that teams should strive to manufacture and finally to option maps, which are intended to be practical coaching tools that show where a player should and should not pass from a given area of the offensive zone.

2 Approach: 3x4 Grid and Expected Goals

I divided the offensive zone into a 3x4 grid containing 12 unique zones, labelled A-L as shown below:



To quantify the danger of a given shot attempt and estimate its likelihood of becoming a goal, I built a pair of expected goals models using logistic regression. The first model was for shot attempts that immediately followed a pass and categorized these passes based on the above grid system. The second model was for all other shot attempts. These allowed me to identify the factors that drive goal-scoring. More detail about model features and evaluation can be found in the appendix.

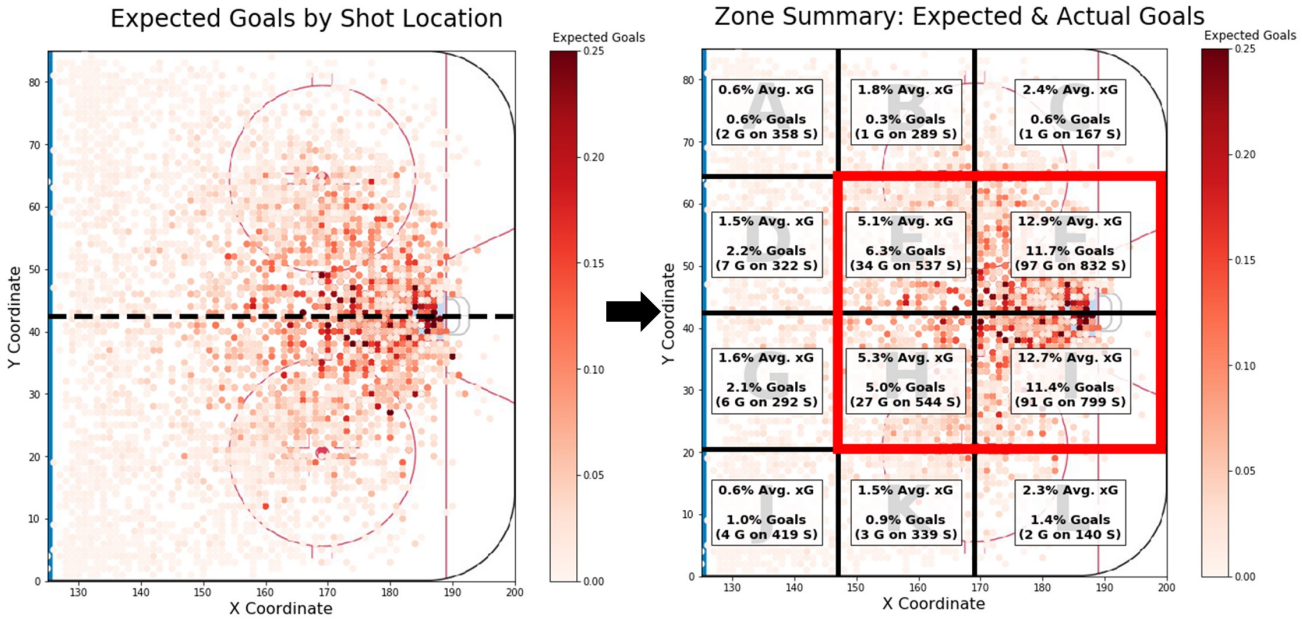
My grid approach created 144 unique passing paths (A $\rightarrow$ C, for example). To identify the highest and lowest value passes, I evaluated each of these 144 paths using **three criteria:**

1. Shot Danger: What is the average expected goals of shot attempts after this pass?
2. Completion Rate: What share of pass attempts are successfully completed?
3. Additional Pass Danger: What potential exists for follow-up high-danger passes to the slot?

3 First Principles: How to Score Goals

Principle 1: Get Close & Get Between the Dots

Intuitively, both shot distance and shot angle are crucial drivers of scoring. As shown below, shots in the red box between the dots are much more likely to go in. 13% of attempts from below and between the dots (Zones F & I) are goals, compared to 5-6% of attempts from the high slot (Zones E & H), 2% from the middle point (Zones D & G), and less than 1% from outside the dots (Zones A-C & J-L). Players should be selective in their shooting locations - it is generally a better idea to carry or pass the puck into the red box rather than attempt a shot from outside it.



Principle 2: Pass Across the Royal Road

Of all pass types analyzed, passing across the royal road (the dotted line shown above) is the strongest driver of expected and actual goals. 9% of attempts after royal road passes go in, compared to 5% of all other attempts. These passes force the goalie to move laterally and reset their sightline onto a new shooting target, testing their mental and physical quickness and creating openings in their net coverage short-side or up high that can be exploited by shooters.

Principle 3: Release Quickly

Release quickness matters. One-timers are much more likely to go in (11% vs. 5% of non-one-timers) and snap shots have the highest success rate of any shot type with 50+ attempts (9%). Notably, fewer than 2% of slap shot attempts are goals, which suggests that predictability is important. Winding up for a slap shot takes time and signals to the goalie a shot is coming, while a quick, disguised release maintains the element of surprise and often takes place before the goalie is fully square.

Combining these principles yields a dramatic data point: one-time snap shots after a royal road pass go in over 25% of the time (36/141). In general, attacking players should live by these principles. Rather than shoot from the outside they should work the puck into the middle close to the net, ideally via royal road passing, and put it on net with a quick, deceptive release, ideally a one-timer. Coaches should be asking themselves how they can apply these principles when designing offensive tactics and set plays in a way that leverages the unique strengths of their team – having a talented shooter switch to his or her off-wing on entries to open up one-time looks, for example.

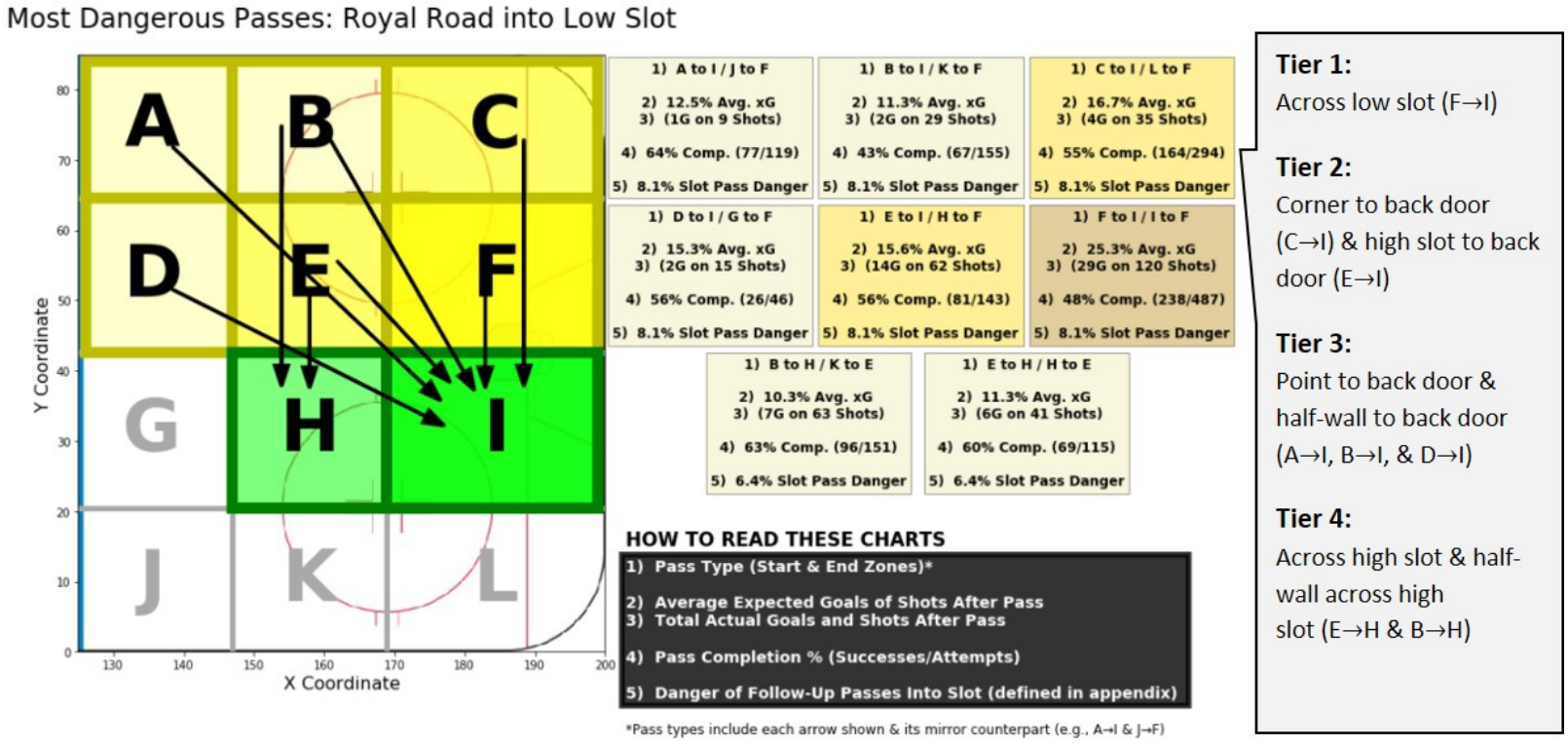
4 Applying First Principles: Most Dangerous Passes

We arrive at a key learning – a tiering of the most dangerous passes, defined by the average expected goals of attempts after that pass. The best passes (Tier 1) cross the low slot from F→I or I→F. 1 in 4 such attempts go in, but this reward comes with risk - completion is just 48%. Even with a strong push-off, goalies will struggle to cover lateral ground and won't have much time to react.

This means that Zones F & I are not only the most dangerous for shooting, but also for passing. Scoring goals is a matter of getting the puck to this area, and offensive sequences should systematically work the puck here then attempt a shot or pass based on reading the goalie/defender(s).

The next most dangerous passes (Tier 2) are corner to back door and high slot to back door (C→I & E→I). About 1 in 6 shot attempts after these passes go in. They are also somewhat less risky than Tier 1 (55% completion). The effectiveness of C→I makes the corner a lethal set-up area. As we will see, teams with the puck along the boards/point with no good slot options should usually pass to a corner rather than along the boards/point, or, worse, attempt a shot.

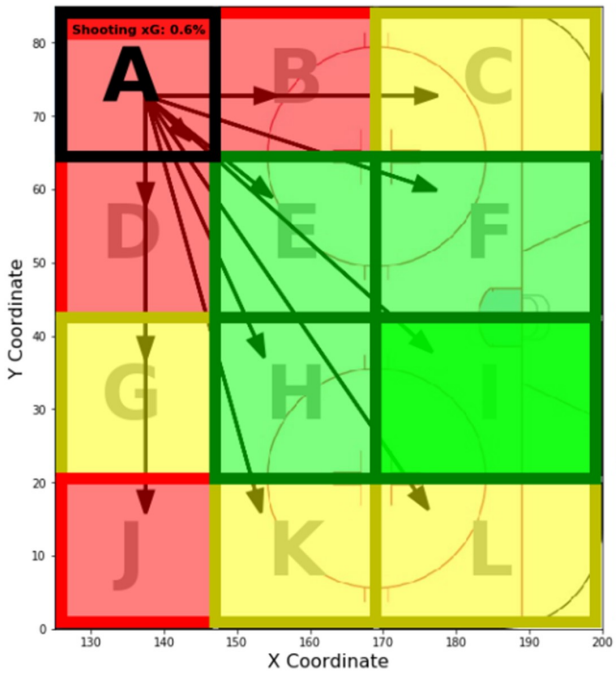
'Tier 3' includes royal road passes from further away into the low slot. A→I, B→I, and D→I are all dangerous if they connect, but are risky with few attempts and/or low completion. If the lane is open, this pass should be the first option from A, B, or D. 'Tier 4' includes royal road passes that move laterally into the high slot (E→H & D→H). These are still dangerous and have good completion rates, but the distance between the shooter and the net gives the goalie more time to react and track the incoming shot.



5 Option Maps: Improving Decision-Making

Finally, applying these ideas leads us to option maps. From a given starting point (shown in black), where should a player look to pass? These maps are meant as guidelines and should not limit creativity or improvisation. Smart players should always read and react to what they are given, and being too predictable has severe drawbacks. Each map is summarized into key action points.

Option Map: Outside Point (A or J)



LEGEND BEST | GOOD | DECENT/SAFE | AVOID

A to A / J to J 1.5% Avg. xG (3G on 62 Shots) 74% Comp. (301/403) 4.7% Slot Pass Danger	**A to B / J to K** 2.4% Avg. xG (1G on 49 Shots) 67% Comp. (312/466) 5.7% Slot Pass Danger	**A to C / J to L** 3.1% Avg. xG (1G on 23 Shots) 66% Comp. (233/351) 6.7% Slot Pass Danger
A to D / J to G 3.4% Avg. xG (4G on 66 Shots) 65% Comp. (203/308) 5.0% Slot Pass Danger	**A to E / J to H** 8.4% Avg. xG (1G on 32 Shots) 43% Comp. (63/145) 6.4% Slot Pass Danger	**A to F / J to I** 5.9% Avg. xG (1G on 18 Shots) 63% Comp. (131/208) 8.1% Slot Pass Danger
A to G / J to D 2.6% Avg. xG (1G on 125 Shots) 84% Comp. (311/369) 5.0% Slot Pass Danger	**A to H / J to E** 7.4% Avg. xG (2G on 19 Shots) 56% Comp. (41/73) 6.4% Slot Pass Danger	**A to I / J to F** 12.5% Avg. xG (1G on 9 Shots) 64% Comp. (77/119) 8.1% Slot Pass Danger
A to J / J to A 1.8% Avg. xG (2G on 109 Shots) 92% Comp. (272/294) 4.7% Slot Pass Danger	**A to K / J to B** 4.4% Avg. xG (1G on 18 Shots) 88% Comp. (88/100) 5.7% Slot Pass Danger	**A to L / J to C** 3.7% Avg. xG (0G on 5 Shots) 79% Comp. (54/68) 6.7% Slot Pass Danger

Action Points:

Avoid shooting

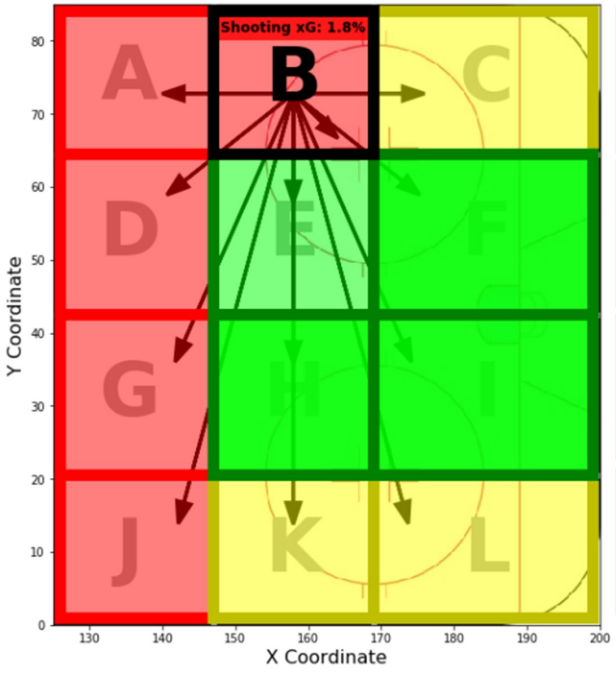
Scan back door first

If slot is covered, look for a corner

Same-side half wall is usually too risky

If no strong option to advance, look for D partner in Zone G

Option Map: Half-Wall (B or K)



LEGEND BEST | GOOD | DECENT/SAFE | AVOID

B to A / K to J 1.2% Avg. xG (0G on 149 Shots) 88% Comp. (543/616) 4.7% Slot Pass Danger	**B to B / K to K** 2.3% Avg. xG (2G on 43 Shots) 74% Comp. (175/235) 5.7% Slot Pass Danger	**B to C / K to L** 3.5% Avg. xG (0G on 21 Shots) 70% Comp. (316/451) 6.7% Slot Pass Danger
B to D / K to G 3.2% Avg. xG (3G on 94 Shots) 87% Comp. (270/308) 5.0% Slot Pass Danger	**B to E / K to H** 7.8% Avg. xG (7G on 78 Shots) 60% Comp. (138/230) 6.4% Slot Pass Danger	**B to F / K to I** 9.7% Avg. xG (5G on 55 Shots) 66% Comp. (249/374) 8.1% Slot Pass Danger
B to G / K to D 5.0% Avg. xG (5G on 59 Shots) 82% Comp. (136/164) 5.0% Slot Pass Danger	**B to H / K to E** 10.3% Avg. xG (7G on 63 Shots) 63% Comp. (96/151) 6.4% Slot Pass Danger	**B to I / K to F** 11.3% Avg. xG (2G on 29 Shots) 43% Comp. (67/155) 8.1% Slot Pass Danger
B to J / K to A 2.5% Avg. xG (0G on 14 Shots) 87% Comp. (42/48) 4.7% Slot Pass Danger	**B to K / K to B** 4.9% Avg. xG (0G on 12 Shots) 72% Comp. (35/48) 5.7% Slot Pass Danger	**B to L / K to C** 6.7% Avg. xG (0G on 4 Shots) 75% Comp. (40/53) 6.7% Slot Pass Danger

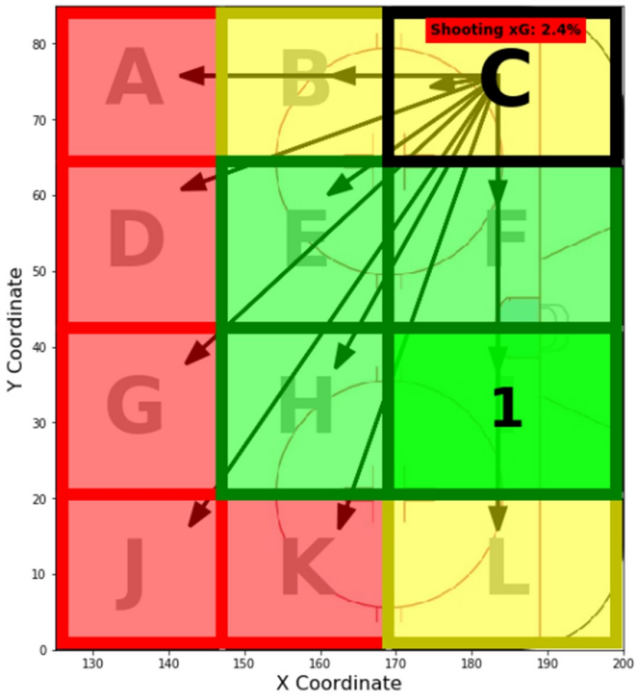
Action Points:

Avoid shooting

Avoid passing to point whenever possible

Both high & low slot via royal road are dangerous

Option Map: Corner (C or L)



LEGEND BEST | GOOD | DECENT/SAFE | AVOID

C to A / L to J 0.8% Avg. xG (1G on 243 Shots) 83% Comp. (686/818) 4.7% Slot Pass Danger	C to B / L to K 3.7% Avg. xG (1G on 32 Shots) 77% Comp. (185/238) 5.7% Slot Pass Danger	C to C / L to L 3.8% Avg. xG (0G on 23 Shots) 72% Comp. (389/539) 6.7% Slot Pass Danger
C to D / L to G 3.8% Avg. xG (2G on 18 Shots) 73% Comp. (66/90) 5.0% Slot Pass Danger	C to E / L to H 12.3% Avg. xG (5G on 75 Shots) 52% Comp. (115/219) 6.4% Slot Pass Danger	C to F / L to I 9.7% Avg. xG (4G on 64 Shots) 60% Comp. (402/666) 8.1% Slot Pass Danger
C to G / L to D 5.1% Avg. xG (2G on 29 Shots) 65% Comp. (49/75) 5.0% Slot Pass Danger	C to H / L to E 13.2% Avg. xG (1G on 12 Shots) 35% Comp. (20/56) 6.4% Slot Pass Danger	C to I / L to F 16.7% Avg. xG (4G on 35 Shots) 55% Comp. (164/294) 8.1% Slot Pass Danger
C to J / L to A 0.8% Avg. xG (0G on 5 Shots) 78% Comp. (32/41) 4.7% Slot Pass Danger	C to K / L to B 5.0% Avg. xG (0G on 5 Shots) 82% Comp. (28/34) 5.7% Slot Pass Danger	C to L / L to C 4.0% Avg. xG (0G on 6 Shots) 78% Comp. (69/88) 6.7% Slot Pass Danger

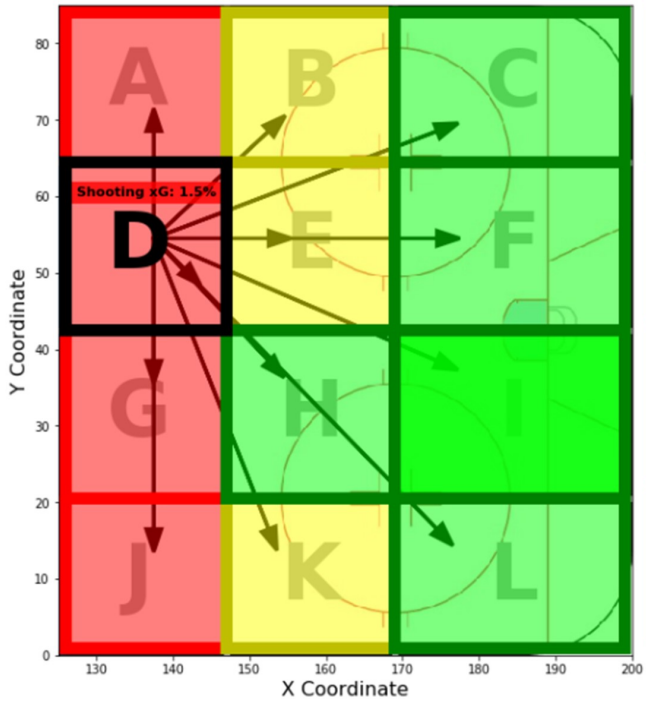
Action Points:

Back door is very dangerous

Avoid shooting

Advancing to E or F is strong backup to I – high slot royal road is usually covered

Option Map: Middle Point (D or G)



LEGEND BEST | GOOD | DECENT/SAFE | AVOID

D to A / G to J 2.5% Avg. xG (3G on 55 Shots) 89% Comp. (266/296) 4.7% Slot Pass Danger	D to B / G to K 3.4% Avg. xG (0G on 46 Shots) 91% Comp. (193/212) 5.7% Slot Pass Danger	D to C / G to L 7.7% Avg. xG (0G on 10 Shots) 95% Comp. (60/63) 6.7% Slot Pass Danger
D to D / G to G 2.7% Avg. xG (2G on 42 Shots) 84% Comp. (105/124) 5.0% Slot Pass Danger	D to E / G to H 3.3% Avg. xG (0G on 20 Shots) 57% Comp. (38/66) 6.4% Slot Pass Danger	D to F / G to I 7.5% Avg. xG (1G on 8 Shots) 68% Comp. (35/51) 8.1% Slot Pass Danger
D to G / G to D 3.8% Avg. xG (2G on 69 Shots) 85% Comp. (191/223) 5.0% Slot Pass Danger	D to H / G to E 7.3% Avg. xG (5G on 50 Shots) 71% Comp. (84/117) 6.4% Slot Pass Danger	D to I / G to F 15.3% Avg. xG (2G on 15 Shots) 56% Comp. (26/46) 8.1% Slot Pass Danger
D to J / G to A 3.1% Avg. xG (3G on 69 Shots) 95% Comp. (233/243) 4.7% Slot Pass Danger	D to K / G to B 4.9% Avg. xG (1G on 47 Shots) 93% Comp. (153/164) 5.7% Slot Pass Danger	D to L / G to C 8.6% Avg. xG (2G on 7 Shots) 89% Comp. (33/37) 6.7% Slot Pass Danger

Action Points:

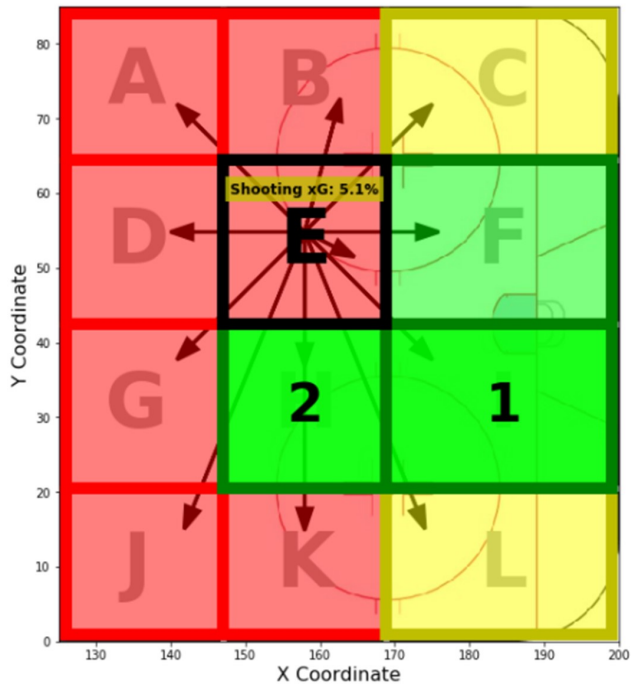
Avoid shooting

Scan back door first

If passing to high slot, make sure to cross royal road

Corners are safe backup (both high completion)

Option Map: High Slot Inside Dots (E or H)



LEGEND: BEST | GOOD | DECENT/SAFE | AVOID

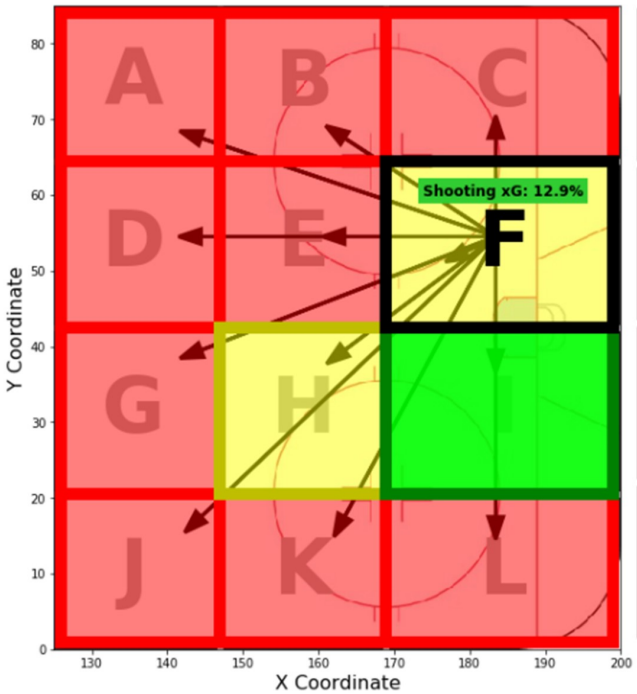
E to A / H to J 1.5% Avg. xG (0G on 8 Shots) 89% Comp. (50/56) 4.7% Slot Pass Danger	E to B / H to K 3.6% Avg. xG (0G on 10 Shots) 89% Comp. (26/29) 5.7% Slot Pass Danger	E to C / H to L 5.6% Avg. xG (1G on 3 Shots) 82% Comp. (24/29) 6.7% Slot Pass Danger
E to D / H to G 2.2% Avg. xG (0G on 20 Shots) 86% Comp. (44/51) 5.0% Slot Pass Danger	E to E / H to H 4.5% Avg. xG (2G on 38 Shots) 72% Comp. (59/81) 6.4% Slot Pass Danger	E to F / H to I 7.3% Avg. xG (3G on 24 Shots) 66% Comp. (62/93) 8.1% Slot Pass Danger
E to G / H to D 4.4% Avg. xG (1G on 12 Shots) 83% Comp. (39/47) 5.0% Slot Pass Danger	E to H / H to E 11.3% Avg. xG (6G on 41 Shots) 60% Comp. (69/115) 6.4% Slot Pass Danger	E to I / H to F 15.6% Avg. xG (14G on 62 Shots) 56% Comp. (81/143) 8.1% Slot Pass Danger
E to J / H to A 4.3% Avg. xG (0G on 2 Shots) 88% Comp. (8/9) 4.7% Slot Pass Danger	E to K / H to B 3.6% Avg. xG (0G on 6 Shots) 67% Comp. (21/31) 5.7% Slot Pass Danger	E to L / H to C 7.8% Avg. xG (0G on 3 Shots) 93% Comp. (15/16) 6.7% Slot Pass Danger

Action Points:

Back door is very dangerous

Shoot if no strong passing option

Option Map: Low Slot Inside Dots (F or I)



LEGEND: BEST | GOOD | DECENT/SAFE | AVOID

F to A / I to J 1.4% Avg. xG (1G on 49 Shots) 83% Comp. (134/160) 4.7% Slot Pass Danger	F to B / I to K 4.6% Avg. xG (0G on 13 Shots) 83% Comp. (76/91) 5.7% Slot Pass Danger	F to C / I to L 7.0% Avg. xG (1G on 15 Shots) 82% Comp. (151/184) 6.7% Slot Pass Danger
F to D / I to G 1.9% Avg. xG (1G on 9 Shots) 65% Comp. (19/29) 5.0% Slot Pass Danger	F to E / I to H 9.0% Avg. xG (4G on 45 Shots) 45% Comp. (66/146) 6.4% Slot Pass Danger	F to F / I to I 12.4% Avg. xG (14G on 145 Shots) 49% Comp. (330/670) 8.1% Slot Pass Danger
F to G / I to D 5.3% Avg. xG (0G on 5 Shots) 66% Comp. (20/30) 5.0% Slot Pass Danger	F to H / I to E 14.8% Avg. xG (1G on 13 Shots) 33% Comp. (22/66) 6.4% Slot Pass Danger	F to I / I to F 25.3% Avg. xG (29G on 120 Shots) 48% Comp. (238/487) 8.1% Slot Pass Danger
F to J / I to A 3.1% Avg. xG (0G on 3 Shots) 62% Comp. (18/29) 4.7% Slot Pass Danger	F to K / I to B 9.6% Avg. xG (0G on 3 Shots) 76% Comp. (29/38) 5.7% Slot Pass Danger	F to L / I to C 6.7% Avg. xG (0G on 3 Shots) 83% Comp. (61/73) 6.7% Slot Pass Danger

Action Points:

Back door is most dangerous of all passes (1 in 4 attempts go in)

Shoot if pass isn't there – read off what defenders/goalie are taking away

Too risky to pass into high slot

6 Appendix: Model Details

This section expands on model features and evaluation, and formally defines passing danger.

Model 1: Attempts After Passes (n=2787)
Total Goals: 166 — Total xGoals: 177.3

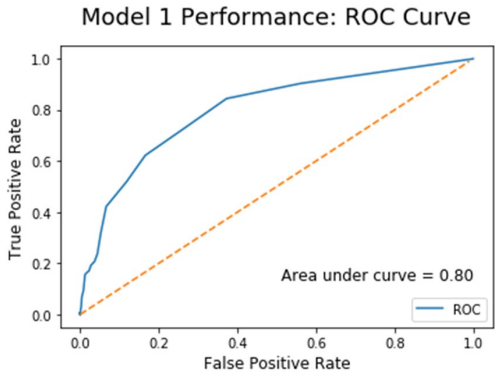
- Distance from Net (scaled to 0-1)
- Angle from Net (degrees, scaled to 0-1)
- One-Timer (binary)
- Traffic (binary)
- Shot Type (binary; wrist, slap, etc.)
- Pass Type (binary; same X/Y lane, etc.)

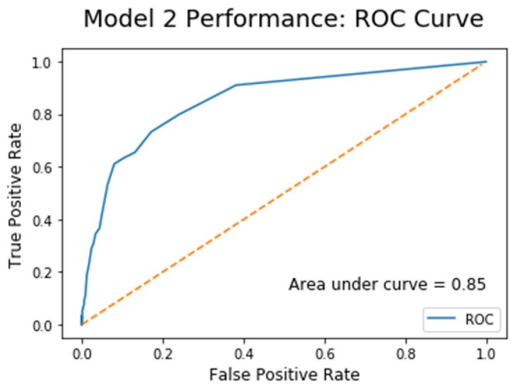
Model 2: All Other Attempts (n=2217)
Total Goals: 107 — Total xGoals: 118.9

- Distance from Net (scaled to 0-1)
- Angle from Net (degrees, scaled to 0-1)
- One-Timer (binary)
- Traffic (binary)
- Shot Type (binary; wrist, slap, etc.)
- Previous Event (binary; shot, entry, etc.)

Additional features such as game state, pass distance, and shooter handedness were considered but ultimately omitted to manage model complexity given their insignificant p-values. Data were split 75%/25% into training/testing data to prevent over-fitting. Empty net goals were excluded.

The models show reasonably strong performance across a range of decision thresholds, with AUC (area under curve) values of 0.80 and 0.85, respectively. In general, AUC values range from 0.5 (random model) to 1 (error-free model).





Passing danger is defined by the following formula. S represents the set of zones in the slot {E, F, H, I}:

$$Y \to Z \ Passing \ Danger = \sum_{i \in S} (Z \to i \ Completion \ \%) \times (Z \to i \ Avg. \ xG) \times \left(\frac{Z \to \ i \ Pass \ Attempts}{Z \to \ S \ Total \ Pass \ Attempts} \right)$$